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Responsible Research and Innovation in Construction

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Abstract

The issue of ethics and responsibility is gaining attention among the creators of scientific policy, funding agencies and society at large. Responsible research is defined as research that aligns both the process and the outcomes with the values, needs and expectations of society. In an EU funded project "Responsible Research and Innovation in Information and Communication Technology (ICT)" a four dimensional framework for defining and monitoring responsibility in that kind of research projects has been defined. The four dimensions are (1) actors who are responsible or to whom research is responsible, (2) kinds of responsibility – in what way are they responsible, (3) how much they are responsible and (4) in what area of ICT responsible research and innovation can take place. After presenting the framework we apply the concept of responsibility to research in the field of architecture, engineering and construction (AEC). We are finding that the particular feature that sets responsibility in construction apart from other research topics is the impact it has on life and safety of large number of people and on the critical infrastructures. While responsibility is important we conclude with a warning that the first responsibility of research is scientific quality and that other responsibilities cannot be a substitute for that.

Keywords: construction research, research policy, innovation, responsibility, social responsibility, scientific method

1. Introduction

With the increasing power of scientific development and impacts of the new discoveries on the planet in general and on society and humans in particular, the issue of ethics and responsibility is gaining attention among the creators of scientific policy, researchers and society at large. The topic has been particularly relevant in some fields of life sciences which are tackling the very fabric of life and the very features that make us human. But the concept is spreading to other fields as well. Among the reasons is the need of funding agencies and policymakers to present the case for societal value of research that is being publicly funded.

Responsibility is broader concept that that of ethics that has been present in life sciences for decades if not centuries. The idea of responsibility has been emerging in European and national research programs for a long time but more intensely in this century. In 2001 "Science and Society Action Plan was created". In 2010 "Science in Society (SiS)" emerged. In 2010 the RRI concept was defined as a response to aspirations and ambitions of European Citizen as a part of the effort to better justify the public investment in research and innovation. In 2014 the idea of RRI in ICT made it into the programmatic document of Horizon 2020. The concept made big advances from the baseline idea, which would claim that the only responsibility of research and innovators is to do good quality research.

2. Responsible research and innovation

The European Commission defines responsible research as "an inclusive approach to Research and Innovation (R&I), to ensure that societal actors work together during the whole research and innovation process. It aims to better align both the process and outcomes of R&I, with the values, needs and expectations of European society. In doing so, it fosters the creativity and innovativeness of European societies to tackle the grand societal challenges that lie before them, while at the same time pro-actively addressing potential side-effects" [1].

It goes on in saying that "In general terms, RRI implies anticipating and assessing potential implications and societal expectations with regard to research and innovation. In practice, RRI consists of designing and implementing R&I policy that will: engage society more broadly in its research and innovation activities, increase access to scientific results, ensure gender equality, in both the research process and research content, take into account the ethical dimension, and promote formal and informal science education".

On the other hand, another European institution, the Economic and Social committee, stated a concern [2] that the RRI might in fact harm the freedom of the mind achieved by the Enlightenment and wrote »What is needed is a fundamental change in social attitudes, so that innovations are not seen primarily as a risk or a threat, but rather as an opportunity for further progress, more jobs and European economic strength and competitiveness, and for shaping the European social model.«

The author is involved in a project "Responsible Research and Innovation (RRI) in Information and Communication Technology (ICT)", funded by the European Commission as a part of the Horizon 2020 program. The project has been set up under the assumption of major impact that ICT research has on society and aims at monitoring, analyzing, supporting and promoting RRI approach in ICT research in Europe [3]. The goals of the project are to (1) promote a contribution of social sciences and humanities to RRI in ICT under Horizon 2020, (2) curate the RRI domain in H2020 empowering projects and other stakeholders, (3) facilitate the interaction for the emerging RRI-ICT community and (4) create a networking platform – real and in cyberspace - where stakeholders would meet and exchange views.

3. RRI Framework

We are defining the RRI concept through mapping. We present a 4-dimensional map of RRI in ICT. The dimensions define (1) who and to whom are actors responsible, (2) what the responsibility is about, (3) how much responsibility there is and (4) to what topic of ICT the responsibility applies.

The **actors** (who) include researchers, funding agencies, policymakers, educators, students, society at large, all either as individuals or in groups or institutions.

The **kinds** (what about) include epistemic responsibility, procedural responsibility, social responsibility, ethical responsibility and finally the legal & financial responsibility [4]:

Epistemic responsibility is to deliver good science, a responsibility that the community of scientist should take care of for their own deontology and career, by making a proper use of the scientific method and source of knowledge in the research; also includes freedom of thought and pursuit of ideas unlimited by limitations of the church or a state.

Social responsibility is responsibility to the needs of society and their challenges and about the outside impact of research and innovation. It is that is primarily a responsibility towards citizens and society that is sometimes channeled into research program priorities, topics and research project goals.

Ethical responsibility is towards a set of established values and norms that in principle represent an "higher being" (i.e. they are beyond the interests and stakes represented by any single actor), but in practice may be identified with the norms and values prevailing in the societal context where research and innovation is done (e.g. with fundamental rights and safety protection levels set by the EU, the UN Chart of Human rights, etc.). It is responsibility towards the planet, living beings, life etc.

Procedural responsibility is responsibility to ensure an open, inclusive, transparent and fair engagement of all stakeholders (including the citizens) affected by research and innovation activities, the latter in particular to be involved because they contribute as tax payers (when the research is publicly funded) and as prospective users/customers of the research results. It includes openness of research findings and openness of research processes for example to women and minorities.

Legal and financial responsibility is about the contractual obligations the research institutions may establish with funding agencies, about regulations and laws needed to introduce new products and services on the market, and new evidence-based policies enforced through legal acts taken by public authorities.

Levels of responsibility range from being unaware of RRI (as a distinct concept) to establishing systematic procedures to maintain and increase the levels of responsibility within an actor [ibid.]:

Not aware about the idea of responsibility, but perhaps doing something about it intuitively. An example of that would be natural tendency to disseminate research, report it on conferences and events, thus making it more open.

Aware of the idea of responsibility and using that occasionally to improve on it. An example would be know the big challenges and include the tackling of them in research that is unfolding.

Aware and systematically practicing responsible ways of doing things. An example of that would be organizational efforts to maintain compliance with rules and regulations.

ICT **topics** are an important dimension because particularly the social and ethical aims may be quite different for different kinds of technologies being developed. Big data research, for example, would have different responsibility requirements than, for example, high throughput computing.

An evaluation of levels of responsibility by topic of responsibility could be depicted on a diagram as the one in the Figure below.

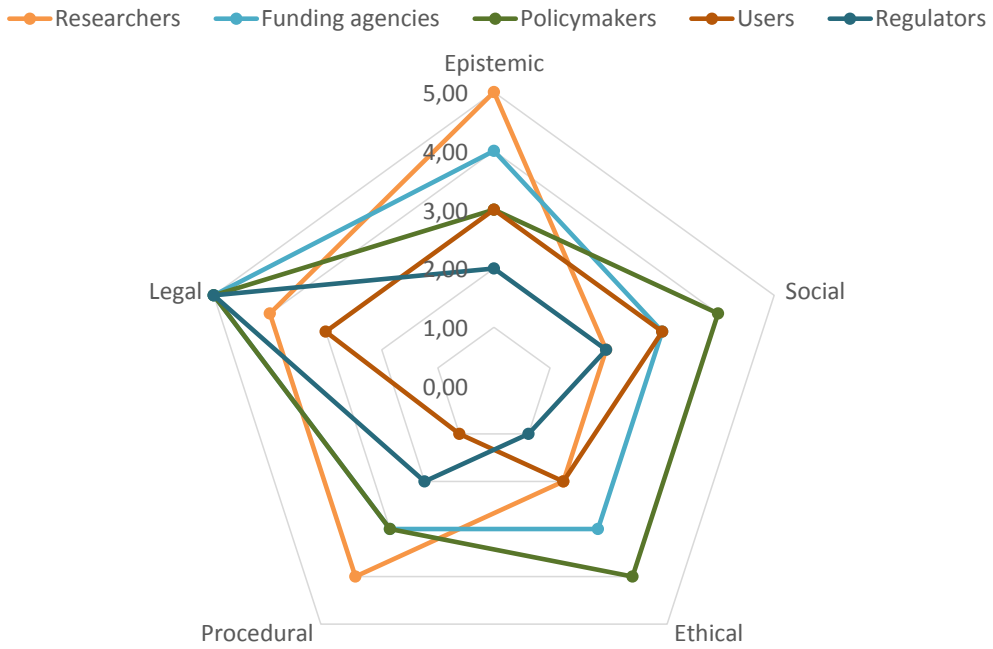

Figure 21: RRI footprint in ICT structured according to the RRI framework and based on informal impression of the consortium members.

4. Responsibility in Civil and Structural Engineering Research

Civil engineering and construction research too has a significant external impact. There is some literature that demonstrates the awareness of construction of the concepts of responsibility, for example in construction management [5][6]. More work, however, is related to ethics [7][8], social responsibility [9] and teaching of engineering ethics and responsibility [10][11]. In the rest of this paper some themes that could be studied with relation to the kinds of responsibility and construction research will be outlined.

4.1. *Epistemic responsibility*

This responsibility is related to doing quality scientific work. The challenge for research in architecture, engineering and construction (AEC) is that the area is so diverse that several scientific methodologies could be deployed. And it would be irresponsible to deny this fact or, for one or the other reason, pick a method which is inappropriate. Some topics in AEC research require the scientific method of natural sciences. They study how materials or structures behave under external influences. Mathematical or computer models can be verified by experimentation and observation. Other topics study social or socio technical phenomena. For example how people interact in projects, how they communicate and collaborate. Modelling and experimentation is possible, but a model may change what is being observed. Methods of social sciences, such as organization sciences or economics are appropriate.

And then there is problem solving research – a need to solve an original engineering problem, hopefully, but not necessarily such where solutions could be reused. Fallibility of this kind of research is in a direct contradiction of the engineering approach to problem solving which is finding a workable solution with the means that are available.

It is also irresponsible to evaluate engineering research using same metrics or criteria regardless of the topic and research method.

4.2. *Social responsibility*

This responsibility is related to addressing societal challenges and societal needs. The author identified five such challenges and opportunities in which AEC research would have a role in addressing them [12]: (a) Automation and abundance, (b) BRICS and globalization, (c) Climate change, (d) Demography and (e) e-technologies. Each has a huge potential for engineering research. In some topics we contribute to pushing the state of the art, for example in automation, which also leads to problems such as abundance and restructuring of the labor market. Engineering research could be responsible about all five areas. It would be responsible, for example, to automate dangerous and unhealthy jobs, to solve, as a part of globalization process, housing needs in developing countries with efficient solutions; to contribute in the mitigation and adaptation to climate change; to take part in creating attractive places to live and work for families and migrants so as to tackle the demographic problem; and to shape the e-technology revolutions with the solutions specific for the construction industry.

In addition to addressing those five areas of new challenges, the responsibility is also towards traditional concerns of AEC – to provide safe, healthy and resilient infrastructure, housing and workspaces. Resilience is perhaps the most important issue that a responsible researcher would not overlook.

4.3. *Ethical responsibility*

What perhaps sets AEC apart is the ubiquity, broadness and long-termism of AEC products. They are everywhere, they will remain there for decades, even centuries. A lot of resources and energy are used to produce them, they take space which is a very limited resource.

4.4. *Procedural responsibility*

In the aspect where it concerns the stakeholders, again, AEC research touches everyone. Stakeholders are all those using the built environment. A particular challenge is that consumers often do not have a choice, as they do with discrete, movable, expendable consumer products. We do not get rid of AEC products as fast as we can replace a failed design of – say – a mobile phone. AEC infrastructure is shared, not only privately owned.

4.5. *Legal and financial responsibility*

A possible peculiarity and difference here could be the stakeholder (and potentially funder) demographics. For AEC industry small and medium enterprises are the rule rather than an exception.

5. Discussion and Conclusion

The concept of responsible research and innovation that has developed for another discipline has been presented. It includes four different dimensions of responsibility. The concept was being verified so as to think about the responsibility in AEC research along those dimensions. It has been found out that the scheme is generic enough to do so. However, the topics or responsibility, particularly the social responsibility are heavily influenced by peculiarities of the AEC industry.

While it is tempting to improve the responsibility of research this should not happen at the expense of the quality of research. In other words – not all responsibility topics are equally important and responsible research in not the sum of all responsibilities. The primary responsibility of researchers is to do high quality, methodologically sound research. If it is, in addition, socially responsible and contributes to solving some societal problems, even better. But funding agencies and policymakers should not be tempted to award researchers doing poor work about the correct issues.

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