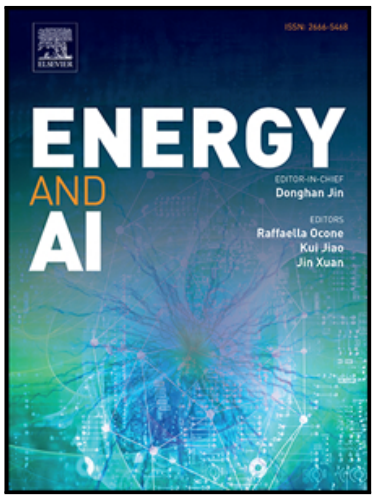
Ethics in Engineering and the Role of Responsible Technology



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Highlights

- The Editorial examines the role of responsible technology in relation to ethical consideration
- The Editorial explains how ethics is core to engineering

Ethics in Engineering and the Role of Responsible Technology

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The idea of writing an Editorial on Responsible Technologies sprung from the plenary lecture that I gave at the at The First International Conference on Energy and AI in Tianjin. It was January 2020 and it was only a few weeks before a major shock hit the World: nobody could predict the approach of a pandemic that would affect the life of every single person in the world. Has the pandemic changed what I wanted to say in my Editorial? Probably so. Undoubtedly the pandemic has reinforced the relevance of technology. We all are living unprecedented times and we all share similar challenges: never as before globalisation has been affected and, at the same time, has been strengthen. Those as me, working from home, are likely spending a good amount of your time attending online meetings. Even those who don't work from home, are likely experiencing platforms as Zoom, Teams, Skype, as new ways of communicating with friends and family. The latest figures show that zoom is handling over 200 million users daily. This is only one example. Robotics, health screening, logistics are only a few, limited examples of how technology is affective our everyday lives. And, whilst I recognise that my work today would not be possible without the current development of technology, I cannot neglect considering the high importance of some unwanted consequences of technology.

In the last two decades I have been interested in studying the role of ethics in engineering [e.g., 1-3] advocating that ethical considerations must permeate entirely every technological activity; ethics should not be simply bolted on engineering and technology but rather it should be systemic, i.e. integrated in the way we operate as engineers, technologist and scientists. Those consideration bring naturally to the relevance of responsible technology as an aspect that, as must affect and must be embedded in any research, development and innovation activity.

In this Editorial, in order to introduce my considerations on responsible technology, I start by recalling briefly my personal idea of ethics in engineering [1-3] and will explore specifically the relationships between ethics and technological innovation. Although I am not a philosopher and I do not know philosophy in depth, philosophy has helped and influenced my thoughts on ethics and, less intuitively, on technology.

Engineering Ethics: action vs analysis

Ethics in engineering is not a new concept. Indeed, codes of conduct have always been a central aspect of the engineering profession and professionalism implies ethical behaviour. Ethics in engineering implies ethical dilemmas which, in turn and inevitably, might be reminiscent of bad practice and disasters. This is unfortunate and based on a very limited vision of engineering ethics. Previous work [ref 4-5] claims that ethics in engineering is quite different from ethics in philosophy. This is because in philosophy ethics is about ***analysis*** – it is about understanding an ethical theory and dispassionately comparing its application to an ethical problem. Ethics for engineers, in contrast, is about ***synthesis***. The engineer has to find 'solutions' to ethical problems (i.e. best courses of action). Therefore, learning skills of philosophical analysis is not necessarily useful for engineers. In addition, the engineer is embedded in the process rather than standing outside of it, as is the case for a philosopher. Hence, engineering ethics should be exercised in the *contexts* in which the ethical dilemma arises, with a focus on making ethical decisions rather than analysing ethical theories. This suggests a similarity between engineering and medical ethics.

I have argued [5] that ethics in engineering goes behind synthesis only; it is more than just the ethical dilemma and the application of ethical principles. Ethics in engineering coincides with the **social aspects of engineering** and in this respect it is very similar to the interpretation that old philosopher gave of philosophy which was seen as coinciding with social life itself. The disconnection between practice and philosophy is a fairly recent development; classical societies such as the Greeks and Romans attributed great importance to practical behaviour which was considered the **same** as ethics. Hegel defined the ancient Greek world as the era of "involuntary" ethics where the individuals lived in immediate symbiosis with their community; only successively, with the advent of theories about individualism, was the link between individual and society weaken. Nowadays, we tend to identify "culture" with "thinking"; the philosophical schools of the past rejected the consideration of philosophical activity as purely intellectual, theoretical and formal, considering philosophy as a choice influencing life in its totality. The philosopher did not teach only how to talk and think but also how to live in the most complete sense. Ethics was not just a concept, but rather "action", i.e. acting in and for the society. This is the lesson that we should keep in mind when teaching and exerting engineering: engineers must integrate the technical aspect of their jobs with the social aspect of life. The engineer is a practical individual who operates within and for the society; their ethical behaviour cannot be disconnected from their profession, and the two seemly separate issues are the same in their essence.

Although I am still profoundly convinced that ethics is action, I have recently review my previous assertions and I am now convinced that even analysis of philosophical theories might contribute to fully embrace responsible technologies. This point will become clearer later when I will introduce transhumanism.

Technological Development in the 21st Century

A number of questions have occupied my thought recently: what do we really mean by "technology"? Does "technology" need to be classified? When does a technology can be considered "entrenched"? Which kind of intervention is required in the development of a new technology? The list of questions can continue and the questions that I have just presented are not exhaustive; the possible answers are not exhaustive as well.

Trying to pose those questions in context, it might be useful to start from technological innovation and the stages that it involves. Those stages are: a) research; b) development; c) production; d) marketing; and e) diffusion into society. A technology that has completed all these stages is sometimes referred to as *entrenched technology*. Entrenched technologies generate a number of products, processes, techniques user ready and user adopted; likely they have generated tangible and often measurable impact. The impact can be continuous or limited. Often, from an entrenched technology new products can derive from future developments and can represent future incremental improvements.

At the beginning of the third decade of the 21st Century, looking back at the previous two decades of the Century, it is evident that technology, at least in some specific areas has moved very fast. Each decade has seen emphasis on some diverse aspect of the technological development as well as on diverse technologies. To put an order in such a complex and crowded field is almost impossible, however I will attempt a simplified characterisation of each decade in the following.

The 1st decade saw the advent of "**Converging Technologies** for Improving Human Performance" (CTIHP). The 2002 report commissioned by the U.S. National Science Foundation and Department of Commerce [6] described and commented on the state of the science and technology of the combined fields of **nanotechnology, biotechnology, information technology and cognitive science** (NBIC). The report discussed the potential uses of those technologies to potentially improve health and disability. The works on planned applications of human enhancement technologies in the military sector and the rationalisation of the human-machine interface in industrial settings was also considered in detail.

The Sustainable Development Goals were developed during the **2nd decade**, at the time when the terminology "emerging technologies" also came into play.

The **3rd decade** will be, in my opinion, the time of "responsible technologies", a quite different matter when compared to the technological developments of the first two decades: this is because responsible technologies, strictly speaking, are not technologies *per se*, and the terminology is rather a way of approaching both the development, the implementation and use of any technology. In that, each technology, if already developed or emerged should be adopted and employed in the framework of responsibility which, in turn, brings back to ethics. On the other hand, when the technology is not developed or emerged yet, responsibility should **not** be considered *a posteriori*, but rather embedded in the development of the technology *a priori*. Responsibility must intervene directly at the stages of research and development.

Current ethical approaches in engineering consider *a posteriori* analysis of the ethics of entrenched technologies and rely on ethical assessment of specific products, uses, regulations, and social impacts that are already in existence. Ethics could recommend modifications of such uses and/or products. In a sense, the ethics of entrenched technology is simplified by the fact that it can draw from a wider range of data that are relevant to the ethical synthesis. On the contrary, the ethics of emerging technologies can only make use of speculative data about future products, uses and impact. Both approaches present challenges: for entrenched technology intervention can be too late; for emerging technologies the train of actions can be unclear and, even worse, can be unwelcomed in that it could represent a delay of the development and employment of the new technologies when ethics calls for intervention that implies substantial modification of the technology under scrutiny.

Considering in detail entrenched technologies and, specifically, the CTIHP, careful consideration must be paid, in my opinion, to the improvements that such technologies have advocated to bring: improvements of both the world (environment) and of the human being. Those "improvements" must be considered in relation to the specific technologies considered [6], namely the **combined** fields of **nanotechnology, biotechnology, information technology and cognitive science**. Such fields are all highly amenable to ethical considerations; as an example, bioethics has emerged as a fields of study on its own right, as a consequence of the development and employment of biotechnologies. For some fields, such as nanotechnology, for instance, the ethical implications are less clear and

regulations about their employment are still in their developmental phase. Other fields, such as information technology, have raised huge interests in their ethical and cognitive science links, somehow reminiscent of ethics in medicine.

It is evident that NBIC, although two-decade old, have developed diverse relationships with ethics; however, importantly, some of their implications on everyday life are not clarified yet: an example is information technology and its extension into artificial intelligence (AI), where ethical issues are mainly linked to collection and use of data paying less attention perhaps to the implications that AI has on "human engineering". The concept of human engineering (or human design) has concerned mainly with biotechnology and generated new areas of philosophical thoughts, such as bioethics (when involving the moral) and biopolitics (when involving governance) [Michel Foucault discussed biopolitics in the 70s during his lectures at the Collège de France]. The implication of AI on bioethics must not be neglected; in addition, an area that I should call ***info-politics*** must be developed insofar as it concerns with the governance and policies of AI. The ethical implication in those areas is high and in engineering and technology we often lack the training and the ability to think of technical issues in a more holistic fashion. This has also huge implications on the formation of technicians and engineers that I will not discuss here.

Artificial Intelligence, that is core to this journal, is a pervasive technology and its consequences have affected and will affect various areas and disciplines, including the environment and the human being as advocated in [6]. The fact is that AI is largely in use and new developments can be expected. I strongly hope that the 3rd decade will be characterised by responsible technologies towards the solution of the urgent challenges that we face. Back in January 2020, at the time of my talk summarised in this Editorial, I indicated those challenges as: Climate Change, Energy Security, Artificial Intelligence, Cobots, Quantum Computers and Extended Reality. Today I must add **Health Security and Wellbeing** that have become a priority as a consequence of the pandemic.

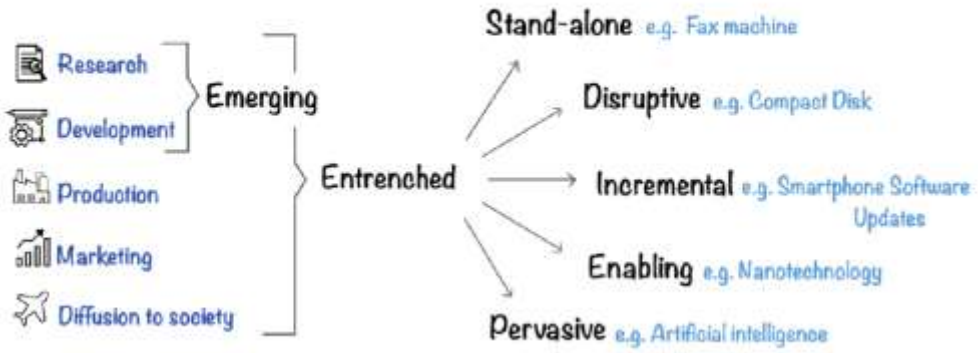

Figure 1. Some examples of technologies and their classification

Conclusions

AI's relevance to help tackle and fight climate change is undiscussed**:** enabling smarter decision-making for decarbonising industries and transportation, understand how to allocate renewable energy are only a few examples. The related ethical issues involve: public surveillance; intentional misuse of data; privacy; transparency; data bias that can lead to discrimination and inequality. Those aspects all contribute to a more efficient and environmentally friendly use of energy which this Journal is meant to discuss. The recent pandemic has quickly shown that those issues, where ethical considerations and professional responsibility are needed, are fast changing and evolving matter. Although I am still convinced that we should get inspiration from the classical Greek world, from the era of "involuntary" ethics where the individuals lived in symbiosis with their community, although I still strongly advocate that we should embed social considerations within engineering and technology, I also realised that such social considerations have taken a more complex dimension recently. This is because engineering and technology modifies nowadays not only the world of things but also the human being. Going back to my starting point: how do we intervene to assure that technology is developed in a responsible way? And, should we intervene when we realise that a given technology might go the wrong way? It is my opinion that technology and scientific discoveries must progress irrespective of their consequences, however regulation and governance are keys and those aspects are still somehow lacking, especially when it comes to AI. This is an area where I would like to call for research and education: a sheer amount of learning and understanding could be gained by exploring philosophy and some of the most recent philosophical movements such as transhumanism. The debate whether the hybridisation of the human being is a natural consequence of evolution should not be left to philosophers only: the technologists and engineers should play a

central role in such a debate since they are responsible of the technology that makes a possible hybridisation possible.

To conclude my short overview, I would like to stress once again that ethical dilemmas permeate every technological research, development and use. Although I do not have definitive answers to the myriad of questions that the complex area of responsible technology poses, I am convinced that those questions should not be discounted. I hope that I have added new questions and generated new doubts; I also hope that research and comments specifically linked to the ethics, responsibility and info-politics of energy and AI will flourish and researches will consider this new journal as the natural platform for those researches to be voiced.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] R. Ocone, “Should we teach Ethics in Engineering?”, The Chemical Engineer, Issue 773, 24-25, 2005

[2] R. Ocone, “The Fox or the Hedgehog: One Idea or Many?”, in “Yearbook of Biosecurity Education”, ISNB 978 1 85143271 4, 2013

[3] R. Ocone. “Ethics and the Accreditation”, Education for Chemical Engineers, **8**, 113-118, 2013

[4] R. Ocone, N. McCarthy, “Bolted on or systemic? How engineering ethics differs from philosophical and medical ethics”, Conference of the Society for Philosophy and Technology, Twente, July 2009

[5] R. Ocone, C. Ocone, “Hedgehog or Fox”, TCE, Issue 883, 52-53, 2012

[6] M. C. Roco and W. S. Bainbridge eds. "Converging technologies for improving human performance: nanotechnology, biotechnology, information technology and cognitive science", U.S. National Science Foundation, 2002