The personal Grid e-workspace (g-work)

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Abstract

ICTs should be conceived as "Interaction & Cooperation Technologies" that promote the process of "networking" public sector, private enterprises and help individuals to facilitate the relationships that make technologies productive, which is the major input to local economic development. Specifically, semantic web technologies and grid computing are emerging as the enabling infrastructure for the next decades because they are providing a unified way for managing distributed computing, data and human resources. The fundamental challenge along the way is to provide an integrated bundle of user-centric web services coupled to processing power resources, namely a personal grid e-workspace (g-work) to every citizen. G-work is another step towards ambient intelligence's (AmI) environment vision.

Keywords: g-work, ICTs, semantic web, grid computing, computon, economic development.

1 Introduction

Information and Communication Technologies (ICTs) are not a discipline looking for approval; it is a strategically crucial force into all aspects of economic development, at low levels of income as well as high. People do not pay for chipsets, but for the advanced microsurgery programs they support; they do not just buy computer programs, but also the collaborative working platforms they provide. Decision makers select solutions and functions needed, not the ICTs that runs them. The Web is implicitly or explicitly a basic part of our everyday life; millions of people buy and sell goods and services, read the news and communicate online. In this context, ICTs should be viewed as "Interaction &

Cooperation Technologies" that promote the process of "networking" public sector, private enterprises and individuals to facilitate the relationships that make technologies productive and hence the major input to local economic development. Specifically, semantic web technologies and grid computing are emerging as the enabling infrastructure for the next decades because they are providing a unified way of managing distributed computing, data and human resources. The fundamental challenge along the way is to provide an integrated bundle of user-centric web services to every citizen in order to promote personal and local economic development.

In Section 2, the disciplines measuring the impact of informatics in human societies, Social and Community informatics are presented. Related work in electronic democracy projects is described in subsection 2.1.2. The economical aspects and consequences of ICTs are discussed briefly in subsection 2.2. A short review in computing and networking evolution is presented in subsection 2.3. Subsections 2.3.1 and 2.3.2 are devoted to Semantic Web and Grid computing technologies, respectively, including architectural and security issues. Specifically, in subsection 2.3.3 the convergence of Grid services to Web services' standards is discussed. Section 3 refers to projects and policies aiming to ICTs exploitation for development. The g-work analytical framework is presented in Section 4. A comparative to established computing and networking technologies definition for g-work is given. Personal and local development issues are followed by an implementation scheme for g-work in subsections 4.5 and 4.6, respectively. Section 5 concludes this article.

2 Related work

2.1 Society

2.1.1 Social and community informatics

During the last twenty-five years, consequences of ICTs in society and economy are investigated in a number of disciplines: computer and communications sciences, social sciences (sociology, social anthropology, and psychology), political science and information sciences (information and knowledge management, and information systems). A serious attempt to team up these separate thematic subsets to a single discipline was done by Rob Kling's working definition to social informatics [1] during a workshop at Indiana University in 1997: "Social informatics refers to the interdisciplinary study of the design, uses and consequences of ICTs that takes into account their interaction with institutional and cultural contexts."

Nowadays, analyzing the horizontal effect of ICTs on every aspect of human life is a major concern not only for many information professionals and policy consultants, but an increasing percentage of the public. For example, physical and social consequences of using mobile and internet communications in education initiate a long discussion among politicians, educators, and parents, as well as researchers. Understanding the organizational and social consequences of ICTs is important for rational professional practices and social policies.

In the same context, Community Informatics (CI) is an emerging, interdisciplinary field concerned with the development, deployment and management of information systems designed with and by communities to solve their own problems. From academic and policy-making perspectives, community informatics is now concerned with developing a systematic theory and methodology drawn from ICTs as a tool to solve life critical community problems.

Michael Gurstein introduced CI in order to describe the emerging field, which seeks to analyze the use and role of ICTs in community development efforts [2]. Since then, CI has been defined in three different ways:

- A technology, strategy or discipline, which links economic and social development efforts at the community level with emerging opportunities in such areas as electronic commerce, community and civic networks and telecentres, electronic democracy and on-line participation, self-help and virtual health communities, advocacy, cultural enhancement, and others [3].
- The adoption and study of how new information and communications technologies can facilitate the social, economic, political and cultural development of communities.
- The use of ICTs for local community benefits [4].

The definition of social informatics and community informatics helps to emphasize a key idea: ICTs do not exist in social, economical or technological reclusiveness. Their organizational, cultural and institutional environments determine the ways in, which they are developed, the kinds of assumptions and specifications that are proposed, how they are realized and used, and the set of consequences that occur for organizations and individuals.

2.1.2 Democracy

ICTs are proven to be a powerful tool for connecting people with structured information, which is considered to be a fundamental input to political decision-making process for citizens and politicians. ICTs provide tools for strong democracy, such as email, forums and online access to documents. Organizations such as Minnesota e-Democracy (www.e-democracy.org) and the Waitakere eDemocracy Group (www.wedg.org.nz) present the potential for citizen-led engagement. Case studies of top-down, government led, initiatives include Brisbane City Council, Camden Council (UK) and Rutland County Council (UK), the Queensland and Scottish Parliaments (e-Petitions) and Estonia, Queensland and Camden Council (broadcasting of legislature and executive). The scope of European Union's eDemocracy R&D projects is to explore ICTs (among others semantic web, grid computing, cryptography and digital signature) exploitation in organizational renewal, and their application in the legislative, executive and judicial branches of government in order to reinforce democratic participation and democratic decision-making in Europe [5]. In its i2010 European Commission's initiative, one of the three fundamental policy priorities is [6]: to promote an inclusive European information society. To close the gap between the information society "haves and have nots", the Commission will propose: an

Action Plan on e-Government for citizen-centred services (2006); three "quality of life" ICT flagship initiatives (technologies for an ageing society, intelligent vehicles that are smarter, safer and cleaner, and digital libraries making multimedia and multilingual European culture available to all (2007); and actions to overcome the geographic and social "digital divide", culminating in a European Initiative on e-Inclusion (2008).

2.2 Economy

2.2.1 Weightless economy

As Quah [7] explains "The weightless economy – also described as the knowledge economy, the intangible economy, the immaterial economy or simply the "new" economy – comprises four main elements. First, there is information and communications technology (ICT) and the Internet. Second, intellectual property, which includes not only patents and copyrights but more broadly, brand-names, trademarks, advertising, financial and consulting services, financial exchanges, health care (medical knowledge), and education. The third element consists of electronic libraries and databases, including new media, video entertainment, and broadcasting. The fourth element comprises biotechnology, traditional libraries and databases, and pharmaceuticals. These four elements constitute the fastest-growing sectors in modern economies, whether measured in value added or employment and job growth. Everything on the list contains elements of intangibility and can be regarded as knowledge. But while steam engines or clay tablets are physical objects, which contain knowledge, they do not resemble knowledge in their use. Their uses are bound by geographical and physical constraints. An oil supertanker is not part of the weightless economy, but computer software is."

A group of researchers argues that ICTs can support community economic and social development through helping communities identify and affect local commitment, resources and skills [7–9, 10, 11]. The assumption is that once community efforts are put together, the resulting joint effort would lead to upgrade of sustainable local economic activity and advance of quality of life [12]. This assertion is based on the premise that communities have considerable unexploited potential and that ICTs can help them become aware of this capacity and bring it to fruition.

2.2.2 Entrepreneurship

A major component in the ICTs for entrepreneurial environment upgrade aspect is the Virtual Organization (VO) prototype [13, 14]. A virtual organization is defined to be a set of co-operating (legally) independent organizations, which to the outside world provide a set of services and functionality based on ICTs as if they were one organization. The set of co-operating organizations can change with time; it can be a dynamic configuration depending on the function/service to be provided at that point in time. It can also be a more stable configuration with a sizeable time span and a stable set of services and functions. A virtual enterprise is a particular case of virtual organization. The most common industries for virtual organizations are information technology, manufacturing, and consulting, but can exist in any industry where the marketplace desires multi-faceted services or products that require very costly logistical or infrastructure investments. An example of a virtual organization could be a "virtual municipality", associating via a computer network, all the organizations of a municipality (e.g. city hall, municipal water distribution services, internal revenue services, public leisure facilities, cadastre services, etc.).

2.3 Technology

2.3.1 Semantic web

The term "Semantic Web" was introduced by Tim Berners-Lee *et al.* [15] describing a "Web for machines" in contradiction to a web to be read by humans. The vital issue is to annotate digital files (i.e. documents, spreadsheets, images etc.) with 'semantic markup', which is not interpreted for display but serves as an expression of document content to be automatically processed by agents and other IT components. The fundamental assumption of Semantic Web is that information on the web is available in modularized form: "information in the information space is in the abstract chunked into addressable things known as resources" [16].

In the architectural scheme, resources have unique identifiers such as a Uniform Resource Identifier (URI; http://www.w3.org/Addressing/). Major research about the semantic web technologies is promoted by World Wide Web Consortium (W3C- w3.org), founded in 1994 to develop common standards for the World Wide Web, the W3C is an international industry consortium, jointly hosted by the Massachusetts Institute of Technology Laboratory for Computer Science (MIT/LCS) in the United States; the Institut National de Recherché en Informatique et en Automatique (INRIA) in Europe; and the Keio University Shonan Fujisawa Campus in Asia. Initially, the W3C was established in collaboration with CERN, where the Web originated, with support from DARPA and the European Commission.

The W3C is an industry consortium, which seeks to promote standards for the evolution of the Web and interoperability between WWW products by producing specifications, guidelines, software, and tools to lead the Web to its full potential as a forum for information, commerce, communication, and collective understanding. Although W3C is funded by industrial members it is vendor-neutral, and its products are freely available to all. The explicit representation of the semantics underlying data, programs, pages, and other web resources, will enable a knowledge-based web that provides a qualitatively new level of service. Automated services will improve in their capacity to assist humans in achieving their goals by "understanding" more of the content on the web, and thus providing more accurate filtering, categorization, and searches of information sources. This process will ultimately lead to an extremely knowledgeable system that features various specialized reasoning services. These services will support us in nearly all aspects of our daily life – making access to information as pervasive, and necessary, as access to electricity is today.

XML Topic Maps are an ISO standard for describing knowledge structures and associating them with information resources. The topics, associations, and occurrences that comprise topic maps allow them to describe complex structures such as ontologies. They are usually implemented using XML (XML Topic Maps, or XTM). As opposed to RDF, Topic Maps are more centralized because all information is contained in the map rather than associated with the resources. According to Park & Hunting [17], topic maps will become the answer for organizing and navigating through large and continuously growing information pools. They provide a "bridge" between the domains of knowledge representation and information management [18]. This standard defines both abstract data model and serialization syntax to represent knowledge structures and to link them to information resources.

As the semantic web matures, there is the need for more and more formal ontology definitions in standard languages such as the Web Ontology Language (OWL) of the World Wide Web Consortium [19, 20]. OWL is a markup language for publishing and sharing data using ontologies on the Internet. OWL is a vocabulary extension of RDF (the Resource Description Framework) and is derived from the DAML+OIL Web Ontology Language. Together with RDF and other components, these tools make up the semantic web project. OWL currently has three flavors: OWL Lite, OWL DL, and OWL Full. These flavors incorporate different features, and in general it is easier to reason about OWL Lite than OWL DL and OWL DL than OWL Full. OWL Lite is constructed in such a way that every statement can be decided in finite time, the higher OWL versions can contain endless 'loops'.

In the same context, Simple Knowledge Organisation System (SKOS-Core) [21] is intended as a complement to OWL. It provides a basic framework for building concept schemes, but it does not carry the strictly defined semantics of OWL. Thus it is ideal for representing those types of KOS, such as thesauri, that cannot be mapped directly to OWL ontology. SKOS is also easier to use, and harder to misuse than OWL, providing an ideal entry point for those wishing to use the Semantic Web for knowledge organization. SKOS-Core also provides a framework for linking concepts to the words and phrases that are normally used by people to refer to them. This valuable information, once captured, can be used to support a number of tasks, such as automated classification of web documents, and automated multilingual translation of glossaries.

2.3.2 Grid computing

Popularity of grid computing and semantic web technologies among researchers and practitioners has been evident by the almost 13 million web pages returned from each search in Google engine.

Grid computing offers a model which solves massive computational problems by making use of the unused resources (CPU cycles and/or disk storage) of large numbers of disparate, often desktop, computers treated as a virtual cluster embedded in a distributed telecommunications infrastructure. Grid computing's focus on the ability to support computation across administrative domains sets it apart from traditional computer clusters or traditional distributed computing. Grid computing has the design goal of solving problems too big for any single supercomputer, whilst retaining the flexibility to work on multiple smaller problems. Thus grid computing provides a multi-user environment. Its secondary aims are: better exploitation of the available computing power, and catering for the intermittent demands of large computational exercises. Grid computing involves sharing heterogeneous resources (based on different platforms, hardware/software architectures, and computer languages), located in different places belonging to different administrative domains over a network using open standards. In short, it involves vitalizing computing resources. Grid computing is often confused with cluster computing. The key differences are that clusters are homogenous while grids are heterogeneous; also, grids spread out and encompass user desktops while clusters are generally confined to data centers.

According to Ong [22]: "What is commonly referred to as "the Grid" is really a distributed computing infrastructure that is to a certain degree analogous to the electric power Grid. Like power Grids, Computational Grids will be able to provide a universal source of computing power and this can potentially have a huge dramatic impact on human capabilities and on the entire society. Just like the World Wide Web that enables widespread information sharing, the Grid is also not bound by institutional or geographical boundaries; any user can access any resource made available on the Grid by a provider. The resource sharing is dynamic because consumers can request for Grid resources as needed and resource providers provide them as and when demanded. However, all this is only possible with adequate standardization of Grid protocols. Only common protocols can ensure interoperability, which is critical for multi-institutional sharing of heterogeneous resources."

Many Grid technology research groups and forums have introduced and promoted standards for Grid computing, namely the Globus Project (www.globus.org) and the Global Grid Forum (GGF) (www.ggf.org). GGF's primary objective is to promote and support the development, deployment, and implementation of Grid technologies and applications via the creation and documentation of "best practices" – technical specifications, user experiences, and implementation guidelines." GGF was born by merging several institutions related to grid standards development, receives financial support through membership fees from sponsor members and more than 5000 researchers are involved. The Globus Project "conducts research and development to create fundamental technologies behind the 'Grid,' producing open-source software that is central to science and engineering activities and is the substrate for significant Grid products offered by leading IT companies". Globus is primarily funded by government agencies and major corporations like IBM, Microsoft and Cisco. Programming tools for Grid environment includes the Shared State models (i.e. JavaSpaces [27]), the Message Passing models (i.e. Message Passing Interface (MPI), the Remote Procedure Call (RPC) and Remote Method Invocation (RMI) models (i.e. GridRPC [23]), the Hybrid models (i.e. OpenMP [24]), and the Peer-to-Peer models (i.e. JXTA [25]). Lee *et al.* offer a comprehensive review for Grid programming tools [26].

2.3.3 Convergence of Grid services to Web services' standards

According to Krishnan *et al.* [25] "a Web service is defined as a platform and implementation independent software component that can be:

- described using a service description language,
- published to a registry of services,
- discovered through standard mechanisms,
- invoked through a declared API, usually over a network, and
- composed with other services.

As the semantic web services' potential started to become a reality over the last years, industry has become increasingly involved by realizing serious number of popular products and services (i.e. Oracle's database 10g is an enabling technology for grid computing, Microsoft's Office suite includes XML features and next generation's operation system, named Longhorn, is based on XML methodology). This popularity means more users and workloads for processors, a task, which perfectly fits to Grid computing methodology. In addition, as Krishnan *et al.* [25] state: "Grid technologies have to solve problems similar to those addressed by Web services, namely description, discovery, communication, remote invocation, and so forth". Recently, this fact has been recognized by the Grid community, resulting in the development of the Open Grid Services Architecture (OGSA). OGSA uses the Web Services Description Language (WSDL) to achieve self-describing and discoverable services. It defines a set of standard interfaces that a Grid Service may enable features such as discovery, service lookup, lifetime management, notification, and credential management. In a similar vein to Web services technology, Grid services can realize their full potential only if there is a mechanism to dynamically compose new services out of existing ones. OGSA, which was developed by the Global Grid Forum [29], builds on Globus toolkit experience. Specifically, Gannon *et al.* [30] proposed four valuable Grid-Web services: Grid Authorization Service, Grid Application Resource Broker, Grid co-Scheduling Service, and Grid File Object Metadata Directory. Within the OGSA framework has been developed the Grid Services Flow Language (GSFL), an XML-based language that allows the specification of workflow descriptions for Grid services [25]. Most profoundly, the recent adoption of web services is bringing significant benefits. Nevertheless, for various reasons there are now competing views of how to implement the architectural design and what standards to adapt. In web services standards, Web Services Resource Framework (WSRF), Web Services Grid Application Framework (WS-GAF), Web Services Flow Language (WSFL) and Web Services Conversation Language (WSCL) are the most popular.

2.3.3.1 Web Services Resource Framework (WSRF) The purpose of the Web Services Resource Framework (WSRF) TC is to define a generic and open framework for modeling and accessing stateful resources using Web services. This includes mechanisms to describe views on the state, to support management of the state through properties associated with the Web service, and to describe how these mechanisms are extensible to groups of Web services.

2.3.3.2 Web Services Grid Application Framework (WS-GAF) There has been a great deal of work and continues to be undertaken by the Web Services community that could be used to implement Grid solutions (e.g. in the areas of security, coordination, transactions, business process orchestration, notification, etc.). Utilizing such work allows Grid developers to exploit existing Web Service tools, specifications, services and practices, educational material, and hence avoid the need to build a parallel set of solutions. This frees the Grid community to concentrate on building the higher-level abstractions (i.e. service interfaces and document structures) that are specific in building Grid applications. WS-GAF is proposing a design pattern for a Web Services Grid Application Framework that is simple and compliant with specifications and practices in the wider Web Services community. The proposal only uses specifications from the Web Services Interoperability Basic Profile and the OASIS WS-Security standard. To allow orthogonal access to resources, the WS-GAF proposal introduces the concept of a Grid Resource Identifier, which is just a URN that uniquely and everlastingly names a (logical) resource and the Grid Resource Metadata document, which is an extensible placeholder for recording metadata about those (logical) resources. The service interactions can deal in terms of high-level names, which can be resolved to something meaningful by applications that create and consume those names. It is based on the fact that the separation of issues of identity and metadata from services and the provision of distinct solutions allow the implementation of a more flexible architecture, the adoption of existing tools, and the support for sophisticated usage patterns.

2.3.3.3 Web Services Flow Language (WSFL) Web Services Flow Language [31], was initiated by IBM to describe the composition of Web services by using a flow model and a global model. The flow model defines a series of activities that represent the operations of the composite Web service, and determines the order in which these activities run.

2.3.3.4 Web Services Conversation Language (WSCL) Web Services Conversation Language (WSCL) [32] is a conversation language framework introduced by the Hewlett-Packard Company, which allows the abstract interfaces of Web services, i.e. the business level conversations or public processes supported by a Web service, to be defined. WSCL specifies the XML documents being exchanged, and the allowed sequencing of these document exchanges. WSCL conversation definitions are themselves XML documents and can therefore be interpreted by Web services infrastructures and development tools. WSCL may be used in conjunction with other service description languages like WSDL; for example, to provide protocol binding information for abstract interfaces, or to specify the abstract interfaces supported by a concrete service.

At the present time, any software developer who wants to create Grid services faces the dilemma of deciding, which of many standards to follow. The GGF, in order to anticipate the multiple-standards problem, has established in December 2004 a research group to begin developing a simple API for Grid applications, which an application developer could use to specify a job request along with associated files and resources. In any case, architecture independence, security [33, 34], performance, quality of service [28], interoperability and pricing of Grid programming model implementations remain an open challenge for IT companies and developers.

3 ICTs for development projects and policies

In this part we examine ICTs for development of specific projects and general policy frameworks adapted from major global institutions. The most technologically advanced project is NASA's Information Power Grid, since it is elaborating hardware and software resources to an individual base. It lacks the general-purpose and local development aspect and the resulting organizational, personal and social characteristics. Hamburg's pilot e-government semantic web service is considered to be a useful and informative test-bed for one-stop web services. Other projects presented in the last paragraph offer insight in community collaboration schemes through ICTs. The ICTs for development policies of the European Union, the OECD, and the G8 World Economic Forum are presented later in this section. Markus [35] and Romm and Taylor [36] describe the following variables as critical to successful diffusion of ICTs within a CI context:

Technology
Given that CI focuses on the whole community, including its less computer literate members, it is important that technological constraints, namely the degree to which technologies are seen as "user friendly" are taken into account when CI projects are undertaken.
Motivation
The degree to which individuals within the community are motivated to participate in CI projects is crucial for the success or failure prospects of these projects. Consequently, from a practitioner perspective, a lot of attention should be given to understanding the unique motivation of subgroups within the community (different age groups, socioeconomic groups etc.).
Task
If members of the community cannot see how they can use technologies, they are not likely to adopt them. From a practitioner perspective, a lot of attention should be given to understanding the tasks that members of the community wish to undertake and how these can be facilitated by ICTs.
Environment
This variable would translate as changes to the social and economic environment in, which the community as a whole is operating. For example, living in a remote area such as Cape Breton, Nova Scotia [2] would work as an incentive for community members in order to embrace Internet technologies as a means for marketing their unique products. From a practitioner perspective, a lot of attention should be given to understanding the external environment in, which the community is operating and using IT to increase the comparative advantage of the community within its environment.

Politics
This variable refers to the degree to which the community as a whole is characterized by harmonious relationships between its members. It would also translate into the degree to which the members of the community support their leaders in their effort to diffuse the new technologies. From a practitioner's perspective, this variable would suggest that practitioners should be sensitive to conflicts within the community and endeavor to resolve them as a means for facilitating the diffusion of ICTs.
Culture
This variable would suggest that the culture of the community to which the new ICTs are being introduced has to be compatible with the goals of the project in order for the project to succeed. From a practitioner's perspective, this would suggest a "culture analysis" of both the community values and the values embedded in the ICTs to be diffused.

3.1 Projects

3.1.1 NASA's Information Power Grid

NASA's Information Power Grid (IPG) [http://www.ipg.nasa.gov] is a high-performance computing and data grid [37]. Grid users can access widely distributed heterogeneous resources from any location, with IPG middleware adding security, uniformity, and control. Scientists and engineers throughout NASA are eligible for IPG accounts. IPG is a high-performance computation and data grid that integrates geographically distributed computers, databases, and instruments. Like the electric power grid for which it was named, the IPG delivers power on the basis of who needs. The power in the IPG is computational power. NASA has pioneered the development of grids and inter-grid accessibility. One of the major goals of IPG is to establish a prototype Grid environment: a heterogeneous, distributed computing, data, and instrument environment that provides uniform resource access. Specifically the major goal was to put into place the IPG baseline operational system, consisting of:

- Computing resources: 600 CPU nodes in half a dozen SGI Origin 2000s and several workstation clusters at Ames, Glenn, and Langley, with plans for incorporating Goddard and JPL, and approximately 270 workstations.
- Communications: High speed, wide area network test-bed among the participating centers.
- Storage resources: 30–100 Terabytes of archival information/data storage uniformly and securely accessible from all IPG systems.
- Software: The Globus system providing Grid common services and Grid programming and program execution support through Grid MPI (via the Globus communications library), CORBA integrated with Globus, a high throughput job manager, and the Condor job management system for workstation cycle scavenging.
- Human resources: Stable and supported operational and user support environments.

- Applications: Several "benchmark" applications operating across IPG (parameter studies, multi-component simulations, multi-grid CFD code).
- Multi-Grid operation (e.g. example applications operating across IPG and the NCSA Grid).
- Active participation in the Grid Forum for standardization and technology transfer.

3.1.2 Hamburg's pilot e-government semantic web services

Hamburg University initiated in 2002 a pilot project [38], which concentrated on the application of semantic web technologies to enable the "contextualization" of DiBIS, an information web service for citizens living mainly in the Hamburg area (www.hamburg.de). The conclusions of this forward-looking project are:

- "Developers do not have time and the necessary domain knowledge to decide about the semantic issues of the application to be developed. Therefore, the informational design of the Web-based service should be as independent as possible from the technical implementation.
- However, the levels of sophistication and granularity of the conceptual modeling and of the implementation of Semantic Web technology are interrelated.
- E-government services employ informational resources on several different levels; at each of these, different ways of semantic markup and approaches to the editorial process are needed".

3.1.3 Other projects

One of the most important themes in the literature on CI is the search for effective means for diffusing ICTs within communities. In this context several success stories are frequently quoted. The first of these, the Missouri Express Project, was established in Missouri in 1993. This project aimed to connect 80 communities in Community Information Networks (CIN's) over a three-year period [11]. The emergence of the Smart Communities concepts in San Diego in 1994, led to the establishment of the World Foundation of Smart Communities in 1997 [39]. Another study that attempted to identify factors that hinder successful diffusion of IT within communities was undertaken in Australia [40]. This study was based on the first and largest CI project in Australia. It involved the establishment of 450 public access points across three Australian States. The most important shortcoming of this project was that its facilities were under-utilized. The authors saw the fact that the project was based on public rather than private access points as the major reason for its limited success. They recommended that in future, public funded CI projects should strive to encourage private access points (through local ISPs) and invest in raising community awareness of Internet technologies through promotion and training activities.

3.1.4 Policies

A large number of initiatives have been made – and are being made – in different parts of the world, to deploy ICTs in a manner that can create an impact on the society. Information and Communication Technologies (ICTs) have been making considerable impact on the society due to their universal application and appeal. While the businesses and urban communities have seen the positive contribution of ICTs in several dimensions like increases in efficiencies, communications and information on anytime-anywhere basis, the same cannot be said of the rural areas, especially in the context of the developing countries.

3.1.5 European Union

European Union policy in line with the previous analysis has set the following three major strategic axes for regional development [41]:

Regional economies based on knowledge and technological innovation: helping less-favored regions to raise their technological level.

e-EuropeRegio: the information society at the service of regional development.

Regional identity and sustainable development: promoting regional cohesion and competitiveness through an integrated approach to economic, environmental, cultural and social activities.

In the following lines, the basic directions for ICT research and application topics are defined [42]:

"With myriads of interconnected devices, we need to explore how to tap into all this computing and networking power in a way that can be adapted to different needs. To build service-oriented infrastructures that autonomously shares and manages multiple resources across customers, business units and applications is a challenge that requires further research in areas like software, Grid and knowledge technologies."

3.1.6 Organization for Economic Co-operation and Development (OECD)

OECD analysis [43, 44] is increasingly directed to understanding the dynamics of the knowledge-based economy and its relationship to traditional economics, as reflected in "new growth theory". The growing codification of knowledge and its transmission through communications and computer networks has led to the emerging "information society". The need for workers to acquire a range of skills and to continuously adapt these skills underlies the "learning economy". The importance of knowledge and technology diffusion requires better understanding of knowledge networks and national innovation systems. Most importantly, new issues and questions are being raised regarding the implications of the knowledge-based economy for employment and the role of governments in the development and maintenance of the knowledge base.

3.2 G-8 World Economic Forum

The World Economic Forum Task Force [45] argues that the following eight principles should be the political decision framework to the international actions to realize global digital opportunity in economy and society:

1. The G-8 should take a leadership role by advancing, together with developing countries, a positive vision of the global digital opportunity and by organizing a coordinated effort, backed by high-level support, to assist developing countries in its realization.

2. While much can be achieved through individual efforts, in many cases it also would be helpful to coordinate the digital opportunity program of multilateral institutions, the international business community, and civil societal and philanthropic organizations.
3. Governments could increase their ability to contribute to the realization of the digital opportunity by establishing mechanisms – subject to high-level oversight and leadership – for the internal coordination of forward-looking national strategies and policies.
4. Universal access to education and technology training is a fundamental prerequisite for the transition to knowledge societies.
5. To create a dynamic climate in which entrepreneurship can flourish, macroeconomic stability and new sources of commercial financing are essential.
6. The digital empowerment of civil society is a key foundation of development in the information age.
7. Pro-competitive telecommunications policies are a prerequisite to realizing the global digital opportunity.
8. Pro-competitive policies for the Internet are essential to promote the deployment of infrastructure and the affordable use of services by organizations and the general public.

3.2.1 Digital Opportunity Initiative (DOI)

The Digital Opportunity Initiative (DOI) [http://www.opt-init.org/framework/pages/title.html] aims to provide some fresh answers for this new reality. The uniquely diverse nature of this partnership has made it possible to combine for such a purpose the skills and expertise that each of its members (i.e. Accenture, the Markle Foundation and the United Nations Development Programme (UNDP)) enjoys in their respective fields. The DOI has developed a strategic framework to help guide stakeholders in investing in and implementing strategies, which take advantage of the potential of ICTs to accelerate social and economic development. The framework consists of five critically interrelated areas for strategic intervention:

Infrastructure – deploying a core ICT network infrastructure, achieving relative ubiquity of access, and investing in strategically focused capacity in order to support high development priorities.

Human Capacity – building a critical mass of knowledge workers, increasing technical skills among users, and strengthening local entrepreneurial and managerial capabilities.

Policy – supporting a transparent and inclusive policy process, promoting fair and open competition, and strengthening institutional capacity to implement and enforce policies.

Enterprise – improving access to financial capital, facilitating access to global and local markets, enforcing appropriate tax and property rights regimes, enabling efficient business processes and stimulating domestic demand for ICTs.

Content and Applications – providing demand-driven information, which is relevant to the needs and conditions experienced by local people.

3.2.2 ICTs for development in India

The project is being carried through the Ministry of Communications and Information Technology, Government of India, with the support of UNDP, focusing on adopting a holistic and multi-sectoral approach to achieve a development boost in the area characterized by substantial digital divide [46]. The National Institute for Smart Government is the implementing agency for the ICTD Project. The major aim is to promote an innovative environment, content rich solutions that work around the challenges posed by lack of infrastructure and resources in the rural areas. Some of the services are summarized to the following:

1. One-stop forum for citizens: Citizens are greatly relieved, as the multiple services became available under a common platform.
2. Prompt settlement of the routine matters. In complicated cases; the center staff accepts the applications and provides the applicant with a solution within a pre-specified time.
3. Facilitation on formalities: The electronic application forms add to a citizen's comfort.
4. Reduce visits to the government offices apart from increasing confidence in the administrative process.
5. A Quality front end: the project offers a non-hostile office environment, which is ICTs enabled and friendly.
6. Empowering citizens through easy dissemination of information: The status of a citizen's case is available through self-help systems at the fingertips of the enquiry desk.

3.2.3 United Nations ICT Task Force

The United Nations ICT Task Force [47] has identified the interventions and policy measures needed to achieve each of the Millennium Development Goals (MDGs). Applying knowledge in development, the Task Force on Science, Technology and Innovation underscores the critical importance of knowledge and innovation for development in every country – an emphasis that is echoed in investing in development. Responding to challenges in areas such as economic productivity, agriculture, education, gender inequity, health, water, sanitation, environment and participation in the global economy will require increased use of scientific and technical knowledge. Technological Innovation and the associated institutional adjustment underpin long-term growth and must be at the center of any strategy to strengthen the private sector. Innovation proposes concrete and practical steps that governments and international agencies can undertake to bring science, technology and innovation to bear on development. It also highlights the particular importance of ICTs as a generic platform technology in the scaling up of policies and programs toward the overall achievement of the MDGs.

4 G-work: semantic integration and personal grid e-workspace

4.1 Introduction

Fully operational implementation of g-work in a local economy constitutes a change in paradigm in personal, economic and social level. The personal development concept is concentrated in an opportunity: more and better input in each individual's information set, and a threat: personal data privacy. The trade-off is not obvious but is crucial: more personal data in a collaborative working environment means more chances to work, co-operate, interact, learn and develop your personality, but also increase possibilities for personal data abuse. In g-work framework, besides the technical aspect of data privacy (i.e. semantic firewalls and Community Authorization Service for Group Collaboration), an independent "third intermediator entity" run by representatives from local authorities is proposed. In such case, local awareness and possible face-to-face interactions between members of a local community minimizes personal data privacy risks. After all, technology is characterized of the double face of Janus, as can be shown in Table 1, disables or enables personal and social development to our perception, building a real collaborative working environment based on a dynamic set of incentives, policies and user-friendly technologies could stimulate the positive face of technology.

Table 1: Eight Central Paradoxes of Adoption of Technology (Source: Glen & Fournier [48]).

Paradox	Description
Control/chaos	Technology can facilitate regulation or order, and technology can lead to upheaval or disorder.
Freedom/ enslavement	Technology can facilitate independence or fewer restrictions and technology can lead to dependence or more restrictions.
New/obsolete	New technologies can provide the user with the most recently developed benefits of scientific knowledge, and new technologies are soon outmoded.
Competence/ incompetence	Technology can facilitate feelings of intelligence or efficacy and technology can lead to feelings of ignorance or ineptitude.
Efficiency/ inefficiency	Technology can facilitate less effort or time spent in certain activities and technology can lead to more effort or time in certain activities.
Fulfills/ creates needs.	Technology can facilitate the fulfillment of needs or desires and technology can lead to development or awareness of needs or desires previously unrealized.
Assimilation/ isolation	Technology can facilitate human togetherness, and technology can lead to human separation.
Engaging/ disengaging	Technology can facilitate involvement, flow, or activity and technology can lead to disconnection, disruption or passivity.

4.2 Definition

G-work was initially introduced as a personal grid e-workspace for every citizen [49] and defined to have four interconnected parts:

- Digital Storage,
- Network Traffic,
- Processing Power, and
- One-stop Web Services.

As Vafopoulos [49] argues "The first three aspects are related to technological infrastructure investments. The fourth aspect, one-stop web services, is the fundamental one for ICT exploitation. In this context, HyperClustering Framework is introducing an innovative, complete and direct method to employ ICT for local development by offering a creative and functional environment, which encourages, structures and diffuses personal and social knowledge instauration. At the first stage, we develop synergies among human activities by mapping implementation paths for the most popular of them. Based on this structured information standard, a web-based Virtual Organization (VO) is constructed, which integrates all the major activities of a local economy. The final stage of HyperClustering constitutes the creation of personal grid e-workspace for every citizen and company. Specifically, operates on a semantic web portal basis as the unique electronic gate for a specific geographical region promoting:

- Established web services like e-mail, yellow pages, maps, tour guides.
- Innovative web services including semantic e-commerce and auctioning services for local goods, human resources, and raw materials based on grid computing technology.
- Advantageous mega-marketing features by aggregating marketing expenses under a single umbrella achieving economies of scale.
- Personal and entrepreneurial productivity upgrade.
- A structured, no disposable, comprehensive and expandable social knowledge base available to all citizens.
- E-Inclusion and direct democracy schemes in practice.
- An innovative environment where new ideas and individual creation can emerge and diffuse in less cost."

G-work for a local community member enables hyperconnectivity (i.e. the availability of people for communication anywhere and anytime), glocalization (i.e. constraint-free communication combining global and local connectivity in order to work and commune together on a common task or shared interest) and establishes an organized collaborative working environment by integrating software and hardware infrastructure. As shown in fig. 1, g-work is based on semantic web and grid computing technologies and drives research to the Ambient Intelligence vision. Defined by the EC Information Society Technologies Advisory Group in a vision of the Information Society, Ambient Intelligence emphasizes on greater user-friendliness, more efficient services support, user-empowerment, and support

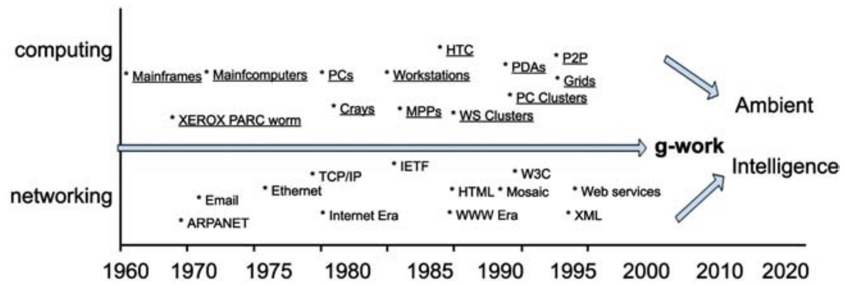

Figure 1: Past and future major milestones in networking and computing technologies from the year 1960 onwards and the g-work framework (based on R. Buyya [54]).

for human interactions. In this vision, people will be surrounded by intelligent and intuitive interfaces embedded in everyday objects around us and also by an environment recognizing and responding to the presence of individuals in an invisible way by year 2010. Since the 1999 IST Programme Advisory Group (ISTAG) vision statement for Framework Programme 5 challenging to create an Ambient Intelligence (AmI) landscape for seamless delivery of services and applications inÿEurope, it rapidly became widely embedded in the work program for years 2000–2001. AmI is also recognized as one of the key concepts related to Information Society in the Framework Programme 6 [50]. Ambient Intelligence builds on three recent key technologies: Ubiquitous Computing [51], Ubiquitous Communication and Intelligent User Interfaces. Ubiquitous Computing means integration of microprocessors into everyday objects like furniture, clothing, white goods, toys, even paint. Ubiquitous Communication enables these objects to communicate with each other and the user by means of *ad-hoc* and wireless networking. An Intelligent User Interface enables the inhabitants of the AmI environment to control and interact with the environment in a natural (voice, gestures) and personalized way (preferences, context). G-work could be considered as an intermediate step to the AmI environment emphasizing in the interconnections of structured digital content, user-centric services, computing resources for all and local development. After all, high technology environments are useless if they do not offer functional solutions, personal and social purpose.

4.3 G-work versus computon and the emerging market

Hewlett-Packard (HP) Company has recently introduced a new unit-of-computing metric, which is being called a "computon" (a mix of computation and photon). A computon is a bundle of processing power, storage, and bandwidth that can be sold and consumed. It would be akin to the pricing models that utilities use to charge customers for kilowatt-hours of electricity based on the ebb and flow of power demand. HP will have to account for variables such as how well its data centers perform and the amount of computing resources that customers require. HP also guides its research efforts in pricing provisions to cover the possibility that companies will use more or less of a specific IT resource, like CPU cycles, than they have contracted for on a monthly basis. In addition, during April 2005, Sun Microsystems introduced a pricing metric called the Sun Power Unit, which sets prices based on factors such as CPU utilization and the storage capacity used by customers. An indicative price range is considered to be a $1 for every hour that a customer uses a processor on one of Sun's computers, and $1 per month for every gigabyte of storage. At the same time, IBM is offering mainframe Linux hosting customers a "service unit" pricing approach. The pricing is based partly on the cost of the hardware being run by IBM, as well as its IT labor costs. IBM also factors in the average amount of hourly mainframe CPU capacity used over a 24-hour period and then tracks monthly utilization rates to come up with the service unit cost.

The computon metric could prove to be a useful way to measure technical aspects of computation, but fails to capture the real impact of Grid computing in everyday life. We do not use yet phrases like "how many computons are needed for your project?" because there is not a "critical mass" bundle of services available on-line. Nowadays, the majority of companies and individuals exploit only a little part of computation capacity due to lack of added-value, user-centric, integrated and interoperable services. Actually, instead of g-working, we use a small amount of computons in a discontinuous way. In this context, g-work is considered to be a systematic way of adding value to computons.

4.4 Pricing issues

In 1969 the Nobel Prize winner economist, William Sharpe, introduced the concept of "The economics of computers" foreseen the future socio-economic impact of computation [52]. Most examples of pricing constitute to the technology and production effort rather than what customers do with the technology. Overlooked in the excitement about utility-like pricing compared to the electrical Grid is the fact that electric utilities were a regulated industry and that regulations to a large extent drove their pricing models. What differentiation do customers see in their power supplier? Likely none. How can these firms capture more of the value provided? First, they should adopt pricing models that directly connect to the full business value to the customer. Second, these firms need to break out of the narrow "computing as a utility" mindset and bundle basic services with more advanced services and deliver complete solutions. For example, flexible on-demand provisioning will be very appealing to cyclical businesses. Consider catalogers for whom the Christmas season is critical to making an annual profit. Such businesses will want the flexibility of adding database, logistics, and billing application capacity in sync with their cash cycles to maintain better control over margins and capital investment. In this context, it makes a lot of sense to implement a probabilistic or options-based pricing model [53] that requires the customer to pay more for greater swings in capacity needs. The above analysis is referred mostly to developed economies, which are characterized by (quasi) efficient market forces. On average, market prices "correctly" innovative services and promote investments in these sectors. On the contrary, developing countries, less favored regions, small and island economies face tremendous under-investment in the ICT sector. In such cases, governmental action is needed in order to build "critical mass" ICT infrastructure promoting technology spillovers to companies and individuals. G-work framework incorporates policies in this direction. In part D of the current paper a business model for g-work is briefly discussed, and is based on an under-the-cost pricing schema. Particularly, for the g-work technological implementation based on grid technologies, a two-fold pricing model is proposed. The basic fold refers to the core computational infrastructure available freely to public and is based on the Bid-based Proportional Resource Sharing family of models [54]. A special program is foreseen for organized communities of individuals, professionals and researchers (i.e. university, chamber of commerce, private research institutes etc), which contribute their members' hardware resources and receive analogously extra credits in the cooperative computing environment. The second fold constitutes more sophisticated and state-of-the-art grid services which will be provided in co-operation with private web-grid services vendors in competitive basis supported by the Auction Model methodology [54].

4.5 Personal and local development issues

Knowledge creation could be considered to be a cornerstone in personal and social development. A major driving force in knowledge creation is human interaction. For analysis purposes, the stylized facts of knowledge creation evolution have been divided into three eras, as shown in fig. 2:

1. Physical era: Knowledge creation is totally based on human interaction by physical means (face-to-face, messages in paper, wood etc)
2. Computer era: Computer machines introduced implicitly or explicitly in human interaction, information storage and exploitation.
3. Ambient era: Completely enveloping technologies emerge in human-machine interaction and knowledge creation.

Today, we face the first phases of the computer era, which is dominated by Internet's penetration in many aspects of social life, accelerating transformation to the ambient era.

The above brief note on the fundamental operating framework in knowledge creation aims to offer insight in to our way of thinking about ICTs exploitation and is far from an analysis in the complex, transdisciplinary concept duo of information and knowledge.

The basic contribution of g-work is considered to be an encompassing and structured input data provision to the decisions-maker's information set. Nowadays, advanced e-government portal services include, among others, business tax services. In contrast, g-work methodology examines a more comprehensive series of actions needed to start and operate a company, involving

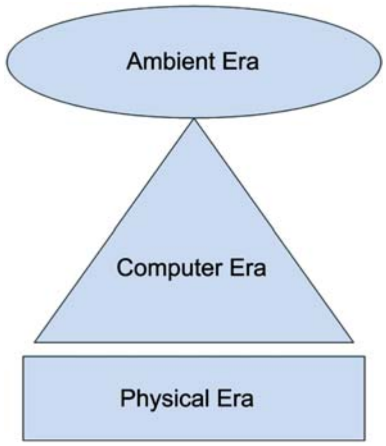

Figure 2: The evolution of knowledge creation.

government, goods, labor and real estate markets, which follow a time path and are interconnected in many ways. In the context of g-work workflows, time paths and interdependencies are modeled and described in machine-readable language based on XML Topic Maps schemas and offered to the public as user-friendly web services. Additionally, in an organized collaborative working environment characterized by local awareness and thematic categorization, collaborative filtering could be an enabling technology for a better information extraction and collective learning externalities. The added value of g-work focuses on upgrading business environment by creating and organizing workflows between community members and exploiting the network externalities and spillovers ICTs offer. Major concern is needed on Less Favored Regions (LFRs) at European Union, where there is lack of critical mass for many resources, locality awareness and substantial digital divide. Access to structured information and computing power has to be a public good in order personal and regional development to be promoted. Specifically, g-work is introducing an innovative way of thinking and acting in local development policy issues.

The organizational structure for both the operating body of g-work and the promoted business model for local entrepreneurial environment upgrade is proposed to be an extension to the Virtual Organization (VO) prototype. As Danny Quah [55] argues, the main attribute of the so-called new economy is digital goods, which have five fundamental properties. Specifically, digital goods are nonrival, infinitely expansible, discrete, aspatial, and recombinant. The above paradigm shift in the business environment parameters coupled to the less favored, limited resources regions argument, direct our analysis to the flexible and extrovert Virtual Organization model. Five are considered to be the main characteristics of the virtual organization entity in the g-work framework:

4.5.1 Dematerialization

Usually, products of traditional enterprises are physical materials. With increasing virtualization the products become potentially immaterial. Dematerialization has the following virtual manifestations along the development of the virtualization. A virtual organization has forms such as:

- Virtual products or/and services.
- Tele-working.
- Virtual Teams and Management.
- Virtual Community of Practice.

Potentially immaterial means in this context, that all object areas in a virtual enterprise are immaterial. A virtual object is characterized by,

- uniform manner towards the customer,
- total optimization of the whole value chain,
- no administration/head office,
- matured information technology (groupware or collaboration software),
- absolute mutual confidence,
- presence of individual core authority,
- flexibility and adaptability, and
- use of a common synergy potential.

4.5.2 Delocalization

Delocalization is related to the three dimensions of the virtuality. It is one of the most important developments in the globalization process. The delocalization goes potentially space independent beyond the decentralization efforts, as a shift of the location results into virtual areas, the cyberspace. Enterprises become independent with space/capacity. It removes a particular location.

4.5.3 Asynchronization

The release of the time which takes place in the context of innovations in an organization, and is used innovatively for more communication and interactions, is called Asynchronization. The Asynchronization makes a contribution for the uncoupling of temporal and spatial conditions (Virtualization). Traditional enterprises use the Asynchronization, in order to increase flexibility and stability in their organization. Potentially, it could be time-independently (24-hours organization) workload organization. The information technology has paved the way to form an organization for the production of "economy of speed" under the criterion of competitive advantage, in the global market. Time has become an important accelerating factor in the context of product innovation, production times, logistics processes etc. This asynchronous division of labor enables the necessary flexibility. For common communication and co-ordination, an electronic collaborative working environment is needed, including instant messaging, voice mail, on line file editing, virtual conference systems, and workflow and project management systems.

4.5.4 Non-Institutionalization

By the suppression of headquarters and by increasing relocation of the work from office to home, the typical physical attributes of an enterprise become virtual. Outsourcing of the legal department to reduce costs is one example. Due to this fact, virtual enterprises can waive to a large extent the cost and time-intensive institutionalization.

4.5.5 Individualization

Individualization is actually an idea related to lower cost mass production with customization. The fast changing trend of the organization from customer-orientation to customer-integration needs drives to new manufacturing techniques and processes/organization.

4.6 Ontology building: the starting point

In the g-work framework in order to tackle the complex challenges of building a comprehensive user-centric model, a life-event approach is needed. Based on XML Topic Maps methodology and OWL Web Ontology Language [19] a human life-cycle model is introduced in Vafopoulos *et al.* [56, 49] and is shown in fig. 3. Vafopoulos *et al.* model socioeconomic needs during different phases of a human being's life and explain that "For instance, a student (school phase) asks for information related to school studies, entertainment, future studies needed for specific profession, a temporary job and he could face the option of attending university (university phase), becoming a professional (freelancer, employee, employer) or being unemployed. The life cycle model presented here accounts also for movements between occupational statuses (a) without education or training (movement

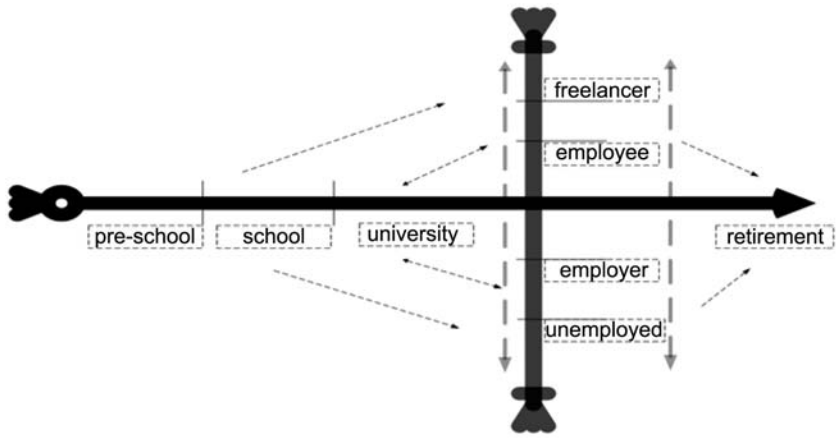

Figure 3: User needs identification is based on a life-cycle model (Source: Vafopoulos *et al.* [37]).

across the vertical axe) or (b) by going back to university in order to change profession (i.e. employee – university – freelancer)".

4.7 Implementation issues

The test of development potential for g-work constitutes to a holistic, horizontal effect policy implication based on the following twelve fundamental factors, which describe the spectrum of g-work analytical framework:

1. Physical access – Is technology available and physically accessible?
2. Technology – What is the appropriate technology according to local and international conditions?
3. Personal Data Security, Trust & Reliability – Is technology secure and reliable?
4. Financial Cost & Affordability – Is technology access affordable for people to use?
5. Education and Collaboration Culture – Do people understand how to use technology – and its potential uses?
6. Digital Content – Is there locally relevant and user-friendly content?
7. Integration – Does technology burden people's lives or does it integrate into daily routines?
8. Social Factors – Are people limited in their use based on gender, race, income or other factors?
9. Legal Framework – How do laws affect technology use and what changes are needed to foster it?
10. Local Economic Environment – Is there a local economy that will sustain technology use?
11. Macro-economic environment – Is technology exploited for business environment upgrade?

Yet most national strategies overemphasize specific technologies or applications and underemphasize local conditions, thereby falling short of a comprehensive approach that combines realistic priorities and effective execution. Relatively little cumulative effort is placed on developing organizational theories and practice related to the implementation of integrated ICTs and developing usable analytic methods and tools to predict the social and cultural impact of adopting new information technologies. Leadership for the knowledge society requires multi-sectoral collaboration rather than the top-down approach of state-dominated policy making systems. This form of cross-sectoral collaboration is most effective when it includes each of the four key sectors: government, business, researchers in labs and universities, and civil society organizations. The consensus build up between different parts is based on EASW mechanism. The European Awareness Scenario Workshop (EASW) Initiative – http://www.cordis.lu/easw/home.html – was launched by the European Commission DG XIII D in 1994 as a pilot action to explore new possible actions and social experiments for the promotion of a social environment favoring innovation in Europe.

It is proposed that complex organizational, social and cultural issues must not only be reactively acknowledged through post-implementation evaluation, but also pro-actively addressed by developing models, tools and techniques that facilitate better understanding of organizational issues. In this paper we put forward a strategic model for implementing g-work, derived from the literature and empirical research, which incorporates an organizational domain.

The simple and realistic business model presented in [57] includes, Partners, Management, Deliverables, Timetable and Financing. The timeframe is decomposed in three phases and is depicted in Table 2. Despite the fact that the logical sequence is fixed (after phase 1 is phase 2 followed by phase 3), starting point could vary. For instance, an e-ready local community could jump directly to phase 2 avoiding phase 1.

Table 2: Basic aspects of a business model for g-work (Source: Vafopoulos and Angelis [57]).

	Phase 1 →	Phase 2 →	Phase 3
Partners	University. Public authorities. Local chambers. NGOs. E.U.	+ private funds	Minimum presence for public authorities
Management	50% Virtual organization 50% traditional practices	80% Virtual organization 20% traditional practices	100% Virtual organization
Deliverables	Ontology building WS mapping Public agreements Pilot grid-ready WS Advertisement campaign WS: Web Service	Full WS implementation Pilot grid service Go national Feedback system	g-work Innovative WS Go international Mega marketing
Timetable	2-4 years	2-4 years	2-4 years
Financing	100% public	70% public 10% member fee 20% advertisement revenue	30% public 20% member fee 50% advertisement revenue

Implementation of g-work involves three main phases. During the first phase (pilot) web services mapping and ontology creation are the main technological issues. Public awareness, and motivation campaign is coupled to central government financing. Public agreements refer to strategic or/and digital content contribution partnerships. As we progress to next phases integrated grid-ready services are delivered and private funds are activated. During phase 2 intra-regional and national co-operation and g-work dissemination is proposed. Feedback system integrated to a semi-automatic web development tool could be essential to the mass production stage. Full potential of the g-work framework will be revealed on phase 3. Newly introduced Web-Grid services – e.g. 3-D collaborative schemes – would become feasible. Implementation of g-work in an international level is a natural step ahead since it is compatible to widely approved standards (semantic web and grid computing technological standards) and a realistic business model.

5 Conclusion and future work

Technology, information and economy are evolving very fast. The way governments, businesses and individuals operate should change in order to avoid threats and capitalize on opportunities. The decreasing cost of basic ICTs infrastructure and services coupled with the increasing ubiquity means that communities can produce collaboratively, disseminate and exploit their own digital content. However, this does not become truly democratic until the barriers to ICTs ubiquity for every citizen have been overcome. This requires policy to promote ICT's literacy as a life skill and ensure that access is available to all who want it. No two communities are the same and the g-work model presented in this paper can act as a road map, assisting less favored communities to identify their own way to becoming effective users of ICTs. Simultaneously, this model can guide policy makers to recognize the appropriate ICT's implementation path within a community. Market trends in developed economies indicate that during the next decade most of us will g-work. Developing economies, according to our analysis, must g-work in order to capitalize on ICTs-based development. The current paper argues that finding optimal solutions for local development is a transdisciplinary issue and involves computer and information sciences working together to economic and social sciences. In other words, how computons can be useful to everybody. G-work analytical framework is designed to be a systematic and bi-directional (technology-society) way for ICTs exploitation in everyday life. Future work should be directed to further analysis of innovative knowledge organization schemes in order to build a prototype based on the g-work model. User profiling [58, 59, 60, 61], interface personalization, content filtering [62], collaborative filtering [63, 64, 66], information filtering [67], role-based access control [68] and security issues (i.e. SAML language) are considered to be open issues for further research. Compatibility of g-work to the Ambient Intelligence's vision will be further analyzed. In this context, real case pilot projects are under way in less favored communities.

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