Confronting the Second Deep Transition

through the Historical Imagination[1]

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I have travelled many disciplines. From history of technology, science and technology studies, transport history, Dutch history, history of Europe, a bit of global history, sustainable development studies, to mobility studies, I also worked with policy-makers and other stakeholders in fields such as innovation policy, technology assessment, and greening of industry. Yet my home is history, in particular history of technology, and the Society for the History of Technology provides the space where I can meet friends driven by a similar love for the history of technology. I feel therefore privileged and honoured to be awarded the Leonardo da Vinci medal. It feels like a recognition from my soul mates, which is important precisely because I so often travel far away from my roots, and then wonder whether historians of technology would still accept me when I come back.

Why is history of technology my home? The short answer is that I value the historical imagination beyond anything else. As I will argue below, it is this imagination that is crucially important for many actors in the world confronting the next Deep Transition.[2] Here I am building on the notion of the Great Transformation a phrase made famous by Karl Polanyi.[3]

History allows me to travel through time and space, to new worlds and to enjoy often amazing experiences. There is no greater pleasure than sitting in an archive and opening up boxes which have not been opened for a long time, reading minutes, letters and other documents, and then using these sources to construct an interpretation, and narrative. However, for me, history is never only about recovering the past; it is a looking glass which makes us understand the present and the future. This is not only the case because the

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[1] I would like to thank Phil Johnstone for his critical reading of the final version of text just before is submission and Laur Kanger for working with me on the Deep Transition idea.

[2] The notion of historical imagination is inspired by the book *The Sociological Imagination*, written by C. Wright Mills, as well as by various work on the theory of history, such as Evans, *Defence of History*, and Gaddis, *Landscape of History*. The sociological imagination is the ability to grasp what is going on in the world and relate this to individual agency.

[3] Polanyi, *Great Transformation*.

questions we ask are fuelled by contemporary concerns, but also because through history we get a better understanding of these concerns and ultimately of ourselves. This is the first feature of the historical imagination.

History is not only a looking glass; it is also a set of scenarios. It teaches us the path-dependencies which shape who were are today, roads not taken, and hidden alternatives, which still might have a future, never in a similar way as they have may have in the past, yet in an unmistakable way may shape what is yet to come. History provides access to experiences, and it shows us alternative scenarios. This is the second feature of the historical imagination.

History not only opens up, it can also produce bias. It may blind policy makers and other actors to certain options because a specific way of understanding history has become embedded in the way people, and organizations think about the options they have. In this way, history is a prison, and certain options are closed because actors believe history has proven they have no future. It is this for this reason that understanding history is more powerful than we often think! It will challenge ways of acting in the world, and opens up new ways of thinking about the future. This is a third feature of the historical imagination.

Now I come to the main point of my address. I would like to use this Leonardo da Vinci address to make a plea to historians of technology to use the historical imagination to engage more with the huge challenges our world is facing. These are recently captured by the United Nations in seventeen sustainable development goals ranging from zero hunger, good health and well-being, quality of education, no poverty, responsible production and consumption, peace and justice and more.[4] These goals contain a double challenge, reducing inequality and well nurturing climate compatible development for all countries in the world. The goals also express that the current financial and economic crisis should not be our main concern, but what comes next among others a series of connected crises in food supply, water provision, mobility services, energy security, healthcare justice, waste management, resource scarcity, migration and climate change. And, of course, existing and historic patterns of inequality, injustice, conflict, war, and environmental degradation already constitute an on-going imperative.[5]

Technology is a crucial site in producing and confronting these crises and imperatives. Technology does not refer so much to individual products and processes, but to socio-technical systems which is a configuration of products, processes, services and infrastructures, regulations, skills, preferences, expectations, and actors (e.g. producers, suppliers, policy-makers, users) that fulfils societal needs such as energy, food or mobility provision. These elements are aligned and fine-tuned to each other, making it a system.[6] We

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[4] See http://www.un.org/sustainabledevelopment/sustainable-development-goals (visited March 6, 2016).

[5] The Tensions of Europe Network is developing a new research agenda which addresses many of these concerns, see Vleuten, Technology and the Making of Europe's Grand Challenges.

[6] For an elaboration see Grin et al, *Transitions to Sustainable Development.*

historians of technology should challenge the view that there are no real alternatives to the currently dominant unsustainable energy, mobility, food, water, healthcare and other sociotechnical systems whose guiding routines are focused on intensive use of fossil fuels and other natural resources, waste production, mass production, mass consumption, mechanization, labor productivity. This is unsustainable because the costs and benefits are distributed in a highly unequal way and their so called externalities, for example global warming, threaten the future of our planet. For sure, if we continue to cling to an ideology fuelled by a belief in the power of the market and innovation to solve all problems, we will not be able to stop climate change and we will make ordinary people pay for the costs. As a society we need alternatives to these sociotechnical systems that have reached the limits of their capacity to adapt. We need to provide these alternatives, without giving up democratic ideals and giving in to a technocratic super State.

Could it be true that we as historians of technology can have significant impact in the collective search for alternatives? My answer is affirmative. Using the historical imagination, we can help the world to understand the current situation; we can challenge the way various actors think about the past, and the way they think about path-dependencies, and alternative scenarios, and by doing so opening up a new understanding of the present and the future. We can only do this when we are prepared to engage with the current world and its problems and come out of our comfort zone. I believe we might need to re-invent how we practice history of technology. What is this about? It is about the need for deep collaboration with other disciplines, not only the social sciences and humanities but also the sciences and engineering. It is also about engaging with the stakeholders of our research, business, the policy-world and civil society, not after our research is finished, but early on in an interactive way. Finally it is about addressing head on what C. Wright Mills has called the troubles of our time.[7]

The question about the social impact of human action brought me to history of technology. As a history student, I was interested in the big questions of history. One of them was the perennial question whether history is made by individual human action or shaped by structural forces. I was looking for a pivotal case-study to explore this rather broad question. Reading the work of Jacques Ellul and Lewis Mumford, and becoming inspired by the social constructivist work of Trevor Pinch and Wiebe Bijker, I decided to use history of technology as a case study.[8] It is a case study I never left.

Of course, to do in-depth empirical research, I had to find a concrete entry point. I decided to focus on farmers in Zeeland, a province in The Netherlands, who had to respond to what was presented to them as a new industrial technology. Modernizers told them there was no alternative. I zoomed in on the growing and manufacturing of madder, which is a natural red dye embedded in a root cultivated by farmers. The Dutch had been the industry leaders for several centuries but during the nineteenth century were confronted with a new type of madder product developed by French competitors. They had industrialized production. The

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[7] Mills, Sociological Imagination, 9-14.
[8] Ellul, *Technological Society*; Mumford, *Technics and Civilization*; Pinch and Bijker, "The Social Construction of Facts and Artefacts."

Dutch farmers responded not by switching to the new industrial production mode, but by upgrading their decentralized way of producing madder. They did not believe that the new industrial option would deliver positive results. On the contrary they argued that innovating their own craft based tradition would produce higher quality madder, a fairer distribution of income and eventually would make it possible to preserve a strong market position, and it did.[9]

This case study became a building block for a larger historical argument about the origins and nature of Dutch Industrialization. In the early modern period the Dutch Republic had claimed a leading position based on technological leadership but they lost this position and the United Kingdom became the birthplace of the industrial revolution, so the story goes. Based on the madder case, I challenged this view by arguing that the Dutch followed their own industrialization path, with was different, based on a form of merchant capitalism married to smaller-scale production, but it was not backward. On the contrary, it was forward looking, presenting an alternative industrialization model.[10]

Later on with colleagues at the University of Twente, led by Arie Rip, we developed a new innovation theory which takes up the idea of concurrent development paths, but also provides a way of thinking about dynamics of radical socio-technical change. This theory is currently known as the multi-level perspective, but beforehand we advanced it as a quasi-evolutionary theory of technical change.[11] It is a bridge between evolutionary theories of technical change, insights from constructivist's scholars and historians of technology. This work on the multi-level perspective was a major input into the development of a new field called Sustainability Transitions.[12]

This is not the place to elaborate on it, but the basic insight of the multi-level perspective is that human action is not driven by rational choice, vested interest or perception. Human action is driven by routines or rule sets which are embedded in sociotechnical systems and therefore highly resilient and adaptive. These rules provide a certain world view which make people prefer certain technological options above others. Yet while certain technological options, and the social relations which come with it, are dominant, there are always niches where alternative forms of behaviour and technology thrive. They might become a threat to the dominant sociotechnical rule-sets and systems. On top of that, external shocks and trends, called sociotechnical landscape, are important since they might create challenges which cannot be solved within dominant regimes and create windows of opportunity for niches to grow. Change or transitions of sociotechnical systems comes about through the interplay between regimes, niches and landscape factors. It always involves political struggle, crisis

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[9] Schot, "Technology in Decline."

[10] Schot, "The Usefulness of Evolutionary Models." Lintsen et al, *Geschiedenis van de Techniek in Nederland*.

[11] Rip, "A quasi-evolutionary model"; Geels, Frank W. "Technological Transitions"; Driel and Schot. "Radical Innovation as a Multilevel Process".

[12] For a discussion of the field and its origins see Smith, Voß, and Grin, "Innovation Studies and Sustainability Transitions." See also John Grin, Jan Rotmans, Johan Schot, *Transitions to Sustainable Development*.

and political conflict, and to explain the outcome of these struggles is the core objective of the multi-level perspective. This perspective has not only been instrumental in developing the field of Sustainability Transitions, but also helped define a large-scale collective research programme on "Technology and the Making of the Netherlands: The Age of Contested Modernization", better known in the corridors of Dutch universities as TIN-20.[13] The multi-level perspective made it possible to integrate technology into a larger story about Dutch modernization.

Coming years, building on these insights, together with colleagues at the Science Policy Research Unit (called SPRU) and from elsewhere, using the historical imagination, we will be working on what we will call the First and Second Deep Transition using the historical imagination. Deep refers to a coordinated change of many socio-technical systems in a similar direction. The main idea is that this coordination is provided by a meta-routine which shapes the individual routines of each separate socio-technical system. The concept of Deep Transition is similar to the concept of Great Transformation, but with a focus on the role of innovation in modernization and on socio-technical system change. For Polanyi transformation had unfolded itself through a double movement: on the one hand the creation of the market and on the other hand the establishment of a strong state to protect people against the dangers of the free market. This double movement is also visible in the way modern societies manage innovation processes, which is not discussed by Polanyi. Let me explain what I mean by this. Modernization was accompanied by the emergence of a set of institutions which rewarded innovation, and disconnected innovation from its impacts. In a modern (or capitalist) system, promoters of innovation are not responsible for its wider impacts on employment, the quality of a society and/or the natural environment. In other words, modernization nurtured the development of a specific modernist practice of science and technology politics in which science and technology should be stimulated as much as possible. They are seen as value-free tools to bring progress, material wealth, health, and a better life.[14] Modernization (and Capitalism) turned science and technology into the Holy Grail, the lever of riches citing Joel Mokyr, the harbinger of progress and the measure of man citing Michael Adas.[15]

In the early modern period this unconstrained freedom for science and technology did not exist. Technological change was embedded in religious and social institutions, in a moral economy and always from the start assessed against social norms. This assessment took place in guilds, for example, but also through protest, and eventually could also lead to machine breaking, which was a legitimate practice to influence technological choice. This does not mean that guilds or for that matter machine breakers were against innovation. They were against specific innovations which would do harm to their values, the society and their vision of the future. They wanted to open up spaces for discussing technological choice and

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[13] Schot et al. eds., *Techniek in Nederland in de Twintigste Eeuw.* Schot, Lintsen and Rip. eds. *Technology and the Making of the Netherlands.*

[14] For this argument see Rip et al, *Managing Technology in Society*; Schot, 'The Contested Rise of a Modernist Technology Politics'.

[15] Mokyr, *Lever of Riches*; and Adas, *Machines as the Measure of Men*

redirecting innovation.[16] During the First Great Transformation or as I prefer to say the First Deep Transition the responsibility for the negative impacts of innovation was transferred to the nation-states. They had to provide regulation and arrange the distribution of wealth and income through taxation.

However the combination of promotion of innovation and economic growth and regulation of negative impacts does not seem to be able anymore to address the problems of a world in transition: poverty, inequality, climate change and many others succinctly captured by UN sustainable development goals. This institutional failure is at the heart of the crisis of capitalism. And it is for this reason science and technology are central to the needed Deep Transition, not because they can fix problems, but because the emergence and institutionalizing of a new way of embedding science and technology in society could help to shape a new form of inclusive development. Inclusive because more actors and factors will be included in the assessment and development of one of the central motors of capitalism: innovation.

Since it is still early days for the Second Deep Transition, it is hard to characterize, but let me try to do this by providing two opposing future scenarios: a brutal Deep Transition and a more inclusive one. Brutal transitions will generate economic growth driven by innovation, but outcomes are a very unequal distribution of wealth, unequal access to opportunities and uneven quality of life, and an unequal exposure to pollution and the effects of climate change. These effects were mainly unequally distributed between North and South, but instead will now also produce ruptures within the North. Inequality is on the move, and is becoming transnational. The state is called upon to safeguard a fairer distribution, but is not able to deliver since its power is eroded by many developments, including the emergence of megacities and new technocratic supranational structures and interdependencies. In this scenario, capitalism becomes unrestrained again, which has the potential to undermine the social, political and ecological conditions on which it is built, leading to economic depressions, war and natural disasters. The costs of which will be highly unevenly distributed, but revolution is contained by technocratic structures and by force.

Inclusive transitions will also generate economic growth driven by innovation, but a different type of growth, one which prevents the generation of huge inequalities. In this type of transformation we do not expect the national state to redistribute ex-post some of the benefits of economic growth. Instead distribution issues are dealt with ex-ante, through a process of inclusive innovation which does not generate such huge distribution issues anymore. The State does not disappear in this scenario, it will only be reconfigured. It will not so focus on promotion of Research and Development and regulation of externalities, but on enabling transformative change. The ambition will to deliver a new type of inclusive modernization building on the creativity of entrepreneurs and civil society.

I want to emphasize that I am not negative about the accomplishments of modernization and capitalism. Let's not forget they provided growth with benefits for many and it led to the

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[16] See Schot, 'The Contested Rise of a Modernist Technology Politics'.

welfare state (but only in the West). It also led to democratisation of mobility, both socially and geographically, but also politically. It inspired the creation of nation states which was once a liberating project. It produced citizens and led to the inclusion of people, both man and women, in a democratic system. This is historically a very positive result. However, modernization generates many new problems which cannot be solved any more by more innovation.

My invitation to historians of technology is to engage with the issues referred to by the concept of First and Second Deep Transition not just individually but also collectively. When I make a plea for engagement with the troubles of our time, I am also calling upon the Society for the History of Technology as a platform where we meet and discuss our research. I am a firm believer and practitioner of collective research projects in which advanced researchers, as well as early career and PhD students can thrive but also form a community working together on a shared set of issues and concerns. This brings a lot of excitement, pleasures and excellent scholarship as the participants of the various collective projects I have been involved in, from the Greening of Industry Network, two History of Technology in the Netherlands programs, the Knowledge Network on System Innovation and Sustainability Transitions program, to Tensions of Europe Network can testify. As a consequence over the years I have worked with so many excellent and inspiring people within all these networks and programs. I owe a lot to all of them. Here I can only mention only a few with whom I have travelled a long time and who have supported me over many years.

First, Harry Lintsen who is the father of the birth of the Dutch history of technology in the late 1970s and 1980s. He has been my mental coach throughout my career. I met Harry for the first time when I was a passionate history Master student. I had started my work on madder industry and was already reading larger implications into my single case study. At that time Harry had begun a larger study of Dutch industrialization from the point of view of history of technology. When I met him for the first time, I immediately questioned his approach. Harry did not respond in a defensive way, but rather encouraged me to develop my thinking, asked further useful and pertinent questions, and eventually invited me to join his gang which consisted of Martijn Bakker, Ernst Homburg, Dick van Lente, Giel van Hooff, and Geert Verbong. Collaboratively, we were writing the history of Dutch industrialization in the nineteenth century, and Harry was our fearless leader.[17] Later on when I was leading similar large-scale collaborative research efforts, his advice helped me through difficult moments and trade-offs involved in such endeavours. He taught me to be reflexive about my own role.

Second, Arie Rip, my PhD supervisor and teacher. I tend to adventure into new fields, but Arie was always ahead of me, pointing at interesting ways to go, forcing me to go deeper and not to accept too easy answers. Arie has shaped my thinking, even to the extent it was difficult to understand where his thinking ended and my own thinking started. Arie is a very generous intellectual, always willing to share his ideas. I have profited from his deep insights

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[17] See Lintsen et al, *Geschiedenis van de Techniek in Nederland.*

in a myriad of ways. He invented the multi-level perspective which became so crucially important to my research and that of many others.[18]

Third, Ruth Oldenziel, whom I met for the first time at the SHOT meeting in Sacramento in 1989; my very first SHOT conference. Over the years Ruth has contributed tremendously to my thinking by questioning its assumptions, showing its limits and opening up new perspectives. For example, about gender, about the role of users in history, about the importance of culture, and fundamentally how to think about technology.[19] She made me better understand what it is to be a historian of technology. During the early 1990s, we started working together, with a larger group of Dutch scholars, on a new Dutch twentieth century history which resulted in the so called TIN-20 book series.[20] We have been working together ever since, in particular in founding the Tensions of Europe project and shaping its intellectual agenda, again with a large group of scholars.[21] The Tensions of Europe project led among other things to the Making Europe book series.[22] Both projects were an adventure and it had been a privilege and pleasure to have Ruth with me during both journeys from start to finish.

Finally I would like to thank the people behind the scene, who made it possible for me and others to do these large-scale collaborative projects.

1. The industrial Board members of the Foundation for the History of Technology, a unique organization in our field. The Board Members often passionately helped getting funding for projects and discuss history of technology insights.
2. The Board members of the Technical University of Eindhoven who always have supported history of technology research and teaching at their university.
3. The staff members of the Foundation, in particular Jan Korsten, with whom I have worked together since 1998 and without whom the Foundation would not exist and TIN-20 and Tensions of Europe would not have been possible.
4. Last but not least all personal assistants. It would not have been possible to work on all these networked collaborative projects without their support: Lidwien Kuipers, Sonja Beekers, Iris Custers, and currently at the Science Policy Research Unit – SPRU, Pip Bolton.

I am working with a new group of wonderful colleagues at SPRU on Second Deep Transition issues. In doing this, I will seek to employ the historical imagination. Our world in transition is facing grim, difficult and urgent problems. We are not in the position to stay complacent. A sense of urgency is necessary without, however, nurturing fear since, as Andy Stirling one of

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[18] Published in Rip and Kemp, *Technological change.*

[19] See for example Oldenziel, Making Technology Masculine; Oldenziel, and Hård. *Consumers, Tinkerers, Rebels*.

[20] Schot et al. eds., *Techniek in Nederland in de Twintigste Eeuw.*

[21] http://www.tensionsofeurope.eu/www/en/files/get/Intellectual_Agenda.pdf (accessed March 8, 2016).

[22] For volumes are published as of March 2016, two others are expected in 2016. See http://www.makingeurope.eu/www/en/bookseries (accessed March 8, 2016)

my colleagues at SPRU, has argued, this closes down debate and leads to bad solutions.[23] During his entire life, the founder of SPRU, Chris Freeman embraced an "Economics of Hope" which embodies a positive view of the potential of mankind to use its resources constructively.[24] In this spirit, I would like to finish this address expressing my hope that many more historians of technology will engage with our world in transition.

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[23] Stirling, Andy. 'Towards innovation democracy'?

[24] Freeman, *Economics of Hope*.

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