

Digital Citizenship and Social Responsibility of Computer Professionals

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Abstract. *Digital revolution is taking us into the Information Society so quickly that the entire Information and Communication Technology (ICT) world has no time to reflect on new social and ethical issues. In particular this dramatic change put computer professionals in a position full of opportunities but also with new responsibilities. Computer professionals and Information Systems managers have in front of them a "rainbow" of risks and opportunities, they face a collection of ethical dilemmas and social issues that requires a deep reflection and debate among all stakeholders: universities, ICT professional organizations, ICT industry, policy makers, users and society at large. A code of ethics for computer professionals could be a good starting point for defining a collection of guidelines.*

Keywords: Social responsibility, computer professionals, computer ethics, Code of ethics.

1. Introduction

In this paper we would like to address one of the themes of the AICA 2013 National Congress, "*digital citizenship*", from the particular point of view of computer professionals and Information Systems managers. They are the real people in charge for the design, development and governance of ICT infrastructures at the basis of our Information Society, they are the real providers of this "*digital citizenship*". How are changed their roles and responsibilities among the years? What are the most important changes from *mainframe era* to Distributed Computing era and finally to Cloud Computing (and Big Data) era? What kind of new social issues and ethical dilemmas are they facing everyday? What kind of instruments have they for facing these issues? What kind of relationship should be in place between "*digital citizens*" and the people that are in charge for ensuring that the "*digital platforms*" run smoothly, respect basic

human rights, and minimize the impact on the environment? What are the relationships between the computer professionals (at all levels) inside an organization and the Corporate Social Responsibility strategy of the organization itself? What kind of support can computer professionals societies (like AICA in Italy, British Computing Society, BCS in UK, etc.) provide to their members? What contribution could provide a *Code of Ethics* for computer professionals? In this paper we would like to set up the stage for finding some possible answers to these questions.

2. From Mainframe to Cloud Computing and Big Data

Computing evolution can be shortly described with three main eras: the (centralized) *Mainframe Computing era*, the *Distributed (Personal) Computing era*, and the *Cloud Computing era*. In each era, computer professionals and Information Systems managers played different roles and faced many responsibilities.

In the (centralized) mainframe computing era (1950s-1970s) the basic technologies were "dumb" terminals (with just input, output and network) connected to big computer (mainframes) inside machine rooms. Any application was designed to run on mainframe platforms. The main issues in front of computer professionals were to properly design the hardware and software platforms to run inside the computer room. The main problems for Information Systems organizations was to control the access to computer rooms (physical and logical) and to guarantee the reliability of the systems. The end users had little or no role in this scenario, they were just "consuming" ICT applications entering their inputs on keyboards or punched cards and visualizing output on printers or screens [Williams, 1997].

In the distributed (personal) computing era (1970s-2010s) the novelty was based on the processing power available to any department and user, and the networking capabilities extended across countries. The computer professionals were involved into the design of "distributed computing" infrastructures and "client-server" applications. The Information Systems role grew in complexity due to the management issues related to networked domains and applications running also at department and user levels [Couloris et al., 2011].

In the Cloud Computing era (2010s-now) the novelty is the re-centralization of computing power and storage ("*in the cloud*"), the decreasing role of end-users' devices (with the local processing and storage capabilities mostly unused), and the network extended at global scale. Computer professionals develop Web-based applications (or simply *apps*) to be "consumed" on touchscreen devices with little or no computing autonomy.

In this scenario the *cloud ICT infrastructure* becomes global with the following characteristics: it is (broadband) *network-based*, the servers are shared-platforms (*multitenancy*), the processing power and storage capabilities are easily scalable (*scalability* and *elasticity*), all resources consumption are *measured* (e.g. for billing purposes) and the users can allocate resources *on-demand* in a *self-service* way [NIST, 2013].

Then there are different Service Models in this scenario:

- *Infrastructure as a Service* (IaaS) where Cloud Providers just rent IT physical components to Cloud Users (in this case Cloud Users organizations have the control of the Applications and shares the Virtual Machines with the Provider, whilst the Provider controls Server, Storage and Network levels);
- *Platform as a Service* (PaaS) where the Cloud environment is used mainly for developing and testing very large applications (in this case Cloud Users shares the Applications and the Services with the Provider, whilst the Provider has the control of Server, Storage and Network levels);
- *Software as a Service* (SaaS) where the entire application is on the Cloud Provider side (in this case Cloud User organizations have no control on any level, whilst the Cloud Provider controls all the Applications, Services, Server, Storage and Network levels) [Mather et al., 2009].

Of course many organizations are implementing Cloud Computing solutions "inside" their domain for using ICT resources more efficiently. In these cases the term used is "Private Cloud", an evolution of the "intranet" concept [Nuttgens et al., 2011], there are no data crossing public networks. In these cases, "*data produced and subsequently distributed within an organization is not only a strategic resource to achieve/maintain a competitive advantage but it is also used as a tool to develop and expand the ability of an enterprise to abruptly respond to unexpected generated by the external environment*" [Zardini et al., 2011; p. 390].

In the standard (Public) Cloud solutions, the data of organizations crosses public networks and are stored "outside" the administration border controlled by Information Systems managers. In these cases, often referred as "Public Cloud" there are many interesting and difficult issues that arise. Information Systems and Chief Information Officers (CIOs) roles are now very critical since the pressure from Chief Financial Officers (CFOs) about moving ICT services towards the *pay-per-use* model of Cloud Computing is growing: with no more investments needed, the move from CAPEX (Capital Expenditures) model to OPEX (Operational Expenditures) model for ICT services is becoming very attractive for CFOs [Patrignani and Kavathazopoulos, 2013].

The risk for CIOs and IT services is to become just "*service brokers*": to chase the best offers from "Cloud Providers" market and offer them to the organization's employees [Ricciardi and De Marco, 2012]. What will happen to all workers inside the IT organizations? Of course all the activities related to design, develop, deploy, maintain all IT services (and the computer room itself) will disappear as all those tasks and responsibilities will be shifted outside to Cloud Providers. Even the task of managing the internal workplaces, personal computers, and laptops is disappearing, since many organizations are encouraging employees to use their daily personal device also at work, it is the so called phenomenon of BYOD, Bring Your Own device [Casey, 2013].

But there are also many other important issues related to Cloud Computing that CIOs have to address like:

- *governance* (in particular in the Service Model like SaaS, the Cloud Provider is delegated to control the entire "stack" of ICT layers, Application, Services, Server, Storage, and Network);
- *de-perimeterisation* (the traditional network boundaries between organization domains will disappear, information storage and processing are outside the control of the organization that still keeps only input, output and network, a kind of "return" to mainframe era);
- *contractual obligations* (there will be the case where the Cloud Provider itself is not the owner of the resources it is "selling"; there will be "ICT brokers", in these cases who will be responsible of what?);
- *problems of many-hands* (when there are several administrators - "*many hands*" - that control mission critical infrastructures, what will happen if, for example, a cloud administrator stops a service for maintenance? There will be cases where both sides – Providers and Users of the cloud – must agree with a kind of "*four-hands-authorization*");
- *risk management plans* (in case of an incident – ICT people know that "*something can always go wrong*" – will the cloud be "*traceable*"? It will emerge the need for storing events in encrypted secure logs, time-stamped and digitally signed, and the need to agree on *joint* risk-management-plans);
- *compliance* (some Cloud Users will need, for compliance purposes, to know the physical location of their data);
- *open market* (what will be the data formats? What kind of standards will be adopted for guaranteeing portability? Can Cloud Users easily change Cloud Provider?).

Computer professionals, Information Systems managers, and CIOs has to deeply reflect on all these issues before signing contracts with Cloud Providers. But there are also many others social and ethical issues related to the management of ICT infrastructures in the current Information Society scenario. Here there are some examples:

- *e-democracy* (what is the correct definition of digital citizenship? What are the rights and duties of citizens online, what kind of decisions are we going to make online?) [Ricciardi and Lombardi, 2010];
- *e-Inclusion* (are we providing the proper interfaces also to elderly people or people with disabilities?);
- *digital divide* (is the access to ICT infrastructures available everywhere? For example, in a "*smart city*" environment, who and how will have access to these kind of "*public digital services*"? Is all the data collected by the smart city applications provided to other organizations in an "*open access*" way?);
- what will be the impact of ICT on workplaces, on information systems users?
- how will change the definition and management of intellectual property in the digital world?

- what will be the approach to *privacy* issues when most of the data and applications will be "outside" the organization? [Patrignani and DeMarco, 2012];
- what kind of reliability of ICT infrastructures and applications will be guaranteed in the Cloud computing scenario?
- what kind of initiatives and procedures will CIOs put in place in order to minimize the environmental impact of ICT? [Patrignani, 2009];
- how will the organization be prepared to face the "*digital tsunami*" of BigData, where Billions of Gigabytes (Exabytes) will have to be processed and stored?

3. ICT landscape: a network with many stakeholders

In the previous part of the paper we have discussed the complex scenarios in front to computer professionals at all levels. These scenarios include several social and ethical issues. Now we introduce some tools or instruments that could help these people in facing these problems that cross the traditional technology borders and reach in many aspects the "*digital citizens*" and the society. Indeed the traditional strategies of the majority of organizations are concentrated only on business opportunities and on short-term profit goals. ICT was always considered just as a "*business enabler*", until 1990s. Since then, with the growing role of *e-business* and online engagement, transaction, fulfillment and service management, ICT is becoming *the (core) business* in itself: without ICT business activities are simply impossible [Rossignoli et al. 2009]. Also, the growing need for organizations to have a clear Corporate Social Responsibility strategy raised the need of a kind of alignment between these strategies and the need to address the social and ethical issues of computing, a clear *computer ethics* strategy. It is now clear how the two domains should be strictly aligned in order of transparently distributing roles and responsibilities inside the organization, and for a complete alignment between *Business Ethics* and *Computer Ethics* strategies [Chartier and Plante, 2013].

Nevertheless computer professionals need some specific tools for facing the immense social and ethical issues and the "rainbow" of risks and opportunities in front of them.

The ICT *stakeholders network* has been proposed as a powerful tool for reasoning and dialoguing about these difficult choices (see fig.1 – Example of ICT Stakeholders Network – applied to the recent Cloud Computing scenario) [Patrignani and Kavathatzopoulos, 2013]. Within this network, it is possible to identify all the stakeholders and relationships related to a specific ICT scenario. The simple construction of this network is already a good help for identifying *conflicts* between stakeholders and missing relationships usually not considered into the customary ICT landscape. In some way it could help also in *ethical decision making* [Laaksoharju, 2010].

Computer professionals and people usually involved just in "technical" decisions are rarely exposed to the concept of artifacts (including information systems), as "*socio-technical systems*", or to the concept that artifacts embed values [Johnson, 1985]. It is difficult for them to see ICT systems as artifacts that at

development-time incorporated the values of the designers, or to see systems as a result of a *Value Sensitive Design* [Friedman, 1996].

This is the main reason of our next proposal: in order to really face their social and ethical responsibilities, as "*digital citizenship providers*", computer professional, or in general, ICT people involved along the entire ICT value-chain need to introduce a reflection inside their professional organizations, this reflection will enrich their "technical" skills with some deontological competences that may prepare the road towards a *code of ethics for computer professionals*.

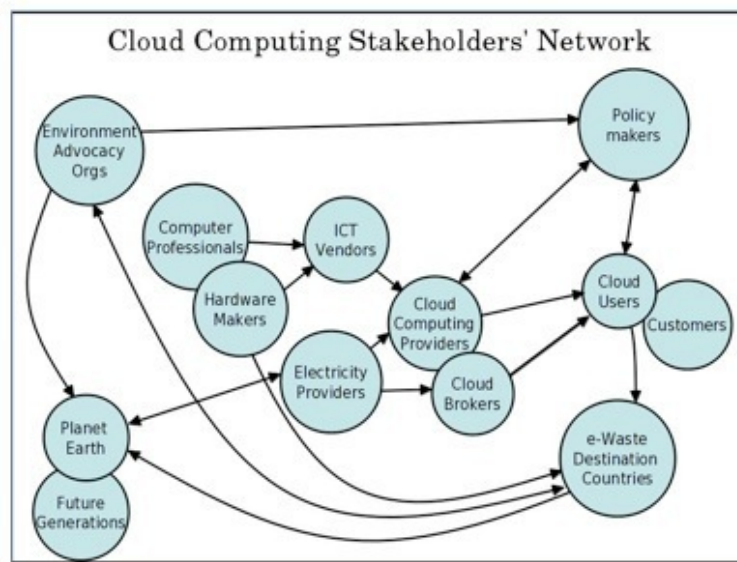


Figure 1
Example of ICT Stakeholders Network

4. Towards a Code of Ethics?

Around the world many computer professionals organizations are providing their members with resources, events, and working groups related to the ethical issues of ICT. One of the most established ones is the Ethics Group inside British Computing Society (BCS) in the UK, one of the oldest ICT professional organizations in the world. The BCS Ethics Group has a challenging responsibility: "... is responsible for promoting awareness and engagement with the ethical issues associated with the advancement of Information Technology science and practice and ensuring that Ethics is fully embedded in everything the Institute says and does" [BCS-a, 2013]. Along the years, they have also defined a "BCS Code of Conduct" for providing support to the people in the field [BCS-b, 2013]. One of the oldest Code of Ethics in ICT is the one defined in the 1990s by the Association for Computing Machinery (ACM) [ACM, 2013].

Maybe that these "codes" will not be able to provide answers to any possible question or ethical issue one can face, but for sure they will provide useful

guidelines and suggestions in order to *be prepared*, in order to improve one status from "*technician*" to a real *professional*.

Also in Italy, the "*Italian Computing Society*" (AICA, Associazione Italiana per l'Informatica ed il Calcolo Automatico) has recently setup a Working Group on ICT and Ethics (Progetto ETIC, Etica e Tecnologie dell'Informazione e della Comunicazione), coordinated by professor Ivo De Lotto of the University of Pavia. There are several ongoing activities within this working group and many of them are preparing the background for a discussion about a *code of ethics for computer professionals* also in Italy [AICA, 2013].

5. Conclusions

The evolution of ICT happened so quickly that gave little time to reflections on different points of view with respect to the common vision of the computer as a technology that can solve most of the problems of society. The risk that we face is to be too fascinated by the wave of technological innovation losing sight of the sea of changes and controversial issues below the sea surface. Yet the widespread diffusion of computers in society, and the indispensable role played by networks of computers in almost all economic activities, induces a series of ethical reflections, not just professionals or experts in ICT, but also to end users and the entire society.

In conclusion we would like to propose some simple recommendations:

- for Universities: to introduce interdisciplinary courses in Computer Science and Computer Engineering courses that could prepare the future generations of computer professionals to face also the social and ethical issues related to ICT;
- for Policy makers: encourage and promote public discussions for decisions regarding the use of ICT in critical systems for the society (e.g. "*smart cities*"), encourage the use of technology for improving quality of life, *well-being* and *well-living* of human beings;
- for ICT industry: define clear Corporate Social Responsibility strategies that involve the analysis of the entire stakeholders network of ICT market;
- for computer professionals organizations: inform the public about the intrinsic limits of ICT systems reliability, question the presupposition that technology can (alone) solve all social and political problems, be involved in national and international debates about the (social, ethical, legal) professional issues related to ICT, and design systems in order to minimize the environmental impact of ICT.

With this paper we would like to support a reflection, in particular among computer professionals and people involved in the ICT value-chain, about their social responsibility as main providers of the "digital citizenship" to the society. We would also like to provide a contribution to the preparation of people with complex skills and knowledge, people that are not just ICT experts, but people that are also able to understand and make right evaluations about social and ethical implications of ICT.

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