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Impact assessment for the 21st century – rising to the challenge

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Abstract

The future of impact assessment has to contend with global megatrends, including the Fourth Industrial Revolution, that are set to change the face of the planet, and with the neoliberal economy, and the implications this has for trade-offs in decision-making under the umbrella of 'sustainable development'. Together these challenges have implications for human health and well-being, and biodiversity. In this letter, we set out these challenges, before moving onto the solutions that are needed to rise to them. These include: formalising technology assessment processes and/or the inclusion of emerging technologies within the scope of legislated IA processes; a move towards legislated substantive outcomes, rather than enforcement of procedure only; and ensuring that the framing of IA goals are based on societal definitions of sustainability.

Key words

Impact assessment; Fourth Industrial Revolution; global megatrends; neoliberalism; emerging technologies; transnational assessment

1. Introduction

Impact assessment (IA) has come a long way since it was first legislated in 1970 (through the US National Environmental Policy Act (NEPA) (1969)), with project-level Environmental Impact Assessment (EIA) now being practiced in all countries of the world (Yang (2019) identified legal requirements in the only jurisdictions found by Morgan (2012) to lack them). IA remains an umbrella term for assessment at all tiers of decision-making, including increasing requirements for, and practice of, Strategic Environmental Assessment (SEA) of policies, plans and programmes, and increasing consideration of social and economic issues (including health) in addition to the biophysical environment (Glasson and Therivel, 2019).

In looking forward and considering the role of IA in the 21st Century, we highlight two specific challenges, which we believe will define its role into the future. The first relates to global megatrends that are set to change the face of the planet, with associated implications for human health and well-being, and biodiversity. The second relates to the neoliberal economy, and the implications this has for trade-offs in decision-making under the umbrella of 'sustainable development'. In this short paper we will first introduce these challenges, before going on to suggest how IA might need to evolve in order to rise to these challenges.

2. Global megatrends and the Fourth Industrial Revolution

Retief *et al.* (2016) reviewed six different reports from the business sector, which identified 16 global megatrends. Across these reports, the following six international megatrends were identified by at least five: i) rapidly changing demographics, ii) rapid urbanization, iii) accelerating technological innovation, iv) power shifts, v) resource scarcity, and vi) climate change.

Whilst low reuse and recycling rates exacerbate resource scarcity, an ever-increasing (and longer living) human population, and changing patterns of living, inevitably bring consequences, including an expectation that mining will continue to grow even as recycling rates improve (Ali *et al.*, 2017). Associated with these changes, current patterns of energy supply and use are having dramatic climate consequences (Bruckner *et al.*, 2014). Together, these megatrends both remove the space for biodiversity and, through climate change, move the geographical boundaries where specific habitats can flourish. That is, megatrends have global impacts, occur on multi-national scales and are driven through a multitude of decisions that escape the scope of current environmental management systems.

The global economy at the same time starts reaping the benefits of the Fourth Industrial Revolution, covering fields as disparate as *"artificial intelligence, robotics, the Internet of Things, autonomous vehicles, 3-D printing, nanotechnology, biotechnology, materials science, energy storage, and quantum computing"* (Schwab, 2016). Initial scoping of the potential impacts of some of these emerging technologies indicates that they could be positive or negative, with much depending on how they are used (Dusik et al., 2018). Figure 1 presents examples of potential environmental implications of automated systems (see Dusik *et al.*, 2018, for more details of these technologies).

Transition to automation	Key environmental opportunities	Key environmental risks
Specific technologies		
3D printing and custom manufacturing	• Fully-customized and more functional & efficient products produced even in small quantities • Easy prototyping and lower energy demands in low production runs • Reduced logistical requirements through distributed and localized on-demand manufacturing • Reduced material intensity and weight of products • Easy upgrading and refurbishing products in use with improved parts and components	• Higher energy consumption, compared with conventional manufacturing approaches (if used for production of large quantities of products) • Emissions of potentially hazardous ultrafine particulate matters and VOCs • Difficulty of recovering high-purity materials from 3D-printed composite materials • Risks of hacking and design flaws in 3D-printed objects – need for re-printing and possible accidents • Potential over-consumption through affordability of 3D objects
Advanced industrial robotics	• Reduced material losses in manufacturing and supply chain operations • Demand-responsive production • Smart recycling systems • Opportunities for digitized environmental monitoring and management and potentially also for environmental accounting systems	• Increased total energy intensity of operations • Increased electronic waste due to proliferation of electronic appliances and equipment • Near-zero marginal cost of production may increase consumption of products and upstream demands for material and energy inputs.
Autonomous vehicles	• On-demand shared transport mobility • Vehicle sharing • Optimization of transport flows through vehicle-infrastructure communication • Increased energy efficiency per journey through route predictions and improved driving behaviour	• Increased use of mobility (induced transport) • Urban sprawl • New infrastructure requirements
Integrated sensors and Internet of Things	• Improved monitoring and management of energy use, resource use and environmental issues of concern • Transparency in trading and supply chains and improved product tracking	• Increased total electricity demands (for operation of IoT devices, machine-machine interactions and transactions) • Increased use of scarce material (e.g. rare metals and earth elements) for production of IoT components

	• Real-time transactions and registered trading – possibly allowing greater deployment of environmental fees	• Increased electronic waste due to proliferation of electronic appliances and equipment • Changes in consumer behavior (due to automated purchases or over-reliance on instructions given by IoT systems) may encourage overconsumption • Potential environmental consequences of cyber-physical attacks through IoT devices
Artificial intelligence, big data analytics	• Multi-source monitoring and verification of energy use, natural resource use and environmental trends at different scales • Better forecasting and early detection of emerging risks and modelling of response measures • Data-driven design and system optimization (e.g. in energy and resource use) • Improved management of distributed resources and operations	• Increased total demand for electricity • Changes in consumption patterns through in-depth behavioral analyses and consumer behavior management
Changes in labour markets		
Accompanying shifts in occupations and livelihoods	• Green jobs in climate change adaptation and mitigation, new materials and energy sources, sustainable lifestyles, ecosystem restoration, sustainable management of natural resource, and environmental management of new production and consumption systems • Personalised consumption through merging producer-consumer roles	• Return migration of displaced labour force to rural areas (specially in export-oriented low-income economies) and increased utilization of natural resources therein • Increased environmental pressures associated with expansion of leisure and experience economy • Increased consumption through use-based business models

Figure 1: Key environmental implications of automation technologies (Source: Dusik *et al.*, 2018)

Figure 1 outlines two core concerns surrounding expected uptake of these next-generation technologies. First are the changing consumption patterns associated with reduced costs of production and an increasingly sophisticated consumption behaviour management. While many of the emerging technologies (such as 3D printing, industrial robotics, autonomous electric vehicles, etc.) may deliver lower emissions per unit when compared with the current technologies, they are essentially designed to ramp up consumption which will lead to potentially significant upstream and downstream environmental impacts. So lower impact per unit, but potentially higher overall footprint. Second, potentially significant impacts can arise during creation of new livelihoods that will replace jobs lost in traditional occupations. While such impacts will depend on the nature of these new economic activities and their environmental management, their impact will be additional to those generated by production-consumption relationships. In short, the Fourth Industrial Revolution may have equally significant implications for natural resource use and environmental management as the previous industrial revolutions.

Thus, there are considerable threats associated with inadequate environmental and social management of future deployment of these emerging technologies; including increasing inequality, resource use, greenhouse gas emissions and ecosystem degradation. At the same time, digital transformation that underpins the Fourth Industrial Revolution opens previously unseen opportunities for enhancing current environmental management – for example through digitisation of impact assessment processes, use of big data and machine learning for enhancing our predictive capabilities, or by presenting previously unseen opportunities for digitized environmental management accounting (Burritt and Christ, 2016). The ongoing technological transformation hence presents us with both risks and opportunities, and it is up to society to determine which effects and scenarios will materialize.

The challenge for IA is that global megatrends occur on scales that are multi-national, and are therefore outside the scope of currently mandated systems. Impacts of new technologies are also difficult to embrace within present IA systems, given the technologies are not captured in screening lists, and are in constant flux of development. That is, the current model for IA systems is ill-suited to address global-scale impacts of ongoing technological transformation.

3. IA in a neoliberal world

The EIA provisions within NEPA were focussed on the human environment (Bina, 2007) and, as the legislation spread to other countries, emerging regulations often focussed solely on the biophysical environment (Vanclay, 2004). However, the Rio declaration on environment and development specified that EIA should be used as the decision-support tool to direct projects with potentially significant impacts towards sustainable development (United Nations Conference on Environment and Development, 1992). Thus, despite this early environmental conservation focus, EIA is now considered to have a sustainable development goal (Glasson and Therivel, 2019), and this focus on sustainable development has pervaded all forms of impact assessment (Partidario *et al.*, 2012).

IA is argued to be inherently political in its operation (Elling, 2009; Cashmore *et al.*, 2010), and the timescale over which it has been the decision-support tool of choice coincides with neoliberal governance, where neoliberalisation is defined after Brenner *et al.* (2010, p.184) as denoting "*a politically guided intensification of market rule and commodification*". Neoliberals promote a weak version of sustainability, whereby socio-economic capital can replace environmental capital and be handed on to future generations. This gives the impression that it is possible to 'have it all' in the form of economic growth and prosperity, whilst inferring environmental protection (Ashford, 2002). Conversely, a strong version of sustainability would argue that current generations should pass on at least the same level of natural capital to future generations (Neumayer, 2010). However, the reality is that socio-economic benefits are often traded off against adverse environmental impacts (Morrison-Saunders and Fischer, 2006), with IA acting to legitimise a weak sustainability outcome. The expected job displacements in the forthcoming technological transformation are likely to intensify pressures on IA processes to legitimise job- or revenue-creating activities in order to maintain basic levels of social cohesion (Frey, 2019). The IA profession should therefore prepare for potential global shifts towards a weak sustainability paradigm.

It is not certain to what extent public participation, which is argued to enhance democracy and reduce the potential for powerful actors to control decision-making (Webler *et al.*, 1995; O'Faircheallaigh, 2010), will be able to counterweight such propositions, especially when undertaken in potentially economically distressed social settings. Already, some Governments have taken actions to streamline IA processes to expedite positive development decisions (see Bond et al., 2014 for evidence relating to Canada and the UK, and Glasson and Therivel, 2019, p. 41-42, for the USA). Intensification of global technological competition may further fuel such propositions.

The challenge for IA is how best to ensure integrity and legitimacy of environmental decision-making, encompassing the views of all sectors of society in outlining a shared understanding of sustainability rather than one that delivers weak sustainability through the application of market economics.

4. IA rising to the future challenges:

The preceding sections highlighted key challenges for IA in the 21st Century as:

1) Global megatrends associated with climate change, biodiversity and resource use operate at such scales that are difficult to capture within even strategic levels of IA.
2) The Fourth Industrial Revolution could affect these trends beneficially or adversely, but technologies do not fall within the scope of existing IA systems and their direct and indirect impacts on sustainability are currently not systematically considered.
3) Economic stress or neoliberal politics can push IA to legitimise environmentally damaging development in the name of sustainability or economic security.

These three realities point out an importance of systematic integration of sustainability concerns into ongoing technological transformation. Since many corporate studies that examine emerging technologies tend to assume best-case scenarios and do not fully consider potentially adverse impacts (Dusik *et al.*, 2018), a question arises whether impact assessments could support sustainability vetting of new technologies.

The key relevant tool in this regard is a Technology Assessment (TA) that was initially defined in NEPA-inspired meaning as "*the systematic study of the effects on society that may occur when a technology is introduced, extended, or modified, with special emphasis on the impacts that are unintended, indirect, and delayed*" (Coates, 1971, p.225). However, TAs developed in parallel with EIA in the USA and did not consider wider institutionalization questions presented by Porter (1995)[1]: 'Who is responsible for these assessments? Who pays for them? Who enforces the findings? Who is in charge of assessment of transnational issues, like global warming?' Since TA processes evolved largely unregulated - which is major difference from IA systems – they have developed different approaches shaped by the context in which they were deployed. Grunwald (2018) categorizes TA methods and approaches based on three main functions: TA as policy advice, TA in public debate and TA in engineering contexts thus supporting research and innovation. Given the diversity of approaches used, TA processes can be broadly defined as "*a scientific, interactive and communicative process which aims to contribute to the formation of public and political opinion on societal aspects of science and technology*" (Bütschi *et al.*, 2004, p.14). At the same time, calls for improved regulation of the ongoing technological transformation suggest that current regulation of disruptive technologies lacks clear obligations of developers and proponents to anticipate, disclose and manage their potentially significant direct and indirect impacts and is *de facto* in 'pre-NEPA' phase (Dusik, 2018). Considering the global megatrends and increasingly lively societal debates about the implications of our growing technological capabilities, it may be useful to formally

[1] Porter laments the separation of TA and IA and describes how the International Association for Impact Assessment (IAIA) was born out of the financial failure of the International Society for Technology Assessment (ISTA), with specific advice being not to use the term 'Technology Assessment' to avoid narrowing the field of impact assessors who would recognise the Association as a home. Whilst IAIA has "*sought to bring together those practising TA, EIA, …SIA*" (Porter, 1995, p.141), there has been no TA section for a number of years, although at the time of writing a new IAIA section on 'Emerging Technologies' had just been approved by the IAIA Board.

examine potentially disruptive technologies through either standard IAs or TAs in their initial NEPA-inspired meaning.

When it comes to addressing impacts of policies, plans, programmes and projects, IA needs a radical shift towards legislated substantive outcomes. That is, rather than Courts intervening only in relation to procedural issues, IA needs better enforcement of its substantive obligation to identify and assess potentially significant impacts, while duly considering cumulative and synergistic impacts of proposed interventions. There is a view that, such is the extent of climate change, and the ever increasing loss of biodiversity, that politicians are beginning to be held to account for the implications of their decisions (Vidal, 2019). This is demonstrated through grass roots movements, like the well-publicised criticism of global leadership by 16 year old Greta Thunberg (Riddle, 2019), followed by over a million pupils from 125 countries staying off school on 15 March 2019 to demand action on climate change (Nevett, 2019). The scale of the climate change issue has been further illustrated through first the UK Parliament following the First Minister of Scotland in declaring an environment and climate emergency (Brown, 2019), and then Ireland declaring a climate and biodiversity emergency (Owoseje, 2019).

The Fourth Industrial Revolution and the changes in political context may be sufficiently conducive to allow the critical changes to be made in IA processes. These changes remain extraordinarily difficult, and include:

1) Formalising TA processes and endowing them with strong sustainability-oriented impact assessment elements and/or inclusion of emerging technologies within the scope of legislated IA processes.
2) A move towards legislated substantive outcomes, rather than enforcement of procedure only.
3) Ensuring that the framing of IA goals are based on societal definitions of sustainability.

These are not trivial changes, with the need for some kind of international-level assessment being particularly difficult to achieve given the current trend of nationalism based on close ties between economics and politics (Gilpin, 2016). Yet they need to be made, and the opportunities presented by grass roots movements may be the only way to disconnect economics and politics, and allow societal definitions to come to the fore in technological progress and political decision-making.

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