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RESPONSIBLE INNOVATION: A PRACTITIONER'S VIEW ON HOW TO PUT IT INTO PRACTICE

Marc Dreyer [*1], Luc Chefneux [2], Luke Collins [3], Anne Goldberg [4], Joachim von Heimburg [5], Roberto Martinez-Neira [6], Norberto Patrignani [7],Monica Schofield [8] and Chris Shilling [9]

[*1]Futopedia, Champsot 28, CH-1822 Sonzier, Switzerland
[2]Académie royale de Belgique, rue Ducale 1, 1000 Brussels, Belgium
[3]Unit 5, Hutchinson House, Adelaide Road, London NW3 3PU
[4]Corporate Research & Innovation, Solvay Campus, 310 rue de Ransbeek, 1120 Bruxelles, Belgium
[5]Jvhinnovation GmbH, 4125 Riehen, Switzerland
[6]RMN Bio GCV, Rue de l'Ancien Presbytère - Oude Pastoriestraat 1, B-1083 Ganshoren
[7]Politecnico of Torino, Via S.G.Bosco 4, 10015 Ivrea, Italy
[8]TuTech Innovation GMBH, Harburger Schloßstr. 6-12, 21079 Hamburg, Germany
[9]The Florin Partnership, Temple Ewell CT16 3DA, UK

ABSTRACT

There is a widespread perception that our business and innovation models must change to be better aligned with societal expectations and pressures on our planet's resources and resilience. This perception has increased since the 2008 financial crisis, as has an awareness that traditional models of business success, based only on financial and regulatory frameworks, are not properly addressing the impact of accelerating change. It is in this context that movements such as responsible innovation, ethical innovation and sustainable finance have emerged. Responsible Research and Innovation (RRI) has emerged as a field of academic research, but so far with little impact upon - or connection to - the business and industry community. As an independent working group of industrial research and innovation managers, we examine from a practitioner's point of view the profound differences between the research and innovation processes. We also consider the need for different assessment tools to measure the success of each of these processes. We link the framework of responsible innovation to the concept of sustainable finance as a critical way of steering priorities, and highlight their commonalities. It is our premise that the responsible and ethical components of innovation must now become part of any innovation project's design criteria, in the same way that the quality concerns first raised in the 1950s, and the environmental issues revealed in the 1970s, already have. Failing to embed societal impact in the innovation process will increase the risk that innovation could generate unintended adverse consequences and/or be rejected by society, which will result ultimately in financial penalties. We propose ways to avoid this outcome.

Keywords: *Modular Multilevel Converter (MMC), Transformer less shunt compensator (STATCOM),Voltage Source Inverter.*

1. INTRODUCTION: THE NEED FOR URGENCY

The last century saw considerable improvements in societal welfare, as can be seen by the increase in life expectancy, rising literacy rates, the reduction of infant mortality and poverty, and so on. Many of these achievements were the result of major scientific progress, in fields as diverse as condensed-matter physics, genomics and life sciences, and the social sciences, enabling breakthrough innovations.

There are signs that we have reached limits that will require a change of paradigm to maintain this rate of progress. Clear indicators of the challenges we face include the decline of productivity in the Western world, falling life expectancy in some segments of the population , the decrease of healthy life years expectancy , growing water stress, issues with endocrinal disruptors or rising urban air pollution.

The so-called great acceleration of change is revealed in parameters such as demography, energy, water or land use, and CO_2 release, all of which are beginning to grow exponentially. Managing this transition successfully, or simply achieving resilience, will require a massive increase in many forms of innovation. This will only be possible if we can rely on robust research and receive support from society, both of which may be a challenge.

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The erosion of the credibility and authority of experts and the decline of the citizenry's trust in institutions are good reasons to anticipate that society will increasingly reject the innovation processes necessary to address the challenges outlined above. This should be a major concern.

In this paper, we define and examine which elements of the innovation value chain should be challenged. We also provide a view from innovation practitioners, working in business and industry, of how responsible and/or ethical innovation can act as a opportunities to better align innovation with societal expectations. This is necessary to ensure societal acceptance of innovation, so that science and technology can remain catalysts of change and provide a resilient engine for the innovations we require to build the future we want. Failing to do this will mean a shift in the delicate balance between precautionary and innovation principles, which will result to more regulation and less freedom to innovate.

2. INNOVATION NEEDS ADDITIONAL DESIGN CRITERIA

There has been a series of milestones in the evolution of the value that industry delivers to customers and consumers. These have included improving quality, prompted by the emergence of the quality movement in the 1950s, and greater respect for our planet's finite resources, driven by the environment movement that came to prominence in the 1970s. As citizens become increasingly concerned that industry's response to today's accelerating pace of change does not address their interests, we need innovators to start considering issues of ethics and responsibility more seriously. Responsible innovation is the engine of this transformation.

But innovations always come with risks, some of which can be anticipated and mitigated through thoughtful design, and some of which may arise out of unexpected combinations of circumstances e.g. the misuse of a product for an unintended purpose. Most innovations have been designed to deliver a particular set of benefits, but can create adverse side effects for society once they become widely used. Just think of Uber, a disruptive challenger to the established taxi business model, and the way it has prompted discussions about regulation, adherence to social standards, bogus self-employment and the promotion of the 'gig economy'.

Responsible innovation strategies are necessary to provide society with credible reassurance that, although such side effects are an unintended but unavoidable consequence of innovation, they will be properly addressed. If this were not the case, society would become suspicious and question the value of accepting such controversial innovations, even for the limited time it takes to fix their unintended consequences. At worst, society may withdraw its licence to practice such innovations at all, whether or not the side effects can be effectively mitigated, as happened with the rejection of GMOs in the food chain and as Uber is facing from on-going regulatory challenges in Europe.

It is also vital for society to recognise and accept that there is a risk to not innovating, for which it will bear some responsibility if it overly constrains the innovation process. This is a particular concern given the challenges that society and our planet face at the moment.

3. ETHICAL AND RESPONSIBLE INNOVATION: A REVIEW

There are several movements that address the need for additional criteria from different viewpoints. Unfortunately, many of these treat the research process and the innovation process as the same thing, despite their being fundamentally different processes in terms of the actors, skills and leadership required.

The Research Process is about generating new knowledge, and is mostly implemented by academia and publicly funded research institutes. Successful research requires leadership qualities such as patience, tenacity, creativity, curiosity, scientific excellence, and the ability to connect ideas, people, and resources. Ethical researchers should consider issues such as the involvement of humans, collection of personal data, involvement of animals, third countries (e.g. using local resources), potential risks for research staff (and of course for the environment), potential misuse of the results of the research, and so on .

The Innovation Process, often subdivided into applied research, development (or design, prototyping and engineering) and launch (or production and distribution), is about generating new benefits for society or

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consumers, and is mostly implemented by business and industry. It is during these phases that the innovation process has to fine-tune the business plan, and starts touching a completely new set of stakeholders. Innovation may emerge from research, but it may also come from a combination of existing solutions to deliver new benefits or a change of business model, as exemplified by companies such as Apple, Uber and Amazon.

Successful innovation requires leadership qualities such as the ability to understand and capture benefits and value drivers that are required by end users, the capability of gauging financial and regulatory risks, and the capability of generating and executing a viable business model in a multi-disciplinary context.

It is worth noting that the innovation process, especially in sectors such as the pharmaceutical and consumer-goods industries, will cost many times more than the research process. If the research behind a new product costs 1 unit, its development may cost 10 to 100 units, and its launch, taking into account investments in equipment, marketing and distribution, may cost 100 to 1000 units - it is for this reason that the journey from applied research to launch is often nicknamed the "valley of death" . However, we should in no way conclude from such ratios that Research is in any way less important: several investigations have clearly underlined the link between breakthroughs in fundamental research and breakthroughs in Innovation

An ethical assessment of innovation is only meaningful when it is conducted in a context, which is provided by the business plan and a definition of the product or service's claims and values. It also has to include the whole supply chain. For example, a responsibly innovating microprocessor company that wants to use a transistor might want to investigate where the rare earths used in its silicon foundry come from, the working conditions in its manufacturing plants, the environmental impact of the production process, the opportunities to design the chips for eventual recycling, and so on .

There are several efforts to develop a framework to address this challenge:

- RRI research, mostly confined within academia, which includes in the process (understood here both as research and innovation) democratic governance, with "societal actors and innovators being mutually responsive to each other". However, this requirement conflicts with innovators' need for asymmetric access to information, and overlooks innovators' role in taking and managing risks.
- The EU has also developed an RRI-Framework , based on 6 principles that promote: early engagement with all societal actors; gender equality; science education; open access to research publications and data; ethical standards and governance. This framework may be of interest to define the ethical conduct of research, but it is doubtful that it will be a basis to screen research proposals for their potential to generate knowledge, or to screen innovation proposals for their potential to generate genuine benefits without inadequate externalities and side effects.
- Additional proposals are emerging, such as SATORI and the EU-RRI toolkit - both from from EC funded projects - but with the same shortcomings. They have so far received very little recognition outside of academic and policy circles.

Industry has not been an active participant in those debates, nor was it invited to participate, apparently because the approaches taken are rather alien to the way business manages its innovation and business development processes and the current debates within sectors.

4. INNOVATION AND ETHICAL ASSESSMENT

If we accept the definition of responsibility as a way of acting that takes accountability for the consequences of our actions , we can conclude that the assessment of responsibility with which an innovation has been undertaken must be situational, or dependent on its intended use. This is often modelled using the Trolley Problem , a thought experiment whose possible solutions clearly depend on the context. The debate about 'killer robots' is another good illustration: the technologies used in these robots, such as sensors, actuators, and algorithms, can also be used in robots that help humans. The ethical assessments for innovations servicing such different needs will, of course, be very different. This dilemma has long been reflected in the debate about dual use of science and technology.

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Consequently, while research can be conducted ethically or not, innovation will have an ethical impact that also depends on its context and the trade-offs described in the business plan.

5. RESPONSIBILITY ISSUES WITH RESEARCH: HOW IT CAN FAIL

Research can be conducted unethically, which is quite different from delivering unethical results. If we accept the definition of research as a process to generate knowledge, it will fail to deliver typically in two ways:

a. When this knowledge is unreliable, because it is based on incorrect methodologies, inadequate data, the use of shortcuts, or weak statistical power. In this respect, the reproducibility crisis , affecting life sciences and social sciences in particular has emerged as a serious concern from various surveys within the scientific community. The causes of this reproducibility crisis seem to include the pressure to publish and the lack of motivation to verify results. This problem is serious, because it erodes the credibility of scientific research. The measures proposed to mitigate the problem focus on methods, reporting and dissemination, reproducibility, evaluation and incentives.

b. When the research is generating knowledge that is not usable, typically due to the mismanagement of a controversy. A controversy, which is broadly defined as an act of debating to reach a consensus, is vital to the progress of science . But the process can be highjacked to create ambiguity and obscure scientific facts and results. Some examples of such behaviour include the obfuscation of the facts to do with asbestos, tobacco, sugar and obesity, and glyphosates. These controversies may have developed due to unintended causes such as cognitive bias, or through the actions of people with vested interests who want to maintain ambiguity. The problem here is that it will never be simple to discern whether a controversy reflects a genuine effort to progress science or an unethical attempt to hide unwanted conclusions. However, independent peer reviews, transparent methodologies and data, and a good understanding of the trial methodologies, of the necessary statistics and the process of developing cognitive bias, are all proven guides in the assessment process.

These two causes of weak and/or ambiguous science often come together to generate inadequate public policies or innovations. They also contribute to eroding the public's trust in research, and hence its willingness to fund it.

6. RESPONSIBILITY ISSUES WITH INNOVATION: HOW IT CAN FAIL

Innovation, when defined as the process of generating new benefits to society and/or consumers, can fail to deliver responsibly by:

A. Not delivering true benefits . This can have several causes, such as:

- Relying on weak science or deceptive research
- Being based upon misleading scientific reporting
- Failing to honestly report the benefits
- Relying on asymmetry of information between the innovator and the customer to make claims that are ambiguous, and which customers cannot validate.

There are several processes for designing products and services that capture the consumer's needs, and Design Thinking has emerged as the currently favoured best practice. Similarly, the Business Model Canvas has emerged as a preferred standard. These methodologies are meant to maximise value to the consumer and the shareholder, but do not ensure that societal values are reflected in the process.

B. Delivering externalities or side effects that do not match the benefits. Malpractices such as:

- Generating an environmental impact that can be reasonably prevented
- Taking liberties with the interpretation of laws and regulations on environment, work safety and contracts
- Abusing a monopoly through pricing

Consequently, responsible innovation is not restricted to consumers or customers, but encompasses society as well. There are frameworks on Corporate Social Responsibility (CSR) and Creating Shared Value (CSV) that provide guidelines, and best-practice outlines such as the United Nations (UN) Global Compact. The UN's

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Sustainable Development Goals (SDG) have been adopted by most states, and endorsed by many companies, and as such offer the best current basis for mapping societal impacts and guiding innovation decisions . Since the societal impact of value creation is complex to measure and assess quantitatively, best practices covering this are in development through initiatives such as the International Integrated Reporting Framework .

It is also relevant to mention the evolving discussion on responsible finance, also known as sustainable finance. Many investors have a fiduciary duty to explore the environmental, social and governance (ESG) factors of the companies in which they invest, and these might apply equally well to rate responsible innovation.

A debate has been taking place for some time about both the concept of CSV , and the role of companies in social responsibility . For some, the role of a company is to pay taxes, abide by the law, and maximise profits. For others, not including ESG goals or constraints causes an additional risk to a company, at least in the long term. There is also a danger in restricting the assessment of innovation to purely regulatory and economic criteria, when the accelerating pace of change makes it increasingly likely that regulatory frameworks will fall behind both technological progress and societal expectations of the protections those frameworks are supposed to afford them.

7. CONCLUSION: TOWARDS AN EXTENDED ASSESSMENT MODEL FOR INNOVATION

Many initiatives are trying to extend the assessment criteria for innovation, to embed societal impacts. We have reviewed the initiatives from academia, and have highlighted their shortcomings from an industry perspective. Because research and innovation are very different processes, typically implemented by different communities, any attempt to use the same criteria for both – the current focus of much academic work - will result in a dysfunctional assessment framework.

Research, the activity of generating knowledge, must eradicate the weak science that results from poor reproducibility, or mismanaged controversies that result in useless knowledge.

Innovation, which is about generating new benefits to society or consumers, must meet societal expectations beyond simple corporate social responsibilities. Although there is a convergence of the sustainable finance and responsible innovation movements, more needs to be done to align these concepts, for example by using mutually compatible definitions. Additionally, the existing models for integrated reporting of how an organisation's strategy, governance, performance and prospects lead to the creation of value over the short, medium and long term, must be improved and standardised to gain credibility and acceptance.

Given the huge impact that research malpractices can have on the credibility of science in society, and the backlash that unethical innovations can generate, it is critical that both researchers and innovators update their assessment criteria, and focus as much on preventing unintended consequences as on trying to mitigate their effects.

Failing to improve the way in which researchers and innovators think about their responsibilities will erode society's trust in their ability to act as an engine of successful transformation or resilience in today's rapidly changing environment. This will increase the risks of innovation generating unintended adverse consequences or drying up completely – which itself forms perhaps the greater risk to society, given today's global challenges.

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