Chapitre de livre | 2025

Published version | Open Access

Decommissioning Ageing Installations and Declining Technologies: Burden or Inspiration?

Bourrier, Mathilde; Marsden, Eric

Chapter 1
Decommissioning Ageing Installations and Declining Technologies: Burden or Inspiration?

Mathilde Bourrier and Eric Marsden

Abstract This book addresses the question of ageing and declining technologies, induced or not, and bets on the fact, that there is much to gain in looking closely at the activities entailed. Dismantling, decommissioning, deconstruction, closing-down, phasing-out, discontinuation, redirecting are all operations that are key to numerous industry sectors and high-hazard activities. Why? Because they represent a form of undoing that may prove to be key in redirecting vast industrial sectors, in light of climate change urgent transition. These operations are rarely the most "glamorous" phase of a system's lifecycle, and may even constitute a form of taboo in some industry sectors. Depollution and waste management are usually envisioned as a *mal necessaire*, rather than as an expected and intentional industrial phase, from which may emerge precious knowledge, expertise and know-how. This book proposes a different approach and a side step, considering that there are different ways to go about decline. The contributors, drawn mainly from academic backgrounds, embarked on the idea that there is much to learn from these phases, also because as the chapters will show, they are replete with surprises, treasures, uncertainties, and reversals. This eight-chapter academic book is based on presentations and earlier drafts by international experts who were invited in January 2024 to the 37th workshop under the auspices of NetWork (New technologies and Work), supported by FonCSI, a French public-interest research foundation. It deals with issues of interest to researchers and graduate students in safety science, transition studies, science and technology studies, organization and management studies, and anthropology, as well as to members of expert bodies and experts in industry and consultancy concerned with similar subjects.

Keywords Dismantling · Decommissioning · Deconstruction · Closing-down · Phasing-out · Discontinuation · Decline · Destabilization

M. Bourrier (✉)
University of Geneva, Geneva, Switzerland
e-mail: Mathilde.Bourrier@unige.ch

E. Marsden
FonCSI, Toulouse, France

1.1   Background and Opening Questions

Dismantling, decommissioning, deconstruction, closing-down, phasing-out, discontinuation, redirecting are all operations that are key to numerous industry sectors and high-hazard activities. Despite their importance, depollution and waste management are not the most prestigious categories of industrial activity, and they tend to be geographically and socially hidden away from public view or sometimes used to contest an industry (Cotton 2022; Schöbel et al. 2017). For example, high-level nuclear waste repositories already have a long history paved with setbacks, social unrest, social, and technological controversies (Macfarlane 2003; Macfarlane and Ewing 2006). These projects could be a source of inspiration (Schläppy et al. 2021). Yet, often, their stories are untold because ageing facilities, ageing and declining technologies, and zombie technologies are the hidden face of a techno-sphere that everyone would prefer to ignore and know less about than more (Bergé 2010 and 2011).

The decommissioning and phasing-out of ageing installations does entail specific safety risks, first for the workers but also ultimately for the surrounding population (Ashforth 1999). There is also a transnational dimension to include, with the offshoring of dismantling (in Bangladesh for instance in the case of ships) associated with pollution and with health and safety problems (asbestos, gas explosions, water contamination). These outsourced industrial practices say something about the activities that we would rather hide in very poor countries. Some countries have made a specialty of these hazardous waste treatment operations (Tanha et al. 2022).

Culturally, professional identities in the engineering world are geared towards innovation, breakthroughs and the creation of new technologies and installations. It has been often noted that maintenance activities, integral to numerous industrial processes, would greatly benefit from better consideration in the earlier lifecycle phases of design and conception (Denis and Pontille 2015, 2025). It is often regretted that they lack the same amount of attention compared to the construction and operations phases. Ageing installations, or legacy facilities in palliative care, are often envisioned as a burden rather than as a source of genuine learning. From ageing to decommissioning across safety-critical systems, there is a lot to uncover (D'Agata 2011; O'Leary 2022).

Of course, this general argument needs to be refined. Some industries have developed dedicated supply chains and specific expertise on how to decommission nuclear power plants, treat radioactive waste and polluted soil, recycle construction materials, remove asbestos from buildings, etc. Specific know-how has been forged through both the "normal" and the catastrophic life of industrial sites (Chernobyl, Fukushima, Deepwater Horizon spill are of course in every mind). Interestingly, these operations are either largely invisible or kept from the view of the general public or worshipped as heroic technical prowess. In and for themselves, these activities are interesting to look at, despite their gloomy reputation. But they entail a much bigger interest in light of the current climate urgency (Bonnet et al. 2021; Ialenti, 2020).

Numerous industry sectors and their related infrastructures are already being (coal, oil and gas, certain nuclear facilities) or will soon need to be (internal combustion engines, kerosene-fueled aviation) dismantled, phased-out, closed down. It will take decades to be able to progressively detach ourselves from forms of industrial production that are integral to our subsistence, yet equally detrimental to further life on earth. There is indeed much more to learn from examples taken from these industrial phases.

The issue of phasing-out carries a lot of complex problems, technical, and safety wise of course, but also social, patrimonial, symbolic, psychological (de Wildt 2020; Joyce 2020; Laraia 2019; Wall 2020). Bringing an entire installation to an end is emotionally draining for employees who worked and devoted time, energy, and skills to its operations and maintenance. This "aftercare" phase (Stegmaier 2023; Goulet and Vinck 2023) is also seen as less appealing, less attractive professionally. While there is some literature on the technical dimensions of ageing facilities and equipment, there is far less work on the organizational and societal aspects (Martin and Guarnieri 2013).

There are many different points of entry in the subject. We have listed below some questions which were put together to stir the conversation at the NeTWork workshop. Are the lessons from existing decommissioning projects sufficiently fed into the design of new projects and the operation of existing ones? How to prepare for decommissioning during design and/or operation? Is this anticipation a regulatory requirement in different industry sectors? What are the tradeoffs to consider between designing for ease of dismantling and for safe operation? Recently, for economic and/or energy supply related reasons, decisions have been made to grant lifetime extensions instead of phasing-out ageing installations: what are the consequences of such decisions, both from a safety standpoint but also from the consideration given to this dismantling phase, endlessly postponed? What governance mechanisms for these tradeoffs? What does it entail from an engineering and organizational point of view? How to manage competencies and careers related to technologies with a long service life (there are concerns here in satellites, aviation, railways, nuclear power, and banking) or which may seem less inspiring and attractive professionally? Can the concept of restoration and renewal, which is implicit in decommissioning, appeal to younger generations of workers, whose environmental consciousness tends to be more developed? While some countries with less developed regulatory frameworks have become convenient hosts for the disposal (and in principle, reuse) of dangerous materials, ships, oil platforms, what are the possibilities to advocate for safer practices? How to capitalize upon and transfer the immense and varied know-how that decommissioning projects generate? How much is transferable from one project to another, from one sector to another? Intergenerational issues have also to be considered among workforces, linked with La Porte's concept of "Never-ending Management and Stewardship" (La Porte and Metlay 1996). What are the key issues from the angle of workers' occupational health and safety? How should society manage the burden of legacy technologies and industries and brownfield sites (e.g. mandatory environmental liability insurance, legal obligations concerning decommissioning and restoration funds, mandatory disclosure in firms' extra-financial reporting, targeted

actions by safety authorities)? Are the lessons from past failures (coal and steel industry, Leboutte 2009), applied to new industries, such as offshore wind power?

However, as we shall see, not all of these questions have triggered contributions in the book. Several topics that we deemed important have been left unattended to, for now. This leads us to think that the topic should stay high on the agenda of researchers and programmes managers. With this book we hope to start a conversation on the conditions under which current examples of decommissioning and phasing-out across safety-critical systems could help establish a basis for envisioning future dismantling, in light of the sustainability transitions that many sectors have to engage with. Under what conditions can we make these operations more than a sad act of deconstruction, but a gesture to learn about technological rebound, renaissance, and ecological redirection? Under what conditions can these critical, often long-term operations, seen as wicked problems, represent a rich field of experimentation? What would it take to seize these moments as culturally rich, replete with patrimonial sensemaking? This book is only the beginning of a marked interest for activities that require vigilance and better understanding in order to ensure the collection of the largest portfolio of empirical cases possible.

1.2   What's in the Book?

Despite evident safety issues related to phasing-out industrial activities, it is of interest to note that the classical safety science community is not at the forefront of the current reflections. On the contrary, the vibrant community of science and technology studies and its offspring, transition studies, have so far made the most sustained effort to understand what's going on. Phase-out, destabilization, and decline have become a dedicated stream of research in transition studies (Koretsky et al. 2022). Three chapters in this book (Koretsky; Stegmaier; Turnheim, Barbier and Matt) offer a flavour of the richness of these approaches.

Koretsky introduces a conceptual framework linking three main components "materials", "competences", and "meanings" and the ways in which their relative alignments or misalignments contribute to decline of technologies. The framework is tested against a large data set of cases. Koretsky's chapter presents us with three cases of "weak" decline (incandescent light bulbs in the EU, cloud seeding in the USA, and the Ural computer in Russia) and documents how misalignments of one of the key components have led to specific pathways to decline.

Stegmaier adds the legal dimension to the crucial discussion of governing decline, where "doing discontinuation" can be observed and understood as governance-in-action. He presents three recent case studies: an inner-city ban on diesel vehicles in North Rhine-Westphalia in Germany, the strengthening of the Climate Change Act through the Federal Constitutional Court in Germany, and the decision in the case of Milieudefensie et al. v. Royal Dutch Shell plc. in the Netherlands. Stegmaier focuses on court proceedings that mobilize existing laws, and analyses how specific

groups and actors are literally forcing discontinuation via the courts, what he calls "discontinuation through judicial action".

And finally, Turnheim and colleagues with a precise historical approach convince us that the long march and never-ending story of pesticide phase-out has to be envisioned as a systemic problem affecting the entire agricultural sector.

A second line of contributions (Bergé; Peris-Raimbault; Nova, Bloch and Le Page) come from the ranks of anthropology, archives science and museography realm, which can, at first, constitute a surprise but which, taking a deeper look, opens up the crucial discussion of documenting and preserving knowledge and know-how. The anthropologist Bergé compares the slow deconstruction of the Superphénix nuclear reactor to the deconstruction and refoundation of Lyon's Natural History Museum, which she calls institutions of knowledge and memory. These institutions harbour treasures of ancient technological, material, and artistic practices, whose preservation is essential if we are to continue to understand their embodied knowledge and social practices.

The archivist Peris-Raimbault discusses aeronautics industry archives as an example, introducing the reader to the constant renewed practice of industrial archiving as a driving force for innovation and transmission of knowledge in a perspective of industrial safety and sustainability.

Anthropologist Nova and colleagues Bloch and Le Page have produced a visual essay that takes a close-up look at amateur practices for preserving and diverting obsolete information and communication technology objects (video game consoles, old video games, old computers, all kinds of computer waste…). These little-known, often informal practices, conceal a treasure trove of heritage, playful or scholarly intentions that could inspire the vast technological deconstruction projects currently underway.

A third angle is represented in the book by the chapters of Viitanen and Guntzburger and their respective colleagues. Anchored in the management and safety science, they both tackle the issue of decommissioning and dismantling nuclear facilities. Both chapters note that there already exists a wealth of regulatory texts and guidance pertaining to such complex projects. However, these efforts are not matched with a similar managerial doctrine capable of handling such large-scale projects in the long run. The decommissioning and deconstruction projects are very different from the construction ones. They require a different skill set and perhaps also a different mindset. Too often, a lack of proper education and training curriculum is missing. Developing a safety culture framework tailored to the specific needs of decommissioning is not a mere variation of a regular safety culture framework used during normal operations.

The work is only beginning. There is an urgent need to envision legacy industries, ageing and declining technologies, in need of phasing-out, deconstruction, decommissioning, dismantling, as witnesses from a past, that it is impossible to get rid of without proper care. Special care is needed to ensure that patrimonial, anthropological, historical, material, sociological, and technological dimensions all concur to resituate the proper place that such technologies played in human history. An

urgent de-consecration is under way and requires proper documentation and accurate storytelling.

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