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Slow Tech: a quest for good, clean and fair ICT

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1. Introduction

We are returning to a set of observations, made in some cases a 150 years ago, but which started to reach mainstream awareness some 50 years ago.

The concept of the limits to growth were first applied to the planetary environment, whereas today questions are being posed about continuing Information and Communication Technologies (ICT) development. ICT, and the encouragement of the rapid expansion of technologies, have always been the most dramatic, technical representation of the Olympic motto, "*citius, altius, fortius*" (faster, higher, stronger). Until recently, the evolutionary speed of ICT was never questioned: it was always taken to be a good (or good) in its own right. Progress in the development of ICT was driven by the apparently unlimited growth represented by Moore's law: an empirical law, observed for half a century already, which states that the number of transistors that can be integrated into a microchip doubles in about every two years or eighteen months (Moore, 1965).

Storage, processing power, and transmission speed have all continued to expand at unprecedented rates. Storage dimensions are now in the order of billions of gigabytes (1 Gigabyte: 10^9 bytes); the 2013 threshold of Big Data is 1 Exabyte (1 Exabyte: 10^{18} bytes). The fastest computer on the planet is Chinese and is called Tianhe-2; it runs at about 33 millions of billions of Floating Point Operations per Second, (FLOPS), i.e., 33 PetaFLOPS (Top500, 2013). Purely as an example, connection communication between Australian cities of Sydney and Melbourne has seen bits transmitted at the speed of 1,000 Gigabit/sec, that is, 1 Terabit/sec (McDonald, 2013).

Yet such untamed growth is not possible on planet earth, not only because of the limits of materials needed to build ICT, but also as the result of a kind of rebound effect: increases in efficiency (due to high-tech) tend to increase the rate of consumption of resources (Hilty, 2011) – what is being seen is a contemporary version of the Jevons' paradox (Jevons, 1866) that is related economically, rather than to coal, to ICT and the materials used to create them and energy to use them.

Over the past fifty years, a new awareness about the importance to establish a more suitable model for our society has grown all around the globe. The cyclical notion of the planet's limits was recognised from the 1960s onwards. In her book, "Silent Spring", Rachel Carson warned of the deadly consequences for animals and human beings of an unlimited use of pesticides (Carson, 1962). A decade later, the Massachusetts Institute of Technology (MIT) System Dynamics Group published the "The Limits of Growth" report, commissioned by the Club of Rome. It argued that the environmental limits of the earth could not continue to sustain an industrial model based on exponential growth and unlimited consumption of natural resources (Meadows et al., 1972). In 2007, the United Nations Intergovernmental Panel on Climate Change, the largest group of scientists studying the consequences of human activities on the environment, published its list of recommendations. The panel advocated the need to take into account the limits of greenhouse gas concentration in the atmosphere, in order to avoid catastrophic consequences on people's living conditions (IPCC, 2007).

Until recently, the world of ICT was considered to be immune from any similar concept of limits. However, this immunity is now being seriously questioned: the entire technology lifecycle and the long-term sustainability of ICT are beginning to be assessed from both the environmental and social points of view (Whitehouse et al., 2011). In February 2013, the First International Conference on ICT for Sustainability was held in Switzerland. It brought together several hundreds of world-leading experts in the field of environmental sustainability and the use of ICT (ICT4S, 2013). In today's digital world, it is equally important to consider various set of limits, such as those that apply to data conservation, to human sensory and intellectual 'bandwidth', and to the roles that ICT applications play in many areas of human life including institutions, organisations and politics (Patrignani & Whitehouse, forthcoming).

As a result of this revival in awareness, this paper examines areas of importance in which to explore several associated, yet separate limits to ICT: for human beings, the environment and society. It shows in what ways contemporary technologies pose both challenges and opportunities in these three domains. It reflects on several traditional approaches to social and ethical impacts of ICT (a domain often defined as computer ethics). A proposal is made for the need for a new, positive and more proactive way of designing technologies. Most concretely, this reflection paper introduces an approach which it calls Slow Tech –

which provides a parallel with the concept of Slow Food. It argues that ICT must be positioned in terms of three important criteria: *good*, *clean*, and *fair*. The paper explores three case study examples of the Slow Tech approach. It goes on to discuss Slow Tech in a more analytical way, and to reach a number of conclusions. This final discussion suggests how Slow Tech as an initiative could be taken further: for example, how it could be applied and implemented in domains populated by researchers, teachers, computer professionals and their associations, policy makers, and end-users. It frames various actions that might be taken to facilitate the growth of a Slow Tech movement.

2. The need for proactive computer ethics

In the same way that planetary preoccupations have grown in the period since the post-Second World War a consolidated period of reflection about the meaning of computers has also developed over the past 50 years. In 1968, in particular, the famous photograph from space of the finite 'spaceship Earth' probably changed people's consciousness about planetary resources and human habitat.

Seen historically, this period can be interpreted as a progression in three-steps in thinking about the field of computer ethics. Reflecting in some ways the Nolan's stages of growth for information systems (Nolan, 1973; 1979), they can be called the initial, compensatory or reactive, and maturation phases of computer ethics. Today, a more proactive form of computer ethics is needed.

Three phases of computer ethics are evident. The first, initial phase preceding computer ethics is that associated with Norbert Wiener. As a professor at MIT in the 1950s, Wiener invited the scientific community, and society in general, to analyse the social and ethical impacts of computers (Wiener, 1948; 1950). As a result, he is considered to be the founder of the computer ethics discipline (Bynum, 1999). Reflection on the role of ICT and society then progressed slowly for a period: while several contributions were made to the field, ethics and ICT remained separate for a number of years. According to Donn Parker: "*It seemed that when people entered the computer center they left their ethics at the door*" (Parker, 1968). A quarter of a century following Wiener's appeal for reflection, another important contribution to the questioning of information technology came from Joseph Weizenbaum (Weizenbaum, 1976). Weizenbaum recommended not to delegate important, life critical, decisions to computers, since computers will always lack human qualities such as compassion and wisdom. He stipulated that there is a fundamental distinction between deciding (a computational activity), and choosing (an activity to be undertaken by human beings). In 1979, Hans Jonas focused on technological choices and their consequences for future generations; as he stated: "*Human survival depends on our efforts to care for our planet and its future*" (Jonas, 1979). Thus philosophy included a consideration not only of human beings' behaviour, but also of artefacts, new technologies and the possible consequences of their deployment.

The very first definition of computer ethics emerged in 1985 when James H. Moor introduced the concept of a "policy vacuum" into the computing world. He wrote: "*... a typical problem in Computer Ethics arises because there is a policy vacuum about how computer technology should be used. Computers provide us with new capabilities and these in turn give us new choices for action. Often, either no policies for conduct in these situations exist or existing policies seem inadequate. A central task of Computer Ethics is to determine what we should do in such cases, that is, formulate policies to guide our actions ...*" (Moor, 1985, p.1). This policy vacuum implies a delay between ICT developments, and societies and their capacity to deal with related social and ethical issues. The speed of technological transformation is so rapid that human beings have little conceptual background with which to address the issues that emerge: they have little time to develop the theory and understanding needed to make informed decisions. The main focus of computer ethics at this stage of development is to provide human beings with advice, guidelines, and policies about what is right and what is wrong with computers. This phase constitutes a compensatory or reactive phase of computer ethics.

The second phase of the computer ethics involved a maturation process. Insights by two theorists are of particular value: they were provided by ethicists, engineers and designers, Deborah Johnson and by Batya Friedman. If, according to Deborah Johnson, "*... technology is not just artifacts, but rather artifacts embedded in social practices and infused with social meaning*" (Johnson, 1985), this means that society

and technology are co-shaping each other. It therefore becomes important to look at ICT systems as socio-technical systems. Similarly, a core assumption of the value sensitive design approach (Friedman, 1996) is that ICT systems are infused with social and moral values and all artifacts created by ICT engineers embody political, social, and ethical values. As a result, one needs to question the values which engineers – among many other stakeholders, that is, alongside their work colleagues, their technical and administrative superiors, the surrounding organisations, and society – embed in ICT systems, and what values drive the ICT evolution.

Now, almost three decades since Moor's initial definition of computer ethics, it has become critically important to raise a further set of fundamental questions about computer ethics: there is a ground-breaking shift in recognition of the need for more proactive form of computer ethics. First, these questions include whether the computer revolution is inescapable in its present form. Is the perceived gap that exists between science and technology on one side and society on the other really unavoidable? Second, they involve a questioning of ICT systems at their design stage and throughout their lifecycle. This calls for an on-going and continuous dialogue between engineers or computer scientists and society: it means that a profound risk analysis needs to take place inside the software development processes (Gotterbarn and Rogerson, 2005).

It signals a departure away from the traditional position of technology push and from the mantra that technology is driving the future. Rather, it is human beings and society that should now form the starting point of ICT developments. Engineers should start working together with experts from fields such as anthropology, human-computer interaction, philosophy, and sociology. According to Richard De George, the founder of business ethics, who articulated sentiments very similar to those of Joseph Weizenbaum: "*Computers and Information Technology should help and serve people and society. Where they do not, they should not be passively accepted*" (De George, 2003).

Thus, today there is a pressing need to rethink the domain of computer ethics, and to place it on a more proactive footing. Computer ethics have to become a tool to steer computing innovation constructively in a responsible way, and not simply a tool to compensate or fill a policy gap. This is a form of responsible innovation that places human beings, society, sustainability, the environment and planet as essential, critical factors at the basis of the development of science and technology. The Slow Tech concept, which at its heart is such a simple, three-part idea, can be used as a simple steering instrument – a compass – to find a more accurate route on this engineering and human quest towards a proactive computer ethics and, ultimately, technologies that serve humanity and the planet more effectively.

3. Slow Tech: an overview

Slow Tech should not be seen as *technology that is slow*, but as a concept or message that enables people to reflect, stand back, and consider. Thus, the opportunity that it provides for human reflection and intervention and action means that it has a growing importance in supporting this striving – or quest – for ethical ICT.

In 1989, an international grassroots organisation called Slow Food was founded. Its goal was to "*counter the rise of fast food and fast life*" (Slow Food International, undated). Slow Food concentrates on the concept of food that must be *good*, *clean* and *fair*. The Slow Food movement introduced a process of reflection on the entire food-chain. Carlo Petrini, founder and main inspiration of the movement, described Slow Food as food that must be *good* (or taste good), and must be a pleasure to eat. Good food is prepared by rediscovering histories and traditions (such as ancient recipes based on local wisdom, that are transmitted orally from one generation to another). Petrini suggested that, while people eat, they should seek to reflect on where their food come from. Good food must be selected according to its quality. It must be produced following criteria that respect the environment – it must be *clean* – and it should promote biodiversity and sustainability. The cultivation and production of food must also respect the rights of farmers (it must be *fair*) (Petrini, 2007; 2011).

Similarly, we propose a Slow Tech approach that begins with a reflection on the whole of the ICT value-chain. We suggest applying the same concepts – of *good*, *clean*, and *fair* – developed by the Slow Food

movement to ICT. We therefore call this trio of socially aware, environmentally sustainable, and ethical considerations, Slow Tech.

In three following sub-sections of this paper, we explore the character of *good ICT*, *clean ICT*, and *fair ICT*. In each case, we start from the meaning of *good food*, *clean food*, and *fair food*. These descriptions are then adapted to ICT. For example, good ICT is concentrated around notions of enjoyment, aesthetics, balance, user involvement, technology assessment, and human-centredness. Clean ICT means taking into consideration the entirety of the materials and product lifecycles used to create, manufacture and dispose of the technology. Fair ICT means paying special consideration to the employment-related side of ICT, and ensuring that it is just or equitable. Each of these aspects of Slow Tech are currently at different levels and stages of maturity and development, and they are often now treated separately.

It is a major challenge to start to bring an understanding of each of these three elements together in a holistic pattern of reflection and action (for example, to consider Slow Tech as a new form of quality assurance in ICT development and use).

3.1 *Good ICT*

Good food is delicious and pleasant. It stimulates the sense of taste and involves all the other senses in a complex and enjoyable experience, extending to the entire body and mind. Can we imagine a similar experience occurring with ICT? Can we transform our interaction with computers into enjoyment? ICT could be good for human beings when the systems are designed by using a human-centred approach. In this case, *good* means good for the essential well-being of human-beings. Slow Tech can enhance human experience and, at the same time, reduce the effort needed to do certain necessary, but sometimes less pleasant, tasks.

Human beings have certain characteristics: they become old, they forget, and they become distracted. Thus, it is important to concentrate more on the complex interaction between human beings and technology. This sophisticated interchange can become an enjoyable experience only if the system and the human-computer interfaces are designed to take human limits into account. Slow Tech therefore implies a search for a new balance between rational thinking and more aesthetic thinking, in which beauty plays a fundamental role. Good ICT means taking into account all the senses of the body, so that it supports people in, for example, enhancing their health and well-being or it specifically helps elderly people or people with disabilities to live a better quality of life.

Good ICT can also help people to find an appropriate balance between their working time and free time or leisure, between the time needed for work and societal obligations and the time needed for themselves as human beings. Nowadays, there is a risk that ICT is accelerating people's daily lives, and transforming the states of 'doing' and 'being' into a single state of only 'doing'. The 'always-on' capability provided by ICT may have a major impact on a variety of aspects of people's lives (Bradley, 2006). A 2012 study on this subject showed that only a small number of organisations has a formal work/life balance policy in place: only one per cent of the organisations studied had "*days or time when email is not used*" such as "*e-mail-free Fridays*" or "*mail-free week ends*" (SHRM, 2012).

Good ICT also needs to involve technology assessments that minimise the risks related to complex software systems. Risk analysis should address very precise questions about the possible consequences of technology development for all stakeholders involved, and find solutions to all the identified issues (Gotterbarn, 1992; Rogerson and Gotterbarn, 1998; Gotterbarn and Rogerson, 2005). Good ICT must involve users and society in the design stage itself as well as later parts of the ICT lifecycle; good ICT cannot just result from technology push. It needs to be the outcome of an approach to the assessment, design, and development of technological and organisational systems that places a premium on the active involvement of workplace practitioners or ordinary people in society itself (who are usually the potential or current users of the system) in design and decision-making processes. This approach to ICT systems development is called *Participatory Design* (CPSR, 1996).

In summary, *good ICT* means human-centred ICT: technologies that improve human *well-being* and *well-living*.

3.2 *Clean ICT*

Clean food means food whose production or consumption does no harm to the environment, animal welfare, or human health. By extension, *clean ICT* focuses on avoiding harm to the environment and human health. Clean ICT means developing computer systems and networks that are respectful of the planet, and that are designed and produced while taking into account their impact on the environment.

In the past, ICT was always accepted by definition as being 'good' for the environment. Only recently has research on ICT sustainability started (Kuhndt et al., 2006), often in response whether directly or indirectly to the Millennium Development Goals (United Nations Development Program, 2005). High tech, however, generates toxic hazards throughout its lifecycle (from its design, production, and consumption to its disposal). Nonetheless, the entire ICT life-cycle and its environmental impact is increasingly being taken into account: from the raw materials involved, to ICT and ICT applications' use, to *e*-waste management and recycling (Patrignani and Kavathatzopoulos, 2012). For example, until few years ago, the primary elements used in microprocessors (the rare-earths) were never considered from the sustainability point of view. Yet, in 2010 a study by Yale University showed that "*... the increasingly use and mining of rare metals, can have devastating environmental consequences*" as well as serious geo-political concerns (Schmitz and Graedel, 2010). For example, gold can be extracted from old computers and then recycled, with approximately the same level of convenience as mining it (Step, 2013).

A major environmental challenge is arising from the need to provide the power to operate ICT: in the cloud computing era, the energy necessary to power gigantic data centres doubles every five years (Uddin and Rahman, 2010; Rowe et al., 2011). The consequent demand for electricity, and the related increase in CO₂ emissions, has an effect on climate change that is around the same level as that of the airline industry (Fettweis and Zimmermann, 2008; European Commission, 2012). Even the least tangible side of ICT – software – could have an impact on the environment. Central processing units consume different levels of energy depending on programming styles: significant power savings can be made possible through appropriate programming (Kern et al., 2013). Clean ICT also means considering carefully the destination of computing hardware at the end of its life. Despite some advances made (due to 2012 European legislation), at a global level the vast majority of *e*-waste is sent to unspecified locations and destinations where its treatment process is also unknown. It remains unclear how such hazardous substances as lead, cadmium, chromium and mercury contained in ICT products are being processed. This lack of regulation implies a high risk of environmental pollution. For these reasons, since 2006, Greenpeace has been monitoring the ICT industry closely (Greenpeace, 2012).

The concept of recyclable-by-design is starting to appear in the ICT world as a welcome proactive step in the appropriate direction. All the necessary possible measures are being taken prior to manufacturing a product so as to ensure that it can be made easily recyclable. "Cradle-to-cradle", or "regenerative"-design is an industrial framework that seeks to create systems that are efficient, waste-free and that learn from natural cycles (Lovins, 2008). However, even the cleanest ICT industry and the most efficient recycling mechanism cannot cope with the growing speed of ICT consumption: on average today, consumers change their smartphones every eighteen months. This fact explains Greenpeace's recommendations to extend the lifetime of existing ICT devices, and for consumers to purchase only what they really need (Greenpeace, 2012).

Clean ICT involves a quest to slow down the ICT life cycle. It aims to minimise any harm done by the production and use of ICT, and – more generally – to extend the life cycle of ICT products by reducing the replacement rate of ICT devices. It also represents two challenges: on the demand side, the desire to accumulate material goods and to follow only the latest fashions or trends in electronic devices, and on the supply side, to the rush to make a short-term profit.

3.3 *Fair ICT*

Fair food implies affordable prices for consumers, and fair conditions and equitable pay for small-scale food producers and farmers. Similarly, *fair ICT* can be defined as being respectful of the human rights, self esteem, and health and safety, of workers in ICT manufacturing as well as of ICT users. Fair ICT must take into account the interests of all types of actors involved throughout the entire ICT stakeholders'

network (Gotterbarn and Rogerson, 2005). From manufacturing, data centre design and product recycling, to the creation and execution of software applications, the whole ICT lifecycle needs investigation by all the stakeholders engaged along the line or throughout the network. Among the many issues involved in creating *fair ICT*, to the fore is the need to secure a good quality of working life for all, wherever the workers are located around the globe and whatever their age. Take China and South Korea as example countries. Towards the end of 2012, it was acknowledged that small improvements were taking place in these countries' ICT manufacturing companies (Bradshaw and Duhigg, 2012). Nevertheless, it is still recognised that profound constructive organisational changes may be required for many more decades to come (Ibid, 2012; Bulard, 2013).

Fair ICT also means open ICT, an ICT that contributes positively to the economy and society through the enabling of innovation potential. When the two concepts of open software and open hardware are applied to ICT, it becomes possible to imagine the immense innovation potential of ICT. Real innovation in ICT is based on the availability of openly defined layers, through which others can use, adapt and improve the systems and technologies. For example, the openness of the basic protocol of the Internet, TCP/IP, with its end-to-end connectivity and network neutrality property, enables anyone to define new applications on top of it (and to develop new physical channels for transporting bits under it). An open definition of standards is thus the main trigger for innovation and for the generation of social and economic benefits. One of the most famous examples of this open software and openness approach, is the "free and open software" defined by the Free Software Foundation in 1985 and related to users' freedom to run, copy, distribute, study, change and improve software (Free Software Foundation, undated). The current contribution of the open source software to the economy of the European Union has been estimated at € 456 billion a year (Daffara, 2012; Hillenius, 2012). Direct cost savings of € 114 billion in licences, and indirect cost savings of € 342 billion, result from the reduced number of project failures (Ibid, 2012), due to the better quality of open software, lower costs for code maintenance, and increases in productivity and efficiency. Open source hardware is another example of this openness: this phenomenon relates to hardware design that is open to everyone. It can include the bill of materials, printed and integrated circuits layouts, schematics, and the necessary software. One of the best known examples of open source hardware is the Italian Arduino platform (Arduino, undated).

Fair ICT can provide a significant contribution to community value by stimulating the creation of local high-tech companies, and organisations that support clients' companies through the development of new business models. These initiatives provide consultancy, and they personalise, customise, and maintain both hardware and software applications. Thus, *fair ICT* can be at the same time innovative and socially advanced. At European policy level there is a growing interest in moving in this direction: in 2011 the European Commission recommended that, by 2014, "*large EU enterprises should make a commitment about their corporate social responsibilities approaches ... and to fully meet their social responsibility, enterprises should have in place a process to integrate social, environmental, ethical human rights and consumer concerns*" (European Commission, 2011, p.6). It will become advisable for companies to monitor the working conditions in their technology providers' manufacturing plants located in such countries as in China and South Korea. Consumers of ICT products and services are becoming more and more sensitive to these concerns. When people and companies use ICT, they too are starting to pose such questions as where the device actually originates from and under what conditions (Elmer-DeWitt, 2013).

Fair ICT drives the achievement of a balance among the interests of all the stakeholders, including the workers and the planet. Aiming for *fair ICT* will help ICT companies and organisations to realise that there are many actors involved in their stakeholders' network who have a wide range of differing interests.

4. Slow Tech: Three case study examples

What, then, does Slow Tech mean as an approach used in practice when applied to the real world? Three case studies are explored to illustrate Slow Tech's real-life application. All three of the case studies aim

for *good ICT*. Some focus more on the notion of *clean ICT*, and others on an approach to *fair ICT*. Generally, the three cases use technology to reduce damage to the environment (cleanness); they concentrate on goodness and fairness; yet, in addition, they develop technology in a way that enables the notion of smartness – innovation – to move forward. Two of the three cases are associated with health, well-being, and health systems.

The number of exemplar cases is growing steadily, and certainly other examples from around Europe or the globe could also have been proposed. Yet, Italy was the destination of choice for these authors. The three examples selected were chosen specifically as coming from Italy, since it is the country of origin of Slow Food and hence it can also be seen as the launchpad location for Slow Tech. The Green@Hospital case is a version of sustainable technology that does not damage the environment. The Olivetti case refers to an ICT company which – although now a small entity within a much larger corporation – had an historical reputation for its focus on the goodness and fairness of its approach to innovation, and design of products and processes. In the third case, Loccioni-Humancare shows how desirable technology can enhance human well-being.

4.1 *Green@Hospital*

Among several new large-scale pilots are three that focus on environmental and sustainability concerns – they investigate hospital energy reduction: Green@Hospital (Green@Hospital, undated), Hospilot, and RES Hospitals. Hospitals are large energy consumers (Ibid, undated). In most European countries, there is a high proportion of ageing building stock (a status that affects most public and private buildings). Hospitals are among the least energy-efficient type of the Union's public buildings. There is thus an important need to achieve real energy savings from existing hospital building stock. At the same time, when new hospitals are built – as many are – they need to be more sustainable (Ibid, undated).

The Green@Hospital pilot is an interesting initiative that started in spring 2012. It aims to integrate the latest ICT solutions into hospitals for environmental purposes. Its goal is to obtain a significant energy saving in existing hospital buildings through two mechanisms: first, a more effective management of energy resources and, second, a reduction in energy loss. Its challenging overall objective is to achieve a 20% reduction in hospitals' consumption of energy. A Web-based Energy Management and Control Systems (called Web-EMCS) is to be developed: *"It will integrate, monitor and control multiple buildings systems at the component level. Moreover models to assess the energy savings will be developed and algorithms for consumption optimisation implemented."* (Ibid, undated).

The developments are being trialled in four hospitals in different European countries. Two are located in the Spanish region of Andalucía, in the cities of Barcelona and Granada; another is based in Chania, Crete; and the fourth is the university hospital of Ancona, Italy. They are to demonstrate the validity of the solution that has been proposed under real-life operating conditions. Each hospital will trial different aspects of the overall plan. The study acts as a basis for replication of the solutions developed. The potential savings and return on investment identified can, it is anticipated, be taken on board elsewhere. As with all the other large-scale pilots being undertaken, it is hoped that the findings can be repeated on a much wider scale and yield more comprehensive outcomes. The pilot's focus, through the four hospitals, is on the development and use of ICT to contribute to a cleaner, more efficient, built environment, i.e., *clean ICT*.

4.2 *Olivetti*

A second, historical, case study is the thinking and work of one of the 20th century's most important Italian industrialists and visionaries: Adriano Olivetti (Ivrea, 1901–1960). Olivetti was able to combine advanced technologies, innovation, production, profit, solidarity, social responsibility and beauty in a joint enterprise. Three examples of his company's technological developments are noteworthy. In 1959, the first mainframe computer based on transistors, the Olivetti ELEA 9003, was designed by Ettore Sottsass, one of the most famous designers of the twentieth century. In 1965, the first personal computer, the Olivetti P101, was designed by the architect Mario Bellini (WSJ, 1965). In 1962, the Olivetti Electronic Center building, located between Torino and Milano, in Italy, was designed by Le Corbusier

(Olivetti, 1959). This climate of innovation was based on the design and construction of one of the most socially advanced working environments of the 1950s: in the factory area there was a library where many cultural events took place, there was a nursery and schools, and the company introduced nine months of paid maternity leave for women. The community included houses built for workers and a development plan intended for the whole city. Many of Olivetti's ideas were forerunners of the notions of *good* and *fair* ICT, in terms of design, equipment, buildings and environments that were also good, fair, and beautiful.

4.3 APOTECACHemo by Loccioni

A third, more contemporary, case-study is APOTECACHemo (the word APOTECA is derived from the Ancient Greek or Latin for a storehouse, which is now used with the meaning of a pharmacy). APOTECACHemo is a robotic application for hospitals developed in 2010 by the Italian company, Loccioni. Designed and tested with the contribution and participation of nurses and clinicians who come from a combination of local hospitals and who collaborate in a dedicated forum, the system is now used in many hospitals around the world. Its robotic arm prepares the precise pharmaceutical dosages needed for the treatment of cancer patients. It produces careful and exact weightings of all the chemical ingredients necessary to treat severely ill patients, and it manipulates the substances in a way that ensures a high level of safety for all the people involved in the process: "... *The manual preparation of cytotoxic drugs has a high possibility of dosage errors with serious consequences for the patient and high professional risks for those who remain exposed to carcinogens of cytotoxic drugs. Patients are protected by humancare high-tech solutions that recognize the active ingredients ... The tracking system of all phases, based on a barcode, allows a perfect integration between the department and the oncological pharmacy service ...*" (Loccioni-Humancare, 2012, p.1).

APOTECACHemo is an ICT solution, based on an integrated approach, that places the patient at the very centre of the hospital workflow. Thus, it reduces the costs of customised therapies, validates them, and makes health systems more efficient, sustainable, and human (Ibid, 2012). Such well-being is a concept that is likely to come to the fore in the next phase of the information society.

Of the three case studies, APOTECACHemo, created by the Loccioni company, is the closest to the concept of Slow Tech. It is a combination of *good*, *clean*, and *fair* ICT. It is *good* because the system has been designed with the goal of ensuring the safety of patients and nurses. Participatory design was fundamental to the system development: a community of patients, nurses and hospital professionals continues to collaborate on monitoring and improving the resulting solution. It is *clean*: Loccioni is a famous example of a joint approach to innovation and environmental care. In 2010, the company received the National Innovation Award from the President of the Italian Republic and the National Enterprise-Environment Award from the environmental association, Legambiente. The company and its products, such as APOTECACHemo, are also *fair*, since Loccioni has defined and demonstrated a strong sense of corporate social responsibility that always puts people and workers at the centre of its strategies and activities.

5. Discussion

Human beings, and the planet itself, are finding it difficult to cope with the increasing speed of consumption of ICT: a point of crisis is likely on the horizon. Thus, this paper focuses on a need for Slow Tech and for ICT that is *good*, *clean*, and *fair*.

To date, the focus of Slow Tech has been on the three notions of *good*, *clean*, and *fair* ICT. However, this quest could also, ultimately, be expanded, in research terms, to include a further six dimensions. These further dimensions are adapted from the work of two authors, Alexander Langer and René Von Schomberg, who have worked quite separately, over different time-periods, but whose work bears some resemblance. According to Langer, a tension exists between competition at any cost (whether social, democratic or environmental) and new concepts of *well-being* and *well-living*. Langer was the first to propose taking a distance from the Olympic motto «*Citius, Altius, Fortius*» (*faster, higher, stronger*), so as to move towards an alternative set of concepts. Instead, they focus on «*Lentius, Profundius, Suavius*»

(*slower, deeper, sweeter*). He suggested that, by slowing down the consumption of resources, life would become more socially desirable (Langer, 1996). Similarly, but more recently and with a more specific focus on ICT, Von Schomberg suggests to making even more precise the meaning of responsible research and innovation in ICT. He proposes three main characteristics (or requirements): ICT should be *socially desirable*, *environmentally sustainable*, and *ethically acceptable* (Von Schomberg, 2012). If these two additional concepts of *slower, deeper, sweeter* and the responsible research and innovation of ICT, were to be added to the initial definition of Slow Tech (*good, clean, and fair*), it would lead to an even more complete, fully holistic, picture of the Slow Tech approach. This work is currently in its elementary stages (Patrignani and Whitehouse, forthcoming).

Concrete proposals are needed for ways in which a Slow Tech approach could be applied practically in the world of academe and research. For the time being, only two proposals follow although many more are feasible. First, Slow Tech could be used to expand the curricula of universities, research institutes, and colleges to encourage computer science and engineering students to take into account the three dimensions of *good, clean, and fair ICT*. Secondly, professional computing organisations or associations could enhance their codes of conduct and professional guidelines to include the same three dimensions, with the dual intention of affecting their members' behaviour as well as promoting a message acceptable to a wider community of computing professionals and computer end-users. A good reference here is the Association for Computing Machinery (ACM) Software Engineering Code of Ethics and Professional Practice (ACM, 1999).

6. Conclusions

Slow Tech is put forward as a means of re-thinking the pace of development of ICT that, until now, has been celebrated because it has been getting faster, stronger and more powerful year on year. Instead, Slow Tech implies a critique of much of the status quo (many technological challenges, conditions and directions taken should no longer be perceived as unavoidable). We need to reappropriate the pace of technological development and overcome the traditional view of 'technological determinism' (Davies, 1997). Slow Tech is proposed as an invitation to start on a quest which is composed of a reflection process around new and future ICT values and uses. Slow Tech is a call to work together on combining the environmental, with the social and the ethical, in a more considered and reflective way. Slow Tech is an appeal to a future way of designing and using ICT to create community, organisational, and planetary environments in which it is possible to live and work with pleasure, a more profound sense of life, in more collective and collaborative ways, alongside technologies that make pleasant companions, and at a more leisurely pace.

To conclude, the ultimate message of this reflection paper is that, in order to guarantee long-term environmental and societal sustainability, human beings need to slow down the whole lifecycle of ICT development and use. For this, a Slow Tech approach is absolutely needed.

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