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The unsolicited rocket: a story of science, technology, and future wars

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ABSTRACT
This article investigates the puzzling case of the unsolicited rocket: a Norwegian research establishment successfully developed a weapon system that no one wanted or had asked for that was later widely adopted. We argue that the 'Terne' weapon existed not because it was needed based on rational calculations about efficiency, but because of the narratives, coalitions, and competitive dynamics that surrounded it and made it useful. Conventionally, war and technology are often considered distinct 'things' with immutable essences, used as variables to explain *other* phenomena, rather than being examined on their own terms. In this case, we focus empirically on the configuration of sociotechnical imaginaries, and the capacities for action that arise out of it. In foregrounding sociotechnical systems, this is not a case of the 'militarization' of civilian society and research in peacetime. Rather, agency lay in competitive networks of narratives and coalitions between technologies, individuals, professions, technological communities, military organizations, and funding bodies, together shaping how ideas and technologies become authoritative and dominant.

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The 'Terne' rocket was a weapon no one had asked for. It was unwanted on grounds of military need and efficiency. Yet, when the Norwegian Defence Research Establishment asked the Norwegian government for 1,5 million NOK to develop the weapon, it was granted 10.

Developed in the 1940s-1960s, 'Terne' was a rocket-born depth-charge. Whilst submarines were indeed seen as a threat in the years after the Second World War, there was no demand for the system from the Norwegian Armed Forces (see Bonde 1990).

The puzzle of how the Terne came to be developed and adopted despite the Norwegian Armed Forces seeing no need for it – arguing that it was neither a military necessity nor efficient in its own rights – is the core question this article seeks to engage with. Doing so, the paper aims to contribute to the study of the relationship between science, war and technology.

In the following pages, we claim that the relationship between science, technology, and war is characterized not primarily by a rational process marked by choice-situations, but by a contingent process of trial and error in an unpredictable, sociotechnical domain that

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spans beyond what a civilian-military duality would imply. Taking neither science, technology nor the military for granted, we argue that science writ large is important for how the military look at the world, including how the important element of 'efficiency' is narrated. In turn, treating the civilian and military spheres as a continuum, rather than as two separate worlds, science and technology themselves become dependent variables, influenced by social processes and context, but also shaping these processes and contexts. Our point is not that a certain technology is inefficient, but that technological processes of developing and adopting it depends on much more than rational calculations of efficiency.

This general insight is not new. Recently, much has been written on the social aspects of technology, not the least within the field branded as Social Construction of Technology (Bijker 1997). Increasingly, the co-production of science, technology and societies, as depicted within branches of Science and Technology Studies (STS) (Jasanoff 2004), has gained traction.[1] In addition, much of the received knowledge about science, technology and war, anchored in a limited selection of historical and social accounts, is increasingly coming under challenge in favour of historical accounts emphasizing the continuous co-constitution of war, science technology and societies (Sharman 2019, 17; Bousquet 2009; Edwards 1996; MacKenzie 1993). Furthermore, the distinction between 'civilian' and 'military' is questioned: recent feminist work and scholarship emanating from Critical Military Studies has recast ontologies where war and society are considered separate spheres, and where military logics 'corrupt' a supposed pristine civilian society, arguing instead for the 'co-extensiveness' of military and civilian worlds (Howell 2018; Bulmer and Eichler 2017; Seigel 2018). Exposing the fluctuating borders between the 'inside' and 'outside' of the military (Basham, Belkin, and Gifkins 2015) recent studies have argued that science and technology are not simply employed by or subordinate to war and the military but that knowledge claims about war are co-constructed through science and technology (Ford 2020).

Our contribution is situated within this scholarship and aims to further the debates around the relationship between science, technology war and the military through insights from STS applied to the development of a weapon no one had asked for. As such, we contribute to the literature in three main ways:

- we show how setting up an institute for military research, being able to influence national policy, and developing rocket-propelled anti-submarine weapons, resulted from a concatenation of contingent factors: narratives of experiences from the Second Word War, expertise from abroad, the authority to define problems, solutions, and assemble coalitions, status and prestige, and internal and external knowledge competition.
- in the case of the 'unsolicited rocket', we demonstrate that technological development and adaptation is not a linear account of instrumentalizing certain technologies, but a process of uncertainties and contingencies through which technologies emerge. This challenges many of the assumptions and empirical findings from other studies arguing that technological developments – although not progressing in a teleological linear fashion – answer-specific questions regarding perceived practical needs and are instrumentalizations of ideas about war.

- a map with boundaries between military and civilian territories would not fit the terrain here: The Terne is not a case of the 'militarization' of civilian society and research in peacetime (Laswell 1997). Rather, agency lay in specific relations – in a competitive network of narratives and coalitions between visions of particular technologies, individuals, professions, scientific and technological communities, military organizations, and funding bodies (Shah 2017), which can fall on either side of the 'society-military'-continuum.

This is our procedure: First, we address conventional takes on the development and adoption of technologies, critiquing determinist views of technologies which treat them as causal variables focussing on rational efficiency, and the notion that efficiency is a straightforward analytical criterium. Second, inspired by Science and Technology Studies, we introduce an alternative take on technological development and adoption as a non-linear process. Third, we operationalize this non-linear process through the concept of sociotechnical imaginaries (Jasanoff and Kim 2009), which we argue are expressed in three mechanisms; narratives, coalition-building, and competition. Finally, we demonstrate these three processes at work in the Terne case and how this shed new light on the relationship between science, technology, war, and the military.

Science, technology and war

One consequence of the traditional division between 'civilian' and 'military' worlds, is that war is seen as one object, whilst technology has been considered another, distinct object. Particularly in International Relations and Strategic and Security Studies, war has often been treated as a coherent phenomenon with an immutable essence and simplified characteristics driven by great battles. War is here either something to be explained – the causes of war, or how to win wars or prevent them – or the outcome of wars is an explanandum for larger processes such as the formation of the modern state or the structure of the international system (Barkawi and Brighton 2011; Kestnbaum 2005).

'Technology', similarly, is regularly treated as one, common 'thing' that can determine balances of power and outcomes of wars. Mainstream historical accounts have tended to present technology as deterministic and autonomous forces, as appearing from nowhere rather than purposively constructed by human actions and choices (Lindee 2020). Technology is all too often treated 'as a "black box", a primary explanans whose nature is itself inexplicable' (Bousquet 2017; also Hall and De Vries 1990, 506). This technology in turn induces major transformations in war, where the organizational and tactical change are considered mere adjustments to a new technological reality (Bousquet 2017).

Such views are prominent in neorealist and strategic studies. Technology is frequently an already given causal variable in which social and military outcomes are determined or caused by factors such as the number of tanks, missiles, airplanes or any other technological advance states can draw upon. Here, technology is a driver of change, but how technological objects come into being and their role in social action is rarely investigated. The driver of innovation is the anarchical system, or the inter-state security competition pushing states to innovate, emulate, be effective, or perish. Technological determinism, where the social and technological are considered separate domains, excludes the agency of humans in designing and engineering certain technologies with specific goals and problems in mind.[2]

When technologies are depicted as appearing out of nowhere and change global politics – be it information technologies driving forward a new era of 'globalization' or networked warfare or artificial intelligence – it often leads to an ahistorical and technological determinist position in which science and technology is beyond the control of human agents, progressing teleologically towards ever more complex systems.

War becomes a phenomenon that can be reduced to a technological problem and quantified according to input-output models in which technology is treated as one variable to calculate an output and solutions. Similarly, the 'military revolution' literature, which seeks to explain how some militaries prevail over others, is foremost interested in qualitative or quantitative changes in military organizations, leaving war and technologies as unexamined, given variables (Downing 1992; Knox and Murray 2001).

In sum, common assumptions concerning the effects and outcomes of the relationship between technology and war are those of

(a) *rational efficiency*: The important output of these calculations becomes efficiency: does the variable 'technology' influence the battlefield? Does it help you win battles? New technology can be effective and gives you an advantage. If it works, and is efficient in warfare and battles, it can give you the upper hand.
(b) *selection*: technologically driven transformations in warfare follow a survival-of-the-fittest logic. When you are successful, others will learn and emulate or counter your technology to survive. If they do not learn and adapt, they will be eliminated and selected out in military competition and repeated fighting (Sharman 2019; cf. Lee 2015).

How does this happen in practice? The relationship between technology and war also concerns the question of how knowledge and science is developed and used for (military) policy. Linear accounts of how knowledge and research is used are driven by either knowledge generation or by problem solving (Weiss 1979).

In *knowledge-driven* research utilization, basic research is conducted by expert communities. Policymakers or the military discover that some of the knowledge generated by this basic research happens to be useful to solve a policy problem. Basic research is then applied to a problem.

In *problem-driven* accounts, the process moves in the opposite direction: knowledge emerges in the first place to inform policy or pending decision, helping to solve a concrete policy problem. This is a situation in which science is seen as subordinate to war and the military and is the dominant account: experts and the military work towards the same goal, where experts help provide lacking knowledge or competence (Weiss 1979).

In these accounts, the process is rational and linear.

Our case of the Terne rocket corresponds to neither of the two dominant linear explanatory models: it is not a case of civilian developed technology adopted by the military, nor driven by a problem defined by the military. Rather, the Terne rocket was a weapon that no one in particular asked for. It was a result of the contingent coming together of narratives, coalition-building, and competitive dynamics across nations, professions, and groups. In other words, the development of the Terne cannot be accounted for using rational linear explanatory models.

The relationship between technology/knowledge and war is not necessarily driven by such rational decisions in concrete choice-situations. Neither the development of technology, nor how and why the military come to adopt and use it, is a rational linear process, but much more disorderly and contingent. One crucial reason for this are the difficulties in establishing what is efficient or not. For one, finding cause and effect in a very delimited field can be a lifelong struggle for social scientists and historians. We should not expect it to be more easily identifiable in what Clausewitz called the 'fog of war' – the realm of uncertainty (Sharman 2019).

The assumption that military organizations can evaluate their performance, learn and adapt, and select out those technologies that are inefficient are linked precisely to the idea that there is a tight cause-and-effect relationship between new technology and output on the battlefield. This assumption has been challenged in the literature. Jeremy Black, for instance, is keen to remind the military establishment of the stark difference between output in the form of battlefield efficiency and outcome in the form of strategic and political 'victory' arguing that 'technological proficiency does not determine end results' (Black 2013: xii). Victory and loss in war depends on a complex combination of factors, many of which are intangible, like morale and leadership (Sharman 2019, 19–20).

In short, the conditions required for assumptions about rational effectiveness are difficult to meet in the context of military competition and assessing the relative efficiency of technology in wars is extremely complicated (Sharman 2019). What is clear, however, is that when consulting historical empirics from the early modern period to the present, technology and dominance of the battlefield are *not* the main characteristics of military effectiveness, victory in war, or geopolitical success – wars are decided by varying combinations of contingent material and intangible factors (Sharman 2019, 7). Even so, common assumptions continue to suffer from simplified linear accounts that read developments on the battlefield as attributable to specific technologies (Bousquet 2017).

However, if technology is not developed and adopted because it is strictly rational and effective to do so, and if it is not a result of 'natural selection' or the survival of the fittest military organization or state, what can explain the relationship between technology and war?

Donald MacKenzie, in his now canonical study of nuclear missile guidance during the Cold War, argued that technological innovation and change was neither percentnatural nor inevitable. Instead, he contended, technologies are socially constructed in complex ways. Focusing on technological details, organizational rivalries, scientific personalities and strategic narratives around nuclear warfare, MacKenzie showed how the mutual shaping of these elements were in large part transformed 'from below', by the development of strategic ballistic missile guidance (MacKenzie 1993).

While MacKenzie's account is framed as a correction to technological determinism, this study and others emanating from social constructivism have tended to exclude the role and agency of the technologies. While granting 'actor' status to technologies might seem like a controversial move, research within the broad field of Science and Technology Studies (STS) have for a long time argued for the agential capacities of technologies (Acuto and Curtis 2014; Latour 2005; Suchman 2007). Technological objects and systems can surpass its intended use and directly or indirectly enable, constrain, mediate and shape certain ways of viewing the world, knowing the world, and acting in it.

What these studies show is that technological innovation and use is not merely instrumental, driven by practical needs or following linear teleological paths towards more complex technologies but emerge out of a network of relations wrought with scientific uncertainties and trial and error that condition its emergence. Such insights have profound implications about how we think about the relationship between science, technology and war, how certain technologies become meaningful and how means influence ends up to a point where they are turned into the only practical and rational option. Means are thus more than neutral tools as they alter the horizons on what can be known and acted upon, thereby having profound consequences for social, cultural and political practices (Latour 2002).

Moreover, not only have existing technological objects been shown to have agential capacities, but also, visions and ideas about future technologies have been shown to inhabit agential capacities as they enable or constrain certain narratives, practices, funds, and projects.

Sociotechnical imaginaries: a non-linear research strategy

If we take seriously the claim that neither war nor science and technology are isolated spheres, but interlinked sociotechnical phenomenon, we need to broaden the domain of its academic study accordingly. And if the links between knowledge, research and war does not follow a linear, rational process, we will also need to broaden the methodological tools we use, and the questions we ask.

A range of factors influence how technologies are developed, what technologies are adopted, and how efficient they are perceived to be. To better understand these processes, we turn to the concept of *sociotechnical imaginaries*.

Imaginaries have a long tradition in political science following Benedict Anderson's book *Imagined Communities* (Anderson, 1983), and is frequently applied in Science and Technology Studies (STS) (see inter alia (Marcus 1995); (Jasanoff and Kim 2015); Fortun and Fortun 2005). Sheila Jasanoff defines sociotechnical imaginaries as

> collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology (Jasanoff 2015).

The concept of imaginaries has also been used in various ways by security, military and war scholars to gain a more nuanced understanding of what shapes security and military knowledge, decision and action (Coward 2013; Lawson 2011; Pretorius 2008; Öberg 2019). Sean Lawson, Martin Coward and Dan Öberg use the notion of military imaginaries to examine the set of assumptions and understandings that form a grid of intelligibility that is constitutive of certain ways of imagining the world and one's role in it. These studies all point to the importance of military theory, understood broadly as a set of concepts, doctrines assumptions and understandings, and 'truths', as guides to how the military collectively imagines and acts in the world. Often taken for granted to the point that they can be considered commonsensical to military professionals, such imaginaries create a unified image linking different conceptions of science, technology, war, organization and practice. Military imaginaries thereby help to produce systems of meaning, assigning logic and legitimacy to the armed forces, which in turn makes certain warfighting practices possible. Importantly, such imaginaries are also, at the same time, like sociotechnical imaginaries, future-oriented visions – descriptive of the world and prescriptive of how to attain this world using armed force. Imaginaries thus have material outcomes, and influence behaviour and the development of technologies, organizations, policy and warfighting practices.

If, as the above suggests, the relationship between technology and war is implicit and taken for granted, highly dependent on context, and cannot be theoretically determined a priori, how can we gain knowledge about it?

To effectively address issues concerning research, development, and integration of new technologies, we need more knowledge about the fundamental processes of how technologies are developed, and how some solutions and technologies become *authoritative* and *seen as* useful and efficient.

In her assessment of the relationship between technology and war, Susan Lindee asks, 'why do we know what we know and (therefore?) not know other things?'. The answer, she writes, at least begins with a consideration of political structures that supported and made sense of scientific and technological knowledge (Lindee 2020). In short, it is about how relevant actors define problems and concomitant solutions. This means that war and technology and its relationship may best be studied and understood through contextual explorations of how military imaginaries, technologies, organizations, practices and knowledges come together and the capacities for action that arise out of this (Suchman 2007). Arguing for bringing analytical attention to the ways in which imaginaries and technologies come together through design and engineering practices, Lucy Suchman argues we can get a better understanding of 'the ways in which technologies materialize cultural imaginaries, just as imaginaries narrate the significance of technical artefacts' (Suchman 2012, 48). Locating and studying imaginaries can thus enable us to get a better understanding of how certain narratives, practices and materialities of the military, war, science and technology are interlinked.

Fundamentally, the object of inquiry becomes how particular sociotechnical imaginaries engender the development of certain technologies and its adaptation and use. Whilst retaining the focus on visions of the future linked to advances in science and technology, to make such sociotechnical imaginaries more concrete and easier to handle in empirical research, we split the above definitions of imaginaries into three component parts – narratives, coalition-building, and competition (Figure 1).

Narratives are stories about cause and effect that include the past, present, and visions of the future. Actors then build **coalitions** spanning the military and civilian 'spheres' to support their preferred problematizations and solutions that result from such narratives. This is not frictionless: such coalitions constantly need to defend, legitimize and justify their claims and differentiate themselves from others through internal and external **competition**.

Below, we illustrate how studying such narratives, coalition-building, and competition within sociotechnical imaginaries, is an alternative to assumptions about linear, rational efficiency or emulation. These components, we argue, can explain how some visions of

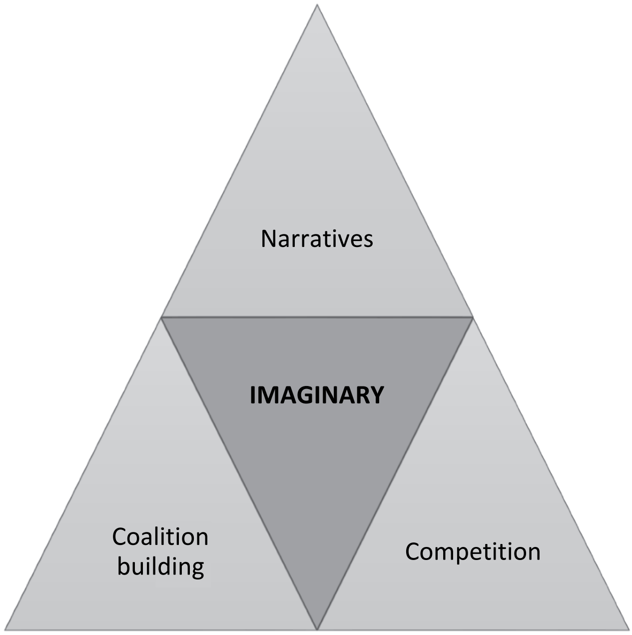

Figure 1. Sociotechnical imaginary.

war, technology and efficiency win over others and how these in turn come to serve as instruments for the legitimization and justification for developing weapons that 'no one wants'.

Yet, studying sociotechnical imaginaries in this way is not bound to any abstract theoretical logic: if we want to avoid determinism in either a technological rationalist or constructivist tapping, neither rational decisions nor our alternatives of narratives, coalitions, and competition should be excluded a priori or considered in isolation (Nexon 2012), but seen in concert with the technology in development.

As noted, what we problematize are linear accounts that treat developments on the battlefield as a consequence of efficient technology. Yet, considering the above, narratives about such consequences can *themselves* have an effect: the way the experiences from the Second World War were narrated shaped the behaviour and priorities of the Norwegian Defence Research Establishment (FFI)[3] even as the conditions changed.

Science, technology, and rockets in the north[4]

Our case shows how a particular socio-technological imaginary led Norway to develop 'a weapon that no one asked for' (Bonde 1990). Originally an anti-submarine weapon, the Terne was the first weapons system developed in Norway. Today, later iterations of this weapon, the Naval Strike Missile (NSM), and the multi-role Joint Strike Missile (JSM), are among the most advanced weapons systems at the disposal of many western military forces.

Terne's initial development took place at The Norwegian Defence Research Establishment Yet, the Norwegian military had expressed no demand for such a weapon (see Bonde 1990). Given the weapons help from the USA, the Norwegian Armed Forces and the Navy were not particularly interested in developing Norwegian weapons. They were sceptical of anti-submarine systems in general and the Terne project in particular. The Navy rather wanted traditional anti-ship capabilities, and encouraged a project on this, but the FFI was not interested (Njølstad and Wicken 1997, 149). Their assessment of technological developments was different from that of the Navy, and the FFI became the official 'advocate for rockets' within the military organization, arguing that traditional weapons were not efficient, and that there was an immediate need for rocket-driven anti-submarine weapons. The Norwegian authorities indeed chose to develop and adopt the Terne system, but not because of expressed military needs. When the FFI asked for 1,5 million NOK, it was granted 10 million, with reference to increased tensions in international politics (Njølstad and Wicken 1997, 71).

The decision to develop and adopt the Terne project was therefore not a linear process primarily based on concerns for military efficiency. The priority areas of science after the second world war, which still influence Norwegian defence industry and military planning, were a result not of rational calculations of needs or efficiency, or of emulating the success of others.

We rather show how setting up an institute for military research, being able to influence national policy, and developing rocket-propelled anti-submarine weapons, were due to a concatenation of contingent factors:

(1) Narratives about efficiency, based on experiences from the war.
(2) Coalition-building and networks, to gain the authority to define problems and their solutions.
(3) Internal and external knowledge competition, to defend independence and jurisdictions.

Narratives*: The Norwegian Defence Research Establishment and the Second World War*

Narratives are, at a minimum, a recounting of a succession of events, involving both past, present and future. The role of such narratives has gained traction in political science, as shared stories have been shown to be crucial to the emergence and maintenance of communities and their collective experiences (Shenhav et al. 2014, 661).

In the study of technology as well, narratives are central (see e.g. van der Laan 2016). Technological narratives are important for what features and uses of it are seen as crucial, and consequently how technologies are represented – in mass media and everyday life, or in military organizations and scientific professions. Narratives, and who tells them, thus affect how individuals and groups respond to technology, and can therefore impact how technology is developed, diffused, and used.[5] Narratives can even make the world seem narrower, limiting available courses of action. For instance, as Paul Edwards has shown, narratives surrounding the development of the computer created a closed, self-referential world. The computer was shaped by the discourses and narratives of the Cold War, and in turn, computer systems became the only viable and rational way of making decisions (Edwards 1996).

Taken together with our critique of linear models, this means that whilst efficiency does not serve us well as an *analytical* explanation for the adoption of new technology, *narratives about* efficiency can play a central part.

In studying the processes whereby problems and their solutions emerge in a bellicose sociotechnical context, narratives of *wars* have a central role: world-shattering experience of war will have institutional consequences and lock-in effects on military technology. The saying 'fighting the previous war' is well known, but the fundamental experiences of a war impact technology also through the institutional embeddedness of narratives about effectiveness. In the justification for granting the FFI more than what they asked for, narratives from the Second World War were frequently referenced.

The establishment of the Norwegian Defence Research Establishment in 1946, was a direct result of Norwegian scientists returning from the United Kingdom after the end of the War. Because there was no history of defence-related research in Norway, the evacuee experts in the UK were civilians, with experience in areas such as engineering, meteorology, and telecommunications (Robinson 2018; Njølstad and Wicken 1997).

When returning to Norway after the war, they brought with them knowledge and experiences from the UK in three areas in particular: radar, sonars, and rockets. And these areas precisely, became the priorities for the FFI. The establishment of the institute, and the priorities within it, was as such a direct consequence of the Second World War. In addition, the narratives of the decisive role technology played in winning the war shaped and legitimized the establishment of the institute and its focus areas. Whilst the dominant narrative in the USA was that the war had been won through strategic bombing, the Norwegian (and British) narratives diverged somewhat. Allied victory, it was told, had relied on scientific advances and the war was won because of radar and sonars – science, it was said in a report, had trumped raw power (Njølstad and Wicken 1997, 56). This narrative became dominant, also beyond the military. Norway should not be behind the curve. Legitimated based on these experiences from the war, the FFI became the institute for the newest, most recent military technologies, and led new professions, like meteorologists, to become involved in war and tactics (Njølstad and Wicken 1997, 32).

In revising a 3-year plan for the armed forces, the FFI was consulted. The plan had previously stated simply that the armed forces 'must be adapted to military technological developments'. In revising the 3-years-plan, scientists at the FFI were asked for an overview of the technological developments during the Second World War. In their overview report, a 'revolutionary' account of science during the Second World War was presented, also to wake up the conservative military establishment (Njølstad and Wicken 1997, 63). The crucial technological advances during the war that the FFI emphasized, corresponded precisely to their own areas of competence: electronics, radars and sonars, and rockets, in addition to nuclear technology (there was no mention of e.g. penicillin, synthetic rubber, computers, or aeronautics – other major inventions of the war). This narrative helped emphasize the perceived centrality of the institution.

The FFIs views eventually won out in government and were included in a white paper: the FFI was mentioned, and it was emphasized how there was a 'technological revolution', that Norway should not risk becoming stuck in old problems and challenges but must be 'up to date' – the military must be modernized based on science (Njølstad and Wicken 1997, 64).

The FFI's narrative of the most consequential technological developments of the war reflected their own areas of competence, including rockets. The FFI had become the official 'advocate for rockets' within Norway (Njølstad and Wicken 1997, 71).

Coalition-building: *International trends and Cold war developments*

How did these general views of war and technology take hold in Norway? Who had the authority to define and solve technological problems in warfare? Here, the political and institutional structures that support certain narratives and make sense of technological developments are crucial. That is, narratives have also been shown to matter for *coalition-building* and institutionalization (Shenhav et al. 2014, 662–663) – how actors and technologies come together, and the capacities for action that is the result (Lindee 2020).

For instance, to make territorial claims, scientists must devise both problems and their own solutions to them – as opposed to the solutions of others, be they internal or external. Since scientists cannot control how their knowledge is received and used by others, making coalitions, defending claims, and differentiating yourself from others is a never-ending process for scientists – to advance own careers, or the success of their research group or peers, and to assert their autonomy from other actors (Mukerji 1990).

From Norway, the FFI mobilized a coalition of actors from the USA and the UK, from the Navy, bureaucrats, and politicians so the FFI could make an independent decision to develop the Terne project (Bonde 1990).

After the war, and approaching the atomic age, a key question globally was how to organize cooperation between civilian research and the state. One publication, Vannevar Bush's book *Science: The Endless Frontier*, became a manifesto for this, arguing the importance of the linear model: knowledge-driven, basic research. This, Bush argued, would lead to applied research, which in turn would lead to technological developments and economic and industrial progress (Bush 1945).

From 1945 on, and particularly in the USA, it was precisely technology that acted as an agent of change in the relationship between war and the state. As technology became increasingly central to the military, the state became the sponsor for the development of defence technology (Chin 2019). Developments in *oceanography* was here of consequence for Norway in particular.

Norway has a long scientific tradition in oceanography, harking back to the polar explores and scientists Fridtjof Nansen and Otto Sverdrup. As such, oceanography was for long the only 'scientific market' for Norwegian science, and Norway participated in a triangular cooperation with the USA and the UK on mapping the North Atlantic. Yet, oceanography was not merely a scientific endeavour to solve scientific problem – it became imbricated in infighting in the US armed forces and found itself at the forefront of the tensions between science and the state (Njølstad and Wicken 1997, 154).

Both the military – the Navy in particular – and oceanographers shared a similar interest in mapping the oceans (Reidy, Kroll, and Conway 2007). Yet, their views of the utility of research differed. Whilst the scientists sought funding for basic research, the Navy considered oceanography useful to collect operational data for existing technology. The key interest of the military in this, was that if submarines knew of the oceanographic conditions, they would be able to navigate undetected from sonar systems – with obvious consequences for tactics (Njølstad and Wicken 1997, 154).

In 1946, with the coming of the nuclear age, Bernard Brodie had published *The Absolute Weapon: Atomic Power and World Order* on nuclear deterrence: 'thus far', he wrote, 'the chief purpose of our military establishment has been to win wars. From now on its chief purpose must be to avert them. It can have almost no other useful purpose'. The implication of this argument was that the traditionally oriented 'old guard' of the military was outdated: 'the relative importance of the army and navy in wartime would be considerably diminished if not eliminated' by the nuclear bomb (Brodie 1989, 71).

With the salience of deterrence, the traditional practical experiences of generals were rendered largely obsolete in this new world. With nuclear weapons, warfare became a blank slate to be filled with new knowledge, competence, and expertise. From Brodie's considerations on nuclear deterrence, a new intellectual community emerged – 'a power elite [. . .] whose power would come not from wealth or family or brass stripes, but from their having conceived and elaborated a set of ideas' (Kaplan 1983, 10). The military was outdated in what was now a mission to avoid war, rather than fighting one.

In the 1950s, the US Navy had been weakened after infighting with other branches of service as they were seen as superfluous to the nuclear doctrine (Hamblin 2002). Then, it was these scientists themselves, who suggested the Navy might not be so irrelevant to nuclear doctrines after all. The oceanographic scientists were the ones recommending nuclear weapons to be included in the Navy's strategy. One reason for this was that oceanographic research and expensive expeditions needed funding, and these were funded mainly by the Navy. Funding was now diminishing, given the side-lining of the Navy in nuclear doctrines. Still, some Navy officials wanted to invest in basic research even in lieu of clear immediate operational gains and continued to pour money and logistical support into oceanographic expeditions (Oreskes 2021; Hamblin 2002). The Navy, therefore, maintained their intimate coalition with oceanography regarding the development of marine technology.

This paid off: during their expeditions, the oceanographers discovered that the ocean consisted of different layers, with varying degrees of salinity and thermal conditions, where submarines potentially could hide from sonars. A massive lobbying campaign triggered increasing funding, and affected US nuclear strategy, of which submarines eventually became a part. Even if Brodie had predicted the Navy's obsolescence, he later acknowledged that sea power and submarines would be crucial to nuclear retaliatory capabilities or so-called second-strike capabilities, which was seen as crucial to nuclear deterrence and the policy of Mutual Assured Destruction (MAD) (Zellen 2015).

Previously, researchers would typically have argued that basic research might lead to new technology, as a side-effect, whilst the Navy wanted research to gather operational data for existing technologies.

Expert communities and scientists may gain both autonomy and dependence through external funding and coalition-building. The question for scientific actors become, how can we make the powerful dependent on our expertise? The knowledge should have just enough practical implications to be of interest to outsiders. As seen in the case of the oceanographers, autonomy can be used as an argument in getting money from the state, whilst that money is used for scientific activities that furthers theory and institutional autonomy (Mukerji 1990).

Harald U. Sverdrup, a famous Norwegian oceanographer with strong ties to the research community in the US (see Munk and Day 2002) considered it impossible to finance a military research institute in Norway. Sverdrup experienced a 'mismatch between the costs of pure and applied science. The latter, used in warfare, costs too much'. He predicted the FFI would become an industrially oriented institute. The institute was early on focussed on dual-purpose technology and Norwegian industry. However, with these Cold War dynamics, things changed also in Norway. With the nuclear bomb and the Cold War, there was a new drive for new technology and research, and this drive could be 'exploited' by scientists and military branches alike. The relationship between war and technology have of course been an intimate one. Still, the *perceptions* of the role of technology in warfare changed exponentially after the Second World War and through the Cold War. Technology became almost more important than the practices of warfare itself – the scientist became the 'commander in charge' (Hamblin 2002, 2011).

How to structure the relationship between science and war became a central problem, also in Norway. International cooperation and coalition making became even more crucial during the cold war. Nuclear technology, for one, became a focus for the FFI in part because of the coalitions and networks maintained by the nuclear scientist Gunnar Randers; in terms of sonars and submarine warfare, the director of the institute – Fredrik Møller – was an expert on asdic research and submarine warfare. Norway's status as a pioneer in oceanography resulted in personal connections and stakes in the tensions that emerged during the Cold War as shown above. Another close international collaboration was with the UK, given the origins of the expertise of the scientists working at the FFI (Agar and Balmer 1998).

Norway was further one of the major recipients of US support globally in the 50s and 60s, and the USA was Norway's main supplier of weapons through the Mutual Weapons Development Program (MWDP). Norwegian doctrines and strategies were formulated in accordance with the available goods supply from the USA, and not vice versa (Græger 2016; Njølstad and Wicken 1997, 103). The extensive and increasing weapons help from the USA therefore made the FFI less interesting for the military. The FFI had to work actively to make coalitions to preserve their relevance and was lobbying for its own interests internally as the military increasingly came to define their own priorities (Njølstad and Wicken 1997, 107). This is an instantiation of the classical dilemma: the FFI depended on military needs, but also needed to assert their independent role and uphold their scientific identity, and to secure funding.

Based on their own capacities, which were in turn based on the experiences from the UK and the war, the FFI then proposed to focus on rockets. The FFI used their network to form coalitions between politicians, bureaucrats, the defence commission, and industry.

Within these coalitions, status and prestige played a part. American financial and moral support was a prerequisite for the development and the production of Terne. American funding was pivotal, and in 1959, the Norwegian Minister of Defence plainly stated that

> if the production costs were to be met within the limits of the defence budget, it would not be justifiable from a military point of view to stake such large amounts on this project (quoted in Bonde 1990, 17).

However, later the FFI director Fredrik Møller reflected that

> what is more important is that the researchers at the FFI through this support have had the feeling that a superpower appreciates the results of their research and regards them as significant. This fact has probably also influenced our authorities and the armed forces (quoted in Bonde 1990, 21).

All these factors that had been building up since the inception of the institute, enabled coalition-building and the possibility to convince outsiders of the need for such a weapon.

***Competition**: scientists vs the military, old vs new*

The research institutions from where scientists operate are also social sites that organize the interaction between groups of technicians and scientists, and a variety of 'others' that compete to define problems and solutions, based on the knowledge they possess, and which they seek to protect and promote. The competition, controversies and conflicts involved in this encompasses both professional infighting over turf, and negotiations and tensions with outside actors. Institutes such as the FFI, are areas for competition and struggles, as well as platforms from which scientists can assert their scientific identity, and protect their interests, and as a political base to demand attention and autonomy. We then see conflicts when military personnel try to insert themselves in scientific activities (Mukerji 1990; Forman and Sánchez-Ron 1996).

In Norway, there was competition between old officers and young scientists over the role of technology – the 'Brodie-school' and abstract technological thinking, versus classical practical experiences. In addition to embodying a technological narrative and being a platform for coalition building, the Terne project was therefore also a means to assert the expertise, position, and independence of the FFI, to which the military explicitly voiced their opposition in connection with the project (see Bonde 1990).

Norwegian scientists had originally been recruited to the UK from Norway during the war, because of an acute lack of scientific expertise and engineers in the UK. In these processes, we see the early signs of competition between scientists and the military. Space on flights from Stockholm to London was limited during the war, and who boarded the planes was an expression of political priorities: the military opposed giving many scientists and engineers seats on these flights (Njølstad and Wicken 1997).

But also in Norway, there were tensions within the military ranks, between the old and new military leadership. Just as Bernard Brodie had argued that the traditional military organization, with their practical experiences of 'fighting the last war' had become obsolete, also in Norway the technical committee of the military staff (*Forsvarets* *overkommandos tekniske utvalg, FOTU*, a precursor to the FFI) argued that the established institutions were based on outdated thinking. The Second World War, they argued, had changed the demands on research and science.

Influenced by trends abroad, particularly through Helmer Dahl who had organized the Norwegian scientists in the UK, the defence staff argued that new science was needed to serve military needs – not only as basic research, but also as military technology (Njølstad and Wicken 1997, 45). Dahl had reasoned that science was 'a part of the apparatus of production', and that advantages in war would no longer be about raw materials and markets but would be afforded to those who could 'make rapid scientific progress' (Kirkeeide and Valaker 2000).

Given these views of the role of technology and science in war and strategy, the FFI could not cooperate with 'the old guard' in the Armed Forces and had to find allies elsewhere (Njølstad and Wicken 1997, 61). Yet, competition also emerged with established science and the universities. There was a strong orientation towards civilian research in Norway (Njølstad and Wicken 1997, 42), and as the FFI was set up to do military research, there was opposition from established science, at the universities and elsewhere. This was a moral opposition to military research, but also an expression of competition over resources, finances, and personnel – the institution would occupy resources, particularly given the development of new technologies, and the researchers at the FFI would receive higher salaries, and new titles outside of either the academic or military hierarchy. All of this were grounds for scepticism and critique.

Yet, the general impact of the FFI on long-term defence planning was significant. Not only did they have exclusive competence on technology, and on numerical and quantitative methodologies that could be used in planning and systems analysis (Maaø 2014), but they had also managed to establish a winning narrative and a coalition to win over the competition. Their role as advisor was used actively to strengthen their own position in the overall structure of the Norwegian Armed Forces (Njølstad and Wicken 1997). The result has been that the FFI had and continuous to have a direct influence on the formulation of central elements in Norwegian security and defence policy, including its strategic concepts (Græger 2016; Gjelsten 2001) shaping the possible ways in which war can be understood and how science and technologies fit into this sociotechnical imaginary.

To recapitulate, we wanted to make sociotechnical imaginaries more attuned to concrete empirical investigations and specified them as consisting of three components: a) *narratives* about cause and effect that are supported by different b) *coalitions* that legitimate their projects though internal and external c) *competition*. The resulting empirical analysis demonstrates the sociotechnical imaginary that emerged in the immediate post-world war era in Norway. The FFI established its narrative about war and the role of technology within it, established cross-cutting coalitions, and competed internally and externally, which produced a particular sociotechnical imaginary of past and future wars. This could justify developing a weapon that no one had asked for. Rather than an orthodox linear account of rational efficiency or emulation, we have highlighted the wider network of relations and contingent developments within it that condition the emergence, adaptation, and use of technologies.

Conclusion

If war and technology are considered separate 'things' that interact, a natural focus for strategic and military studies is on how the external variables 'war' and 'technology' trigger changes in military organizations. How, for instance, does the autonomous force of technology affect warfare, and can it help you win? These are questions of efficiency – new technologies appearing on the scene might give you an advantage.

The military gets hold of such technologies either by discovering that knowledge generated by civilian, basic research can solve a problem or, alternatively, by recruiting scientists and technologists to provide lacking knowledge or technological solutions to an already defined problem statement. These are linear accounts of a succession of rational choice-situations.

Through this paper, we have critiqued such determinist, instrumental and linear views of technological development and adaptation, and the notion that efficiency is a straightforward analytical criterium. Drawing on literature and theoretical and methodological accounts from the broad field of STS, we have shown how three mechanisms of socio-technological imaginaries – narratives, coalition-building, and competition – contributed to Norway developing a weapon no one had asked for. By empirically demonstrating the contingent emergence of the Terne rocket, we have challenged the assumptions that technological developments are a response to specific questions of practical needs and efficiency. While this is only one empirical case, it finds, as we have shown, support in a variety of literatures outside of the narrow confines of traditional IR.

The story of the Terne is not a tale of technology appearing on the scene, deciding the outcome of a war, and then being rationally incorporated into the armed forces through scientific research. Rather, work was needed to assemble and legitimize coalitions of scientists, military, and politicians to focus on science and technology, to set up an institute, to define areas of priority, and to put research into practice.

The point is not to deny that the development and adoption of new weapons were considered a military necessity, but that the process through which this happened, happened precisely the way it did because of an array of intervening social factors – a socio-technical imaginary that goes beyond the orthodox dichotomies of civilian-military.

The dynamics driving the early development of the Terne system forward were narratives about war and technologies, coalition building, and competition – including tensions between views of knowledge-driven versus operational research, conflicts over funding, and between the old and the new guard of the Armed forces. These lines of conflict are not specific to a Norwegian context but have been recurring in many contexts after the Second World War, into the Cold War era, and beyond. They do however have genealogies, a component of which has been addressed above in the relationship between visions of science and technology, the Cold War, the US Navy, and oceanographic research. Although the Terne is a particular case of a technology that no one wanted, the broader developments at play here indicates that our approach of focusing on operationalizing sociotechnical imaginaries holds potential to be of use also to other cases of technological development and war, both past and present and future.

Further, our account foregrounds a civilian-military *continuum*, rather than a dichotomy. An intimate collaboration between 'civilians' on the one hand, and 'the military' on the other, is not required to make explanatory accounts in the field of military technology. Nor is simply science subordinate to war and the military. Scientists developed the Terne independent of the Norwegian military, within a wider network of socio-technical relations of foreign funding, international scientific communities, domestic politics, narratives of war and technology, and internal and external competition and quests for authority. Fundamentally, these were processes where problems and solutions emerged, and where constellations of actors across sectors came to see the solutions as authoritative and support them.

In the end, the path on which the institute embarked, partially in their quest for independence and protecting scientific identities, also altered the orientation of the institute: paradoxically, seeking independence, the institute became more oriented towards the military and needs-oriented research (Njølstad and Wicken 1997, 248). The initial Terne-project was followed by Terne II and Terne III, Penguin, and eventually today's Joint Strike Missile (JSM), all leading to an increase in military research. Still, this is not a case of the 'militarization' of civilian society and research. Rather, agency here lays in webs of relations and specific pathways within a socio-technological imaginary composed of competitive networks of narratives and coalitions between individuals, professions, technological communities, military organizations, and funding bodies.

Therefore, the Terne rocket did not matter because it responded to a need grounded in military efficiency. Rather, the development and implementation of the weapons system shaped social, political, and institutional orders through the socio-technological imaginary that made it useful. This case of the unsolicited rocket therefore has potential to trigger new investigation into the winding roads of technological developments and adoptions, rather than assuming that there is an even landing strip for technologies into international politics.

Notes

1. For an excellent introduction of these fields to the question of World Politics see McCarthy, D. R. (Ed.). (2018). *Technology and world politics: An introduction*. Routledge.
2. See (McCarthy 2017) for an excellent discussion regarding the role of technologies in strategic studies.
3. *Forsvarets Forskningsinstitutt (FFI)* in Norwegian, is funded by the Norwegian Ministry of Defence and remains the main institution for defence-related research in Norway, advising the Armed Forces on issues pertaining to science and technology and strategy (https://www.ffi.no/en/about-ffi).
4. Much of the following account is based on the only proper historical work published on The Norwegian Defence Research Establishment: Njølstad and Wicken (1997), and Aslak Bonde's study of the organizational aspects of the development of Terne (1990).
5. The Royal Society 2017, «The stories we tell about technology: AI Narratives", https://royalsociety.org/blog/2017/12/the-stories-we-all-tell-about-technology-ai-narratives/

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References

Acuto, M., and S. Curtis, Eds. 2014. *Reassembling International Theory: Assemblage Thinking and International Relations*. UK: Palgrave Macmillan.
Agar, J., and B. Balmer. 1998. "British Scientists and the Cold War: The Defence Research Policy Committee and Information Networks, 1947-1963." *Historical Studies in the Physical and Biological Sciences* 28 (2): 209–252. doi:10.2307/27757795.
Anderson, B. 1983. *Imagined Communities: Reflections on the Origin and Spread of Nationalism*. London: Verso.
Barkawi, T., and S. Brighton. 2011. "Powers of War: Fighting, Knowledge, and Critique." *International Political Sociology* 5 (2): 126–143. doi:10.1111/j.1749-5687.2011.00125.x.
Basham, V., A. Belkin, and J. Gifkins. 2015. "What Is Critical Military Studies?" *Critical Military Studies* 1 (1): 1–2. doi:10.1080/23337486.2015.1006879.
Bijker, W. E. 1997. *Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change*. Cambride, MA: MIT Press.
Black, J. 2013. *War and Technology*. Bloomington: Indiana University Press.
Bonde, A. 1990. *The Making of Terne: The First Norwegian Weapons System 1953-1962*. Oslo, Norway: Norwegian Institute for Defence Studies.
Bousquet, A. 2009. *The Scientific Way of Warfare: Order and Chaos on the Battlefields of Modernity*. London: Hurst & Company.
Bousquet, A. 2017. "A Revolution in Military Affairs? Changing Technologies and Changing Practices of Warfare". *Technology and World Politics: An Introduction*, edited by D. R. McCarthy, Ch. 9, 165–181. London: Routledge.
Brodie, B. 1989. "The Atomic Bomb and American Security." In *US Nuclear Strategy*, edited by P. Bobbitt, L. Freedman, and G. F. Treverton, 64–95. London: Palgrave Macmillan.
Bulmer, S., and M. Eichler. 2017. "Unmaking Militarized Masculinity: Veterans and the Project of military-to-civilian Transition." *Critical Military Studies* 3 (2): 161–181. doi:10.1080/23337486.2017.1320055.
Bush, V. 1945. *Science, the Endless Frontier: A Report to the President*. Washington, D.C: National Science Foundation.
Chin, W. 2019. "Technology, War and the State: Past, Present and Future." *International Affairs* 95 (4): 765–783. doi:10.1093/ia/iiz106.
Coward, M. 2013. "Networks, Nodes and de-territorialised Battlespace: The Scopic Regime of Rapid Dominance." In *From Above: War, Violence and Verticality*, edited by P. Adey, 95–117. Oxford University Press.
Downing, B. 1992. *The Military Revolution and Political Change*. Princeton: Princeton University Press.
Edwards, P. N. 1996. *The Closed World: Computers and the Politics of Discourse in Cold War America*. Cambridge, MA.: MIT press.
Ford, M. 2020. "The Epistemology of Lethality: Bullets, Knowledge Trajectories, Kinetic Effects." *European Journal of International Security* 5 (1): 77–93. doi:10.1017/eis.2019.12.
Forman, P., and J. M. Sánchez-Ron, Eds. 1996. *National Military Establishments and the Advancement of Science and Technology*. Dordrecht: Kluwer Academic Publishers.
Fortun, K., and M. Fortun. 2005. "Scientific Imaginaries and Ethical Plateaus in Contemporary U.S. Toxicology." *American Anthropologist* 107 (1): 43–54. doi:10.1525/aa.2005.107.1.043.

Gjelsten, R. 2001. *Simulert Forsvar? Forsvarets forskningsinstitutt og Sjøforsvaret - ulike tilnærminger til forsvarsplanlegging*. Oslo, Norway: Norwegian Institute for Defence Studies.
Græger, N. 2016. *Norsk forsvarspolitikk - territorialforsvar og internasjonal innsats 1990-2015*. Oslo: Spartacus.
Hall, B. S., and K. R. De Vries. 1990. "Essay Review: The 'Military Revolution' Revisited." *Technology and Culture* 31 (3): 500–507. doi:10.2307/3106067.
Hamblin, J. D. 2002. "The Navy's 'Sophisticated' Pursuit of Science. Undersea Warfare, the Limits of Internationalism, and the Utility of Basic Research, 1945–1956." *Isis* 93 (1): 1–27. doi:10.1086/343244.
Hamblin, J. D. 2011. *Oceanographers and the Cold War: Disciples of Marine Science*. Seattle, WA: University of Washington Press.
Howell, A. 2018. "Forget 'Militarization': Race, Disability and the 'Martial Politics' of the Police and of the University." *International Feminist Journal of Politics* 20 (2): 117–136. doi:10.1080/14616742.2018.1447310.
Jasanoff, S., ed. 2004. *States of Knowledge: The Co-production of Science and Social Order*. New York: Routledge.
Jasanoff, S., and S.-H. Kim. 2009. "Containing the Atom: Sociotechnical Imaginaries and Nuclear Power in the United States and South Korea." *Minerva* 47 (2): 119–146. doi:10.1007/s11024-009-9124-4.
Jasanoff, S., and S.-H. Kim. 2015. *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*. Chicago: University of Chicago Press.
Jasanoff, S. 2015. "Future Imperfect: Science, Technology, and the Imaginations of Modernity." In *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*, edited by J. Sheila and K. Sang-Hyun, 1–33, Chicago: University of Chicago Press.
Kaplan, F. 1983. *The Wizards of Armageddon*. New York: Simon & Schuster.
Kestnbaum, M. 2005. "Mars Revealed: The Entry of Ordinary People Into. War among States." In *Remaking Modernity: Politics, Processes, and History in Sociology*, edited by J. P. Adams, E. S. Clemens, and A. S. Orloff, 249–285. Durham, NC: Duke University Press.
Kirkeeide, N., and T. Valaker. 2000. *Vitenskap og lidenskap: Historien om Helmer Dahl og det nye teknologiske Norge*. Bergen: Eide.
Knox, M., and W. Murray. 2001. *The Dynamics of Military Revolution, 1300-2050*. Cambridge, UK; New York: Cambridge University Press.
Laswell, H. 1997. *Essays on the Garrison State*. New Brunswick, NJ: Transaction.
Latour, B. 2002. "Morality and Technology: The End of the Means." *Theory Culture & Society* 19 (5–6): 247–260. doi:10.1177/026327602761899246.
Latour, B. 2005. *Reassembling the Social: An Introduction to Actor-Network-Theory*. Oxford: Oxford University Press.
Lawson, S. 2011. "Articulation, Antagonism, and Intercalation in Western Military Imaginaries." *Security Dialogue* 42 (1): 39–56. doi:10.1177/0967010610393775.
Lee, W. E. 2015. *Waging War: Conflict, Culture and Innovation in World History*. Oxford: Oxford University Press.
Lindee, M. S. 2020. *Rational Fog: Science and Technology in Modern War*. Cambridge, MA: Harvard University Press.
Maaø, O. J. 2014. *Vitenskap for politikk?: Systemgruppen ved Forsvarets forskningsinstitutt og norsk forsvarspolitikk fra 1950 til 1980*. PhD Thesis, NTNU.
MacKenzie, D. A. 1993. *Inventing Accuracy: A Historical Sociology of Nuclear Missile Guidance*. Cambridge, MA.: MIT Press.
Marcus, G. E., ed. 1995. *Technoscientific Imaginaries: Conversations, Profiles, and Memoirs*. Chicago: University of Chicago Press.
McCarthy, D. 2017. "Introduction: Technology in World Politics." In *Technology and World Politics: An Introduction*, edited by D. R. McCarthy, 1–21. London: Routledge.
Mukerji, C. 1990. *A Fragile Power: Scientists and the State*. Princeton: Princeton University Press.
Munk, W., and D. Day. 2002. "Harald U. Sverdrup and the War Years." *Oceanography* 15 (4): 7–29. doi:10.5670/oceanog.2002.02.

Nexon, D. 2012. "Historical Institutionalism and International Relations." *E-International Relations*, Accessed 16 April 2012. https://www.e-ir.info/2012/04/16/historical-institutionalism-and-international-relations

Njølstad, O., and O. Wicken. 1997. *Kunnskap som våpen: Forsvarets forskningsinstitutt 1946-1975*. Oslo: Tano Aschehoug.

Öberg, D. 2019. "Ethics, the Military Imaginary, and Practices of War." *Critical Studies on Security* 50: 1–11.

Oreskes, N. 2021. *Science on a Mission: How Military Funding Shaped What We Do and Don't Know about the Ocean*. Chicago: University of Chicago Press.

Pretorius, J. 2008. "The Security Imaginary: Explaining Military Isomorphism." *Security Dialogue* 39 (1): 99–120. doi:10.1177/0967010607086825.

Reidy, M. S., G. R. Kroll, and E. M. Conway. 2007. *Exploration and Science: Social Impact and Interaction*. Santa Barbara, CA: ABC-CLIO.

Robinson, S. A. 2018. *Ocean Science and the British Cold War State*. London: Palgrave Macmillan.

Seigel, M. 2018. *Violence Work: State Power and the Limits of Police*. Durham, NC: Duke University Press.

Shah, N. 2017. "Death in the Details: Finding Dead Bodies at the Canadian War Museum." *Organization* 24 (4): 549–569. doi:10.1177/1350508417700403.

Sharman, J. C. 2019. *Empires of the Weak*. Princeton: Princeton University Press.

Shenhav, S. R., O. Oshri, D. Ofek, and T. Sheafer. 2014. "Story Coalitions: Applying Narrative Theory to the Study of Coalition Formation." *Political Psychology* 35 (5): 661–678. doi:10.1111/pops.12072.

Suchman, L. 2007. *Human-machine Reconfigurations: Plans and Situated Actions*. 2nd ed. Cambridge: Cambridge University Press.

Suchman, L. 2012. "Configuration." In *Inventive Methods: The Happening of the Social*, edited by C. Lury and N. Wakeford, 62–74. London: Routledge.

van der Laan, J. M. 2016. *Narratives of Technology*. New York: Palgrave Macmillan.

Weiss, C. 1979. "The Many Meanings of Research Utilization." *Public Administration Review* 39 (5): 426–431. doi:10.2307/3109916.

Zellen, B. 2015. *Bernard Brodie and the Bomb: At the Birth of the Bipolar World*. PhD dissertation, Rovaniemi: Lapland University Press.