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A business model for the personal grid e-workspace

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Abstract: The personal grid e-workspace (g-work) is a bidirectional (technology-society) set of technologies, methods and policies for ICT exploitation in everyday life and belongs to web science research effort. In the present paper, a business model for implementing the g-work environment in a small city is presented, based on info Watt (iWatt), a combined metric for digital storage, network traffic, processing power and one-stop web services.

Keywords: g-work; web science; iWatt; business model.

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1 Basic aspects of g-work

Information and Communication Technologies (ICT), as the principal agents and infrastructure of 'globalisation', are often a cause of significant disparities in wealth and welfare, not just between rich and poor, but also among culture, gender and age groups. Each major innovation – telephones, computers, faxes, spreadsheets, mobile phones, World Wide Web, search engines – has spread unevenly throughout the globe. The varying ability of people to adopt and adapt these technologies seems to be one of the principal determinants of their prospects for economic, social and political development in general. The resulting differences give rise to what is commonly referred to as a 'digital divide' (Norris, 2001), but which is, in fact, a series of divides, disruptions and dynamics, presenting a complex mosaic of the penetration of technology. Persistently high and deep digital divide in a local community will increase social inequality towards the 'new democratic deficit'. The new democratic deficit is described as a metastasis of the digital divide and has two dimensions:

a the lack of free access to structured information and knowledge concerning public action for all citizens

b unauthorised and no voluntary access to personal data from third parties (Vafopoulos, 2006).

At the same time, ICT should be thought of as "Interaction and Cooperation Technologies" that facilitate processes of 'networking' public and private enterprises and individual entrepreneurs to facilitate all the necessary processes that make technologies a major development driver. In this direction, an analytical framework for providing integrated bundle of user-centric web services coupled to processing power resources for every citizen, have been introduced as the *personal grid e-workspace* (*g-work*). G-work is defined (Vafopoulos, 2005) to have four interconnected aspects:

- digital storage
- network traffic
- processing power
- one-stop web services.

As Vafopoulos et al. propose

> "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 Organisation (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." (Vafopoulos et al., 2005)

G-work for a local community member enables inter-creativity (Berners-Lee and Fischetti, 2008) through hyperconnectivity[1] and glocalisation[2] and establishes an organised collaborative working environment by integrating software and hardware infrastructure. G-work is based on semantic web (Berners-Lee et al., 2001), Linked Data (Bizer, 2009; Berners-Lee, 2006) and Grid computing (Foster and Kesselman, 2004) technologies and could be considered as part of the web Science transdisciplinary research effort (Shadbolt and Berners-Lee, 2008; Hendler at al., 2008) towards an Ambient Intelligence environment (ISTAG, 2001).

The term 'semantic web' was coined by Berners-Lee et al. (2001) referring to a "web for machines" as opposed to a web to be read by humans. The core issue is to annotate documents or other informational resources 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. One of the core assumptions of the semantic web is that information on the web is available in modularised form: "information in the information space is in the abstract chunked into addressable things known as resources" (Berners-Lee, 1998). In the technical architecture, resources have unique identifiers such as a Uniform Resource Identifier.[4] 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, thus providing more accurate filtering, categorisation, and searches of information sources. This process will ultimately lead to an extremely knowledgeable system that features various specialised 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.

Linked Data are part of the semantic web and refer to a set of best practices for exposing, sharing, and connecting data via dereferenceable URIs on the web. These best practices have been adopted by an increasing number of data providers (i.e., US[5] and UK governments, BBC, Wikipedia, IEEE, ACM and many others) over the last years, directing to the creation of a global data space containing billions of assertions.[6] This global data space enables accessibility and computability in a massive amount of public data for every citizen, constituting a fundamental step towards g-work's full implementation.

Grid computing and Computing on Demand (Vafopoulos et al., 2007) in general, offers a model for solving massive computational problems by making use of the unused resources of large numbers of disparate computers treated as a virtual cluster embedded in a distributed telecommunications infrastructure.

The personal grid e-workspace (g-work) for every citizen could be considered as part of web foundation's[7] goal to empower people to bring about positive change. Creation and analysis of possible implementation paths for g-work is part of the web science research effort both in technological and social terms, because this new transdisciplinary field is taking the web's technologies and social implications as the primary object of study. One of the envelope questions of web science is what social and technological changes need to be made in order for the web to work better for more people. It is focused in the significant interplay among the social interactions enabled by the web's design and the scalable and open applications development mandated to support them.

Having the software and hardware infrastructure is not enough to derive socioeconomic benefits. Other factors, such as the regulatory environment, the availability of appropriate skills, the capability to change organisational set-ups, the strength of accompanying innovations in ICT applications, as well as a feasible implementation plan, affect the ability and enthusiasm of citizens and Small and Medium Enterprises (SMEs) to seize the benefits of ICT.

2 A business model for g-work

Yet, most national strategies over-emphasise specific technologies or applications and under-emphasise local conditions, thereby falling short of a comprehensive approach that combines realistic priorities and effective execution.

Relatively little cumulative effort is placed on developing organisational theories and practice related to the implementation of integrated ICT, and on developing usable analytic methods and tools to predict the social and cultural impact of adopting new information technologies. We propose that complex organisational, 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 the human and organisational issues. In this paper we put forward a strategic model for implementing g-work, which incorporates organisational domain aspects.

2.1 Basic factors

Implementation issues involve organisational, social, economic, strategic, and technological aspects. The fundamental factors driving our analysis are summarised in two main categories, the cultural and the technological level:

2.1.1 Culture

For the purpose of this paper we will use the following definition of culture:

> ''… as shared meaning, understanding, values, belief systems or knowledge that depends upon both community and diversity." (Hatch, 1997)

Local culture is, in effect, the operating 'software' of any society and the source of the 'social capital' that keeps a community together and makes it function. Development requires the updating of this cultural software to make it more receptive to economic and technological opportunities (and more accommodating to global imperatives). Societies will, therefore, readily adopt some practices from outside cultures and influences, while strongly resisting others. In short, there is nothing 'neutral' about the adjustments required to apply ICT to development agendas. National leaders must advance a vision of change that can steer a political course that somehow balances rapid development with social cohesion and cultural integrity.

Based on the above definition for culture the following four aspects playing a centre role in the proposed implementation path:

1 business relationships and practices ('business culture')

2 how and where the important political decisions are made ('political culture')

3 willingness of people to cooperate ('cooperation culture')

4 the importance of risk and taking risky decisions.

For instance, it is not feasible to operate g-work in local community characterised by the lack of local awareness and cooperation culture. Conversely, if businessmen and politicians understand the opportunities and risks that ICT offer, g-work is an innovative and efficient tool to exploit them.

2.1.2 Technological level

Technological level characterising societies under consideration constitute the ICT use in everyday life. An adequate proxy for both culture and technological level for a specific country could be the "yearly e-readiness rankings" produced by Economist's Intelligence Unit written in cooperation with IBM Institute for Business Value.[3] The presented metrics are based on measures for:

- connectivity and technology infrastructure
- business environment
- consumer and business adoption
- legal and policy environment
- social and cultural environment
- supporting e-services.

E-readiness rankings are failing to measure explicitly the 'cooperation culture' which remains a complex and open issue for further research.

2.2 A working scenario

The above factors are represented in a decision matrix which determines the business model to be adopted (Vafopoulos, 2005). Furthermore, due to scale and heterogeneity of the proposed techno-social framework it is necessary to establish a standard measurement unit for g-work, the info Watt (iWatt) (Vafopoulos et al., 2007). Analogically to Watt

for electric power, Vafopoulos et al. defined the mathematical formula for iWatt measurement unit as a 'two-way' metric, because every Computing on Demand service is been assigned a specific amount of iWatts (demand side) and each Computing on Demand infrastructure is designed to have a certain amount of iWatts (supply side).

In the present paper a simple and realistic business model is presented; its main aspects include partners, management, deliverables, timetable and financing. The timeframe is decomposed into three phases (Table 1). Despite the fact that the sequence is fixed (phase 1 is followed by phase 2, which is followed by phase 3), the starting point could vary. For instance, an e-ready local community could jump directly to phase 2, avoiding phase 1.

Table 1 Basic aspects of a business model for g-work

	Phase 1 →	*Phase 2* →	*Phase 3*
Partners	• University • Public authorities • Local chambers • NGOs • EU	+ Private funds	• Minimum presence for public authorities
Management	• 50% Virtual Organisation • 50% Traditional practices	• 80% Virtual Organisation • 20% Traditional practices	100% Virtual Organisation
Deliverables	• Ontology building • WS mapping • Public agreements • Pilot Grid-ready WS • Advertisement campaign	• 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

WS: Web Service.

2.2.1 Partners

Leadership towards 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, academia and civil society organisations.

In phase 2 private funding is introduced and includes the following:

- *Member fees*

During phase 1 there are no fees because services are in pilot (beta) version. Since ICT infrastructure is a limited and not storable resource, a pricing model is needed in order to avoid abuse. The basis for a g-work pricing model is a free and analogical percentage

accesses per capita, to 50% of the available ICT infrastructure and competitive pricing and allocation based on special needs for the rest half. A working scenario setup could be the following:

Assume that a local community is composed by 100,000 inhabitants. Specifically, 9000 of them are freelancers, 10,000 are scholars and 1000 are researchers. ICT infrastructure can be summarised in 2,000,000 iWatts in monthly basis and various web services, both open source and licensed. An indicative ICT resources allocation for digital storage is given in Table 2.

Table 2 Digital storage allocation based on g-work pricing

	iWatts allocation (%)	*iWatts*	*iWatts per capita*
All inhabitants	50	1,000,000	12.5
Students	10	200,000	20.0
Freelancers	10	200,000	22.2
Researchers	2	40,000	40.0
Competitive pricing	28	560,000	On demand
Total	*100*	*2,000,000*	

Based on our analysis an individual has free access to 12.5 iWatts, a student to 20 iWatts, a freelancer to 22.2 iWatts, a researcher to 40 iWatts, and 560,000 iWatts (28% of total digital storage infrastructure) will be competitively priced. Similarly, network traffic and access to free and licensed web services will be allocated.

- *Advertisement revenues*

Web advertisement (e.g., banners) in a popular set of web services could be the major source of revenue (Yang et al., 2006).

- *Public–private joint ventures*

During phase 3 public authorities will be only responsible to run an administrative unit consisting of three basic components:

- information management and workflow component
- security and personal data component
- standardisation component (Vafopoulos, 2005).

Joint ventures between public and private institutions could facilitate the development of innovative fee-based web content and services. In such a case, the public contributes to expansion of the g-work infrastructure and a wide member base. On the other hand, businessmen should put up new ideas, know-how and efficient production schemes.

2.2.2 Strategy and management

Strategies must make clearer allowance for local differences in culture, 'social capital' and institutional capacity, and recognise the need for 'real access' to infrastructure and locally useful content. In addition, they should aim to achieve not just specific

sector-by-sector increases in productivity, but also broad cultural changes in the way information and communications are used in general.

Management is selected to be innovative and technology-driven (teleconferences, certain deliverables per partner, outsourcing, e-project management etc.) based on the VO prototype (The VOSTER IST Project, 2001), which involves in brief the following characteristics:

- Dematerialisation
- Delocalisation
- Asynchronisation
- Atomisation
- Individualisation
- Participation.

2.2.3 Deliverables

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 the next phases, integrated Grid-ready services are delivered and private funds are activated. During phase 2 an intra-regional and national co-operative dissemination scheme is proposed. A feedback system integrated into a semi-automatic web development tool could be essential to the mass production stage. The full potential of the g-work framework will be revealed in phase 3. Newly introduced web services – e.g., 3D collaborative schemes – would become feasible. Implementation of g-work on international level is a natural step ahead since is compatible with widely approved standards (semantic web and grid computing technological standards) and a realistic business model.

2.2.4 Timetable

An indicative timeframe for all three phases is defined to be 2–4 years, depending on internal factors for a specific local community discussed in Sections 3.1.1 and 3.1.2. External factors like technology evolution and business models supporting it are of great importance.

2.2.5 Financing

We expand the working scenario presented in Section 3.2 by including the following hypotheses:

- progressively increasing availability of g-work to local citizens
- exploitation of redundant processing power resting in public offices
- three euros buy 1 iWatt over a Wide Area Network (WAN).

In Table 3 indicative costs per phase for data storage availability are computed. Data services are available in the pilot base during phase 1 (participation rate 10%) and are progressively increased to 70% of inhabitants. At the same time, exploitation of redundant processing power resting in public offices is 100,000 iWatts in phase 1, 300,000 iWatts in phase 2 and 500,000 iWatts in phase 3.

From the revenue perspective, if we account that advertisers pay more than a euro per thousand impressions (CPM) on the web and additional fees could be imposed to selected web services, g-work could be proven to be a low-cost project with positive spillovers all across the socio-economic spectrum.

Table 3 Indicative costs for computing availability

Phase	*Participation rate* (%)	*IWatts needed*	*Redundant iWatts*	*New iWatts*	*Cost* (€)
1	10	200,000	100,000	100,000	300,000
2	30	600,000	300,000	300,000	900,000
3	70	1,400,000	500,000	900,000	2,700,000

3 Conclusion and future work

The decreasing cost coupled with increasing ubiquity of ICT infrastructure and services enable local communities to exploit their own digital content in a collaborative way. However, this will not become realistic until the access barriers to ICT for every citizen have been overcome. The current paper proposes a simple implementation scheme for the *personal grid e-workspace* (*g-work*) analytical framework based on a small city scenario. Future work should be directed to further analysis of innovative knowledge organisation schemes and the arising privacy, trust and security issues. Practically, real case projects for less favoured communities (i.e., Web Alliance for Re-greening in Africa[8]) but also policy framework for the information society (i.e., EU's i2010) could benefit by adapting parts or the whole g-work model.

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Notes

[1]The availability of people for communication anywhere and anytime.

[2]Constraint-free communication combining global and local connectivity in order to work and commune together on a common task or shared interest.

[3]www.eiu.com

[4]URI; www.w3.org/Addressing

[5] www.data.gov

[6] www.linkeddata.org

[7]www.webfoundation.org

[8]www.webfoundation.org/projects/greening-africa