The "Evolution" of ICT: Greater Benefits and Greater Challenges.

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While Information and Communication Technologies (ICT) has been around for some time, citizens' interest and awareness of its applications, consequences and impacts on all sectors of civic society is relatively recent, and even more so in education.

In the following dialogue, Laura and Norberto exchange their thoughts on the immense challenge of seeking to understand digital technologies which continue to influence and shape our ways of thinking and making decisions in our everyday lives.

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Laura: Starting from the very beginning: when did you first become interested in ICT?

Norberto: I was hired by Olivetti[10] at the Research Department in Ivrea in 1974. With a diploma in Electronics and a first degree in Computer Science from University of Turin, I have seen the last 45 years of history of ICT, from Personal Computers to Cloud Computing.
In 1985 I started to investigate the social and ethical implications of ICT, thanks to the international organization named Computer Professionals for Social Responsibility (CPSR), based in Palo Alto (where Olivetti had a Research Lab). In 1993, I introduced the first course "Computer Ethics" in Italy. Since 2008 I am teaching "Computer Ethics" at the Polytechnic University of Turin.

Laura: The change from personal computers to cloud computers is of interest to *Visions.* It seems that we started from a product which was largely deployed for tracking people and resources for military and commercial purposes. Now we have reached the point when every single person with access to a computer can be 'wired' into a large data system. Such transition has occurred quite fast but also quite subtly, as many of us still retain images of personal computers as little 'black boxes' in the living room, for playing videogames. It is interesting to see how young people appear to be the 'key brokers' in the relationship between business, the military sector and civic society. From an educational point of view, this raises questions about the opportunities that exist for young people in schools to monitor and critique the world of technological objects populating their lives. But before moving on to that aspect, can we clarify what we normally understand by Information and Communication Technology: its applications and uses?

Norberto: Normally people consider technology (and ICT in particular) as "neutral", often ignoring that technology and society co-shape each other.

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[10] Olivetti was founded as a typewriter manufacturer in 1908 in Ivrea, near Turin, by Camillo Olivetti. The company is known internationally for the manufacturing of electric calculators, first launched in 1948 and the production of Italy's firslectronic computer.
While the company sold its electronics division to the American company General Electric in 1964, it continued to develop computing products on its own; one of these was Programma 101, one of the first commercially produced personal computers.

So, people accept all new technology passively, they do not see the opportunity for designers of computer systems to drive in some directions their development.
Every new generation of devices is accepted as an "evolution": they are faster, with more features, etc. but very few people ask about the social, environmental and ethical impact of these new "gadgets".

Laura: Evolution, involution, devolution… the key is in the language! In an article I had co-written with my colleagues Anna Perazzone, Elena Camino and Martin Dodman in 2013, we reflected on the use of metaphorical language in science. We have become so accustomed to using particular words that are derived from everyday contexts that we no longer pay attention to the social context surrounding the origins and uses of those words, and the values they carry. In that article, we asked students to draw their understanding of evolution in Biology: their visual descriptions indicated largely a process of linear transformation leading to 'improvement', either by acquisition of new features or enlargement of existing capacities. The surrounding environmental context - or the relationship with other species or other non-living things - was largely ignored. It is an idea of 'evolution' which appears to have been seamlessly extended also to the 'evolution' of information and communication technologies: a view which assumes all changes to be positive and desirable, largely ignoring the context and the purposes for which products have been devised.
To this point, why do you think we do not hear so much about military applications of ICT?

Norberto: Society in general is not involved in military discussions, for example, in Italy very few people are aware that in our territory we have many atomic weapons installed. The same applies for ICT applications in a war scenario.
The very first ICT researcher that raised this issue was in 1947 (!), when the founder of computing and cybernetics, prof. Norbert Wiener ("A Scientist Rebels", *Atlantic Monthly*, January, 1947) publicly refused to collaborate with the military: *"I do not expect to publish any future work of mine which may do damage in the hands of irresponsible militarists"* (p.46).
The second historic example was in 1985, when the founder of Object-Oriented Software Programming, prof. David Parnas resigned from the United States Government Scientific Committee of the project SDI (Strategic Defence Initiative). His experiences are recounted in this article: Parnas L.D. "Why the SDI software system

will be untrustworthy", American Scientist, 73:5, Sept-Oct 1985, 432-440.

The last example is the debate inside Google where many software designers refused to collaborate with a Pentagon Project https://globalnews.ca/news/4124514/google-project-maven-open-letter-pentagon/ Let's keep the discussion open and diffuse!

Laura: I find this information very interesting. For example, I have come to learn that the field of science education in the United Kingdom is relatively recent. I believe it started when funding was allocated to Technical Institutes (later Universities) after the Second World War to promote scientific literacy aimed at developing a 'specialist scientific workforce' to be deployed both in the commercial and military sectors. The history of the field is bound-up with the economic and technological changes which have followed the 'petroleum era' as recounted by Rodger Bybee in an article published in 1975! Currently, the rebranding of science education as 'STEM' (Science, Technology, Engineering and Mathematics) appears to be aligned with forms of economic imperialism. Another area that is also emerging within this is 'data education', teaching young people to 'code' arguably to develop logical thinking and practical skills, while detracting attention from critical, evaluative and ethical reflection that is required to deal with the complexity of our changing environment. In a recent article "Neoliberalism and STEM Education", published in 2016 in the Journal for Activist Science and Technology (JASTE), Prof. Lyn Carter is particularly critical of this view. There are important responsibilities for the educational sector, at all levels in education.

As a scientist, what do you think are the most pressing and concerning issues in this sector?

Norberto: I think the "autonomous weapons" is the most pressing and concerning issue https://www.stopkillerrobots.org/. Such weapons would be able to identify, select and attack without further human intervention, thus effectively further distancing 'attackers' from 'those who are being attacked', and circumventing moral responsibilities for those who make the decisions.

Laura: Who are the stakeholders involved? And who drives these developments?

Norberto: The main stakeholder is the Weapon Industry that in many countries has a strong impact on the government.

https://www.nytimes.com/2017/09/22/business/economy/military-industrial-complex.html Of course, the key is to have the support from society (the risk of losing jobs, etc ...) particularly in those countries/areas which have largely devolved primary production activities (farming; manufacturing etc) to other countries. So, the key actors involved are the military industrial complex; governments; society (e.g. the Union of workers! they should say a word about the involvement of workers in these applications); Peace advocacy organizations (e.g. https://www.icrac.net/) and of course, Computer professionals' organizations (ACM, IEEE; IFIP, etc.).

Laura: I would add also research centres in the Universities, and the critical role played by private-public partnerships which are taking centre stage particularly in the global South. There seems to be a need for gaining a much broader, systemic view and concerted action on the matter. In what way can you incorporate this knowledge into your role at the European Union (EU)?

Norberto: I am a member of several panels of Ethics Reviewers for EU projects (Horizon2020, etc.) but military projects are following a different track: there is not a peer-review process on the ethical aspects of such projects provided by external and independent subjects.

Laura: Are there national or international institutions which should demand transparency over the financial support given to the military?

Norberto: It is a complex issue due the lack of independent ethical procedures I described in the previous point. Of course, the entire society should have a word about how to spend public money. I think that organizations like the United Nations Institute for Disarmament Research (UNIDIR) should demand transparency, but also computer professionals' organizations should. In fact, returning to the subject of STEM education, I would agree that we need to prepare next generations to deal with digital technologies, 'coding' is necessary, but not enough. They also need tools for reflecting about the co-shaping between technologies and society, they need to use ICT with 'wisdom', we can call it 'digital wisdom', which is taking care also of the social and environmental impact of computing. For example, very few people know about the CO_2 contribution of ICT: about 4%, so addressing the climate change is also connected with our electronic devices' consumption. Another example: very few people know the conditions of

workers in manufacturing plants for the electronic industry in the South East of Asia. Can we still accept to buy e-things that comes from working conditions very close to slavery? So 'digital literacy' need also a 'digital wisdom'.

Laura: it looks like there is plenty more research and action to be taken with regards to Information and Communication Technologies. Computer Ethics should be incorporated in education at all levels, from early years onwards. We deal with a field which grows faster than our ability to understand it; however, we are also grappling with very fundamental questions and problems concerning the impact of wars on the livelihoods of many people. As citizens, we should all be asking the key questions of where do our computing resources come from; who benefits? And to what end?

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