

A Framework to Integrate Ethical, Legal, and Societal Aspects (ELSA) in the Development and Deployment of Human Performance Enhancement (HPE) Technologies and Applications in Military Contexts

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ABSTRACT

In order to maximize human performance, defence forces continue to explore, develop, and apply human performance enhancement (HPE) methods, ranging from pharmaceuticals to (bio)technological enhancement. This raises ethical, legal, and societal concerns and requires organizing a careful reflection and deliberation process, with relevant stakeholders. We discuss a range of ethical, legal, and societal aspects (ELSA), which people involved in the development and deployment of HPE can use for such reflection and deliberation. A realistic military scenario with proposed HPE application can serve as a starting point for such an iterative and participatory process. Stakeholders can discuss this application, modify its features, and design appropriate processes around it – for instance, procedures for informed consent. We propose that organizing aspects into these three categories – ethical, legal, and societal – can help involve appropriate interlocutors at different moments: *legal* aspects with people in strategy or management roles, from the start of a project; *ethical* aspects with people in operations and medical roles, during development; and *societal* aspects with people in communication and personnel roles, during deployment. Notably, we developed and discussed this framework and the three aspects in close collaboration with personnel from the military.

KEYWORDS

Human performance enhancement; ethical aspects; legal aspects; societal aspects

1. Introduction

The increasing complexity and speed of military action puts ever higher physical and mental demands on soldiers (Billing et al. 2021). The use of scientific discoveries and technological innovation to optimize human performance has historically been and continues to be a core element of military activity (Raisamo et al. 2019). In addition to human performance optimization (HPO), for example, through better training, there

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is also an increasing interest in interventions and technologies to improve human performance *beyond* what is biologically achievable. The latter is often referred to as human performance enhancement (HPE) (Haggenmiller 2021). The military's interest in HPE is exemplified by a recent North Atlantic Treaty Organization (NATO) announcement that *biotechnologies and human enhancement* was selected as one of their nine priority technology areas (2023b). However, as acknowledged by NATO, the desire to optimize or enhance soldier performance also demands caution, care, and accountability of those involved in military decision making (2023a). Ethical questions, legal requirements, and societal concerns will need to be taken into account during the development, deployment, and governance of HPE (Davidovic and Crowell 2021; Howell 2017; Rice and Selman 2022; Saniotis and Kumaratilake 2020; Sattler et al. 2022; Van Baarle et al. 2022; Whetham et al. 2022).

1.1. Our contribution

Our work can be positioned within a broader international awareness of ethical, legal, and societal aspects in military HPE; see, for example: a hybrid framework, proposed by Lin, Mehlman, and Abney (2013), a discussion of the limitations of dual-use frameworks (Howell 2017), discussions of ethical issues of HPE by Defence Research and Development Canada (Girling, Joelle, and Alain 2017), a European ethical approach to HPE (De Boisboissel and Revue 2020), and a reflection on soldier enhancement by the French Ministry of Armed Forces (2020). Our aim is *not* to review these existing frameworks for HPE, as this was recently done by Whetham et al. (2022). Rather, our goal is to build on these frameworks and to further discuss and clarify several key concepts.

Moreover, we propose to distinguish, more clearly than is sometimes done, between ethical, legal, and societal aspects – rather than putting them all under the label of ethics, as is often done. We do this in sections 3, 4, 5, and 6. We first propose how such a distinction can be beneficial, and then identify and discuss several ethical, legal, and societal aspects that we believe are especially relevant.

Furthermore, we will discuss how people can use such frameworks in practice; we do that in sections 3 and 7. In addition, we provide examples of how the aspects from sections 4, 5, and 6 can be utilized in practice, using the example of one particular HPE, namely vagal nerve stimulation (VNS). We close the paper with a proposal – and, indeed, an invitation – to apply the framework that we present.

It is worth noting that we developed this framework and these aspects in collaboration with people from the Dutch military, with various backgrounds and roles, in a series of interviews and workshops.¹ This collaboration is meant to promote the practical applicability of the framework. Additional efforts may, however, be needed to make it interoperable with other military forces, both within and outside NATO.

1.2. Ethical, legal, and societal aspects

Questions about ethical, legal, and societal aspects of HPE have been asked for decennia, most notably from a bioethics perspective. We can also turn to the field of technology assessment (TA; Rip, Misa, and Schot 1995; Schot and Rip 1997), which has been used to assess aspects of new technologies that can have large impacts on society, such as

nuclear energy or genetically modified crops, or to its variations, such as participatory TA (Joss and Bellucci 2002) or constructive TA (Rip and Robinson 2013). We can also turn to approaches like value-sensitive design (VSD; Friedman and Hendry 2019; Friedman and Kahn 2003) and responsible innovation (RI; Grunwald 2014; Kiran, Oudshoorn, and Verbeek 2015; Stilgoe, Owen, and Macnaghten 2013; Von Schomberg and Hankins 2019). Crucially, these approaches involve not one-off, ex post assessments of particular applications – as if they need to pass an exam or get a rubber stamp. Rather, they involve organizing a participatory and iterative process of reflection, inquiry, and deliberation (Reijers et al. 2018; Steen 2021, 2023a, 2023b; Steen, Neef, and Schaap 2021), with various dialogues: between experts with different backgrounds, and with diverse stakeholders in society. Recently, and based on these traditions, an ELSA (ethical, legal, societal aspects) approach has been developed for the design and deployment of artificial intelligence (AI) systems (Van Veenstra, Van Zoonen, and Helberger 2021). The motivation is that AI systems can have large impacts on society, for instance when they are deployed in health care, education, or policing. HPE in the military is different in the sense that only a limited number of specific people (soldiers), in a specific context (military operations), are directly impacted.

In this article, we will build on these traditions and approaches, and propose a framework that can help people to apply an ELSA approach to the development and deployment of HPE in military contexts. A key element of our approach is that the people involved need to build a shared understanding of substance and context (Steen, Buijs, and Williams 2014); what type of HPE is being discussed, and how can it be used in operations? This is meant to prevent abstract discussions or answers, such as “it depends” – which is indeed the case: our evaluations of ethical, legal, and societal aspects *do* depend on the practical circumstances in which a specific HPE application is applied. In line with that approach, we first need to clarify what is meant by HPE – what technologies and applications we want to talk about. We also provide a practical example (VNS), which will recur in the remainder of our article.

2. Human performance enhancement

A good starting point to discuss HPE is the Multinational Capability Development Campaign (MCDC). Their report on *Human Performance Optimization and Enhancement* offers several definitions, which are supported by substantial international agreement. They define HPE as “the process of applying existing and emerging science and technology to individuals allowing them to exceed the biological potential of the individual” (Haggenmiller 2021, 13). Moreover, they put HPE under the umbrella term of “human performance modification,” which they define as the active or passive change of an individual’s performance.

A well-known category of HPE is biomedical or pharmaceutical enhancement, including examples such as the use of erythropoietin (EPO) and anabolic steroids to enhance physical performance (Friedl 2015), or amphetamines and Modafinil to enhance alertness or combat fatigue (Bower and Phelan 2003; Van Puyvelde et al. 2021).² Another category that is gaining attention is driven by neuroscience and neurotechnology (Brunye et al. 2022), with examples including brain–computer interfaces that translate brain signals to robot commands (Kotchetkov et al. 2010), neuroprosthetics that enhance

vision or hearing (van Velthoven et al. 2022), neurofeedback to regulate arousal in stressful situations (Faller et al. 2019), and various neurostimulation techniques (Brunye et al. 2022). The latter is a broad category, ranging from invasive applications, like brain implants, that can stimulate specific brain areas (Binkley, Politz, and Green 2021) to non-invasive applications, such as transcranial magnetic stimulation (TMS), transcranial direct current stimulation (tDCS) (Brunye et al. 2022; Feltman et al. 2019; Levasseur-Moreau, Brunelin, and Fecteau 2013), and VNS. In a recent study with the US Air Force, McIntire et al. (2021) tested VNS as a method to restore cognitive performance under sleep deprivation. The results showed that sleep-deprived individuals who received VNS were more aroused, performed better on multi-tasking tasks, and felt less fatigue compared to the control group (McIntire et al. 2021). In another study, VNS also showed a considerable improvement in learning and retention (McIntire, Goodyear, and McKinley 2019). In order to focus and ground our discussion of ethical, legal, and societal aspects, we focus on the application of VNS to boost alertness in fatigued special forces operators, and start with a practical and realistic scenario; see Box 1.

Box 1: Scenario with vagal nerve stimulation (VNS)

Victoria works in the special forces. In high-risk settings or tasks, if and when she feels extremely tired, or after physically exhausting days and multiple nights with less than three hours of sleep, she can use VNS to boost her alertness. She does so via a small device that she wears behind her ear. She can easily attach and remove this device, akin to applying and removing a band-aid. VNS uses small electrical pulses to heighten alertness, without side effects. Each soldier can choose to administer the VNS themselves; the device allows for a maximum number of treatments per period of time. The mission's commander monitors the usage and can modify this maximum, allowing more or allowing less.

Note that there are multiple ways to implement this application; this is one way, and it functions as a starting point for reflection and deliberation. Variables could include the details that commanders can or cannot see, on the level of individual soldiers or groups of soldiers. Also, there could be differences in maximum dosage, depending on the type of mission, the current general state of the soldiers, or other factors.

3. Legal, ethical, and societal aspects

Below, we briefly mention various ethical, legal, and societal aspects, in order to clarify what we mean with these aspects, and to discuss several overlaps and differences between these three different types of aspects. The various aspects are discussed in more detail in sections 4, 5, and 6 respectively; there we also give reasons for focusing on these particular aspects.

3.1. Legal aspects

Discussions of *legal aspects* ideally start in the early phases of HPE research, development, and deployment, and continue throughout the process, in strategic decision making and in conversations with legal and medical experts. Typical questions are: *Is this permissible? What needs to be done to comply with relevant legislation and rules?* These discussions require proficiency with various domains of law: public international law, international humanitarian law, human rights law, and domestic law. We propose to focus on the following aspects: *legality*, *necessity*, *accountability*, and *autonomy*. The people involved will understand these aspects from a legal perspective (details below). For *legality*, this makes sense, as it is primarily a legal concept. However, concepts such as *accountability* and

autonomy can be understood also from an ethical perspective. For clarity, we have teased these apart and discuss them as separate aspects. We associate *accountability* in a legal sense with a top-down and retrospective view – with accountability in the military organization regarding an incident that has occurred. We propose this is different from an ethical aspect that we refer to as *responsibility*, which we associate with a bottom-up and prospective view – how soldiers deal with responsibility in an operation that has yet to happen. Likewise, we view *autonomy* as a legal aspect, and discuss a different ethical aspect, namely *agency*.

3.2. Ethical aspects

Discussions of ethical aspects can also take place from the start of research, development, and deployment. Moreover, such aspects are especially relevant *during* development and deployment, with regards to practical contexts such as operations and training. Many practical decisions will need to be made, and here ethical aspects are especially relevant. How exactly do we want to implement this technology, and how exactly can we train soldiers to use this technology appropriately? Typical questions are: *Do we want this? How can we better align this technology or application with our values?* Interlocutors can be people who are responsible for military operations and training, or experts on medical, military, or operational aspects. Typically, they will want to start from the perspective of soldiers (micro level) and also discuss the application within the military organization (meso level). Discussions on the *macro* level of society, however, we put under the heading of societal aspects (below). Furthermore, we propose to focus on the following aspects: *dignity, fairness, agency, and responsibility* (details below).

3.3. Societal aspects

Societal aspects can be discussed during all phases of research, development, and deployment. Possibly, they are most relevant in the later phases, during deployment. Such aspects will need to be discussed with people in strategy and in recruitment, because of the relation between the military and society, and with people in communications, and with civil society organizations (CSOs), non-governmental organizations (NGOs) or other stakeholders in public debate. Key questions are: *What effects can this application have on society? Is there support for it? and How can we better align this application to values in society?* Typically, the societal aspects of specific HPE applications will be relevant in discussions with ministers, members of parliament, policy makers, and journalists. These people have key roles in a democracy, in creating policies. Ideally, such conversations also involve the soldiers who will use these technologies, and people from NGOs or CSOs who can talk about societal concerns. We propose to focus on the following aspects: *impact, democratic control, alignment, and support* (details below).

4. Legal aspects

A relative advantage of legal aspects, compared to ethical and societal aspects, is that they are, to a large extent, codified in laws, regulations, and jurisprudence. We can turn to various sources of (international) law and distil legal aspects from these. For HPE, the

following legal regimes are applicable in armed conflicts, and can help to identify and discuss relevant legal aspects:³

- Public international law, which governs the relationship between subjects of international law, for example, *jus in bello* – law of armed conflict – which governs the way warfare is conducted, and also the Articles for Responsibility of States for Internationally Wrongful Acts (2001), which deals with states’ responsibilities;
- Human rights law, which focuses on rights and freedoms, as a basis for the relationship between governments and citizens. For our discussion, the most relevant are the European Convention on Human Rights (ECHR) and the International Covenant on Civil and Political Rights (ICCPR).

In addition, the following regimes are relevant, for procurement and training, on the state level:

- National law, for example, constitutional rights of soldiers (between state and soldiers), national military law (between the military organization and soldiers), labour law (in the military organization), and also tort law, liability law, and professional medical codes (between the military and soldiers and citizens), in cases of accidents.

Here, we will focus on *just war* (Walzer 2015) situations and on human rights law and international humanitarian law (IHL); the relevant human rights are the following:

- Right to life – codified in art. 2 ECHR, art. 6 ICCPR, and art. 2.1 of the Charter of Fundamental Rights of the European Union (CFR);
- Right to bodily integrity; protection against torture, and inhuman or degrading treatment or punishment; and human dignity – codified in art. 3 ECHR, art. 7 ICCPR, art. 1 and art. 4 CFR, and in domestic law, such as art. 11 of the Dutch Constitution;
- Right to privacy; respect for private and family life, home and correspondence – codified in art. 8 ECHR, art. 17 ICCPR, art. 7 CFR, and domestic law, such as art. 10 of the Dutch Constitution.

IHL covers two areas: it protects those who do not, or no longer, participate in fighting; and it puts restrictions on the “means of warfare,” in particular weapons and “methods of warfare,” such as certain military tactics. The basis of these restrictions can be found, *inter alia*, in article 36 of the Additional Protocol I of the 1949 Geneva Conventions, which requires a review of new means and methods of warfare.⁴ Human rights law and IHL are critical to strike a balance between humanity on one hand and military necessity on the other. From these sources, we selected several key aspects and propose to focus on these: *legality*, including the right to life; *necessity*, including considerations regarding effectiveness, subsidiarity, proportionality, and the right to bodily integrity; *autonomy*, including the right to privacy; and *accountability* – which we will discuss in turn.

We choose to discuss the *right to life* under *legality* because both are fundamental and black-or-white; there is a legal basis for the application of a certain technology or there is not; likewise, the right to life has this black-or-white quality. Furthermore, we discuss the

right to bodily integrity under *necessity* because for both, the degree can vary, depending on considerations of effectiveness, subsidiarity, and proportionality. One can argue that a relatively modest violation of bodily integrity, in terms of temporary discomfort, can be necessary. Moreover, we discuss the *right to privacy* under autonomy because privacy, including requirements of giving informed consent, can be understood as a form of autonomy.

4.1. Legality and the right to life

Legality forms the basis for any military operation that claims to be a *just war* (Walzer 2015). We will focus on the application of HPE in just war, assume that criteria for *ius ad bellum* are met, and aim to meet criteria for *jus in bello*. In the context of HPE, it is essential to consider the legality of developing and applying such technologies, as well as the extent to which a government can infringe upon the fundamental rights of soldiers, notably in terms of their right to life. The legality of HPE development and application can be found in national laws and regulations of the state(s) involved, and in fundamental principles of IHL: the principles of humanity; of distinction between civilians and combatants, and between civilian objects and military objectives; of proportionality; and of military necessity (ICRC n.d.). In addition, legality is also at play in terms of protecting the human rights of soldiers of the armed forces.

Key questions for legality are: *What is the legal basis for using this HPE application? And does this legally justify this HPE application in this specific case?* Directly related to these are questions about the right to life: *To what extent, and under what circumstances, can a state infringe the right to life of members of its armed forces?* Significantly, the right to life is guaranteed to everyone and no category of individuals can be excluded (art. 31 Vienna Convention on the Law of Treaties). Moreover, the European Court of Human Rights (ECtHR) has paid attention to the particularities of the military services (*Engel and others v. the Netherlands*, ECHR, 8 June 1976, para. 54). All signatories intend to include soldiers within the scope of the ECHR (some made reservations, but *not* to the right to life). Critically, there is (as of yet) no jurisprudence about whether, when or how states can limit the right to life of military personnel. Related to this would be the Smith case (UK Supreme Court, 19 June 2013, UKSC 41, para. 63), where the UK Supreme Court recognized, for the first time, that a state has obligations under Article 2 ECHR towards members of its armed forces in armed conflict. The challenge was to balance between the obligation to protect soldiers and the reality of war that is “inherently unpredictable” and a “dangerous business.” In IHL there is also the principle of *humanity*, which ensures the protection not just of the civilian population but also of belligerents (combatants), in The Martens Clause of 1899.

4.2. Necessity and the right to bodily integrity

First, we need to note that necessity cannot be seen as separate from legality; rather, military necessity is one of the fundamental principles of IHL (above). Furthermore, we can discuss and evaluate necessity in terms of effectiveness, proportionality, and subsidiarity. In a military context, necessity has been defined as follows: “That the only legitimate object which States should endeavour to accomplish during war is to weaken the military

forces of the enemy. That for this purpose it is sufficient to disable the greatest possible number of men” (The Saint Petersburg Declaration of 1868; see International Humanitarian Law Databases [n.d. a](#)).

The assessment of necessity for a specific HPE, with regards to IHL, happens when such a new technology is subject to a review in the light of Article 36 of the first additional protocol to the Geneva Conventions (AP I) (see International Humanitarian Law Databases [n.d. b](#)):

In the study, development, acquisition or adoption of a new weapon, means or method of warfare, a High Contracting Party is under an obligation to determine whether its employment would, in some or all circumstances, be prohibited by this Protocol or by any other rule of international law applicable to the High Contracting Party.

Moreover, necessity also has a meaning within human rights law, in particular as an element in determining whether an infringement upon a human right can be justified. Additionally, we can look at how the ECtHR understands *necessity* in the context of a “democratic society”; it assesses necessity in terms of effectiveness, subsidiarity, and proportionality.

Given specific military goals, mandate, and context we can ask, for some specific HPE application: *How effective is it, in practice? Are there other means with similar outcomes, but with less negative effects (subsidiarity)? How do the positive/desired effects compare to the negative/undesirable effects (proportionality)?* Such questions can help to evaluate potential violations of soldiers’ right to bodily integrity against criteria for effectiveness, proportionality, and subsidiarity. Moreover, these criteria can be used not only retrospectively, when a court evaluates a situation that occurred in the past, but also prospectively, to evaluate, develop, and modify a future application.

4.3. Autonomy and the right to privacy

Human autonomy is a key concept in human rights law, similar to human dignity. Sometimes, an HPE application can go “too far”; in such cases, both autonomy and dignity are violated. We understand *autonomy* broadly, in the sense of individuals’ abilities to act freely. Critically, we need to appreciate that autonomy and freedom have distinct meanings for people in a military organization – rather different from autonomy and freedom for civilians. Soldiers’ autonomy and freedom are shaped and bound by the military organization and mission they are part of.

With regards to autonomy, we need to look at *privacy*. Let us look at the application of vagal nerve stimulation (VNS). Imagine that some civilian needs VNS. They will talk with their general practitioner about the pros and cons and will give explicit permission for the procedure. This is how informed consent works for civilians. In a military context, however, this works differently. There are hierarchical structures, and a culture of obedience and loyalty. This does not mean that no informed consent is needed. But it can work differently. The information can be extensive in a training programme, because soldiers will need to improvise and thus need information to do that properly. Or the information can be less extensive, to avoid leaking classified information. Maybe the consent is implicit, assumed to have been given without formalities. Or maybe the consent is more explicit, because the stakes are higher – it is a military operation, and multiple lives are at stake.

4.4. Accountability

Accountability refers to a range of legal aspects that are at play: before a mission or operation, during a mission or operation, and after a mission or operation. (Below, we will contrast accountability – which we understand as a legal aspect – to look at the level of the military organization, retrospectively, with responsibility – which we understand as an ethical aspect – to look at the level of soldiers, prospectively.)

If we want to evaluate the aspect of accountability for some specific HPE application, we can look at how it affects processes of accountability. Does it promote or facilitate or improve the ways in which soldiers can be accountable? Or does it corrode or undermine or diminish the ways in which they can be accountable? In some cases, an HPE technology or application can create a gap in accountability or cause a lack of accountability. Such issues are well-known in the application of algorithms, notably in so-called *decision support systems* – notoriously, if (semi-autonomous) weapons are involved, and “meaningful human control” or “human oversight” are at stake (Santoni de Sio and Mecacci 2021; Steen et al. 2023; Verdiesen, Santoni de Sio, and Dignum 2021).

We can also turn to the Articles on the Responsibility of States for Internationally Wrongful Acts (ARSIWA) (United Nations 2005); these clarify the responsibilities of states when soldiers breach IHL or human rights law.

4.5. Discussion

We would like to point out that we take a *practical* view of these legal aspects, beyond the stereotype of law as setting boundaries and forbidding certain technologies or applications. We view the role of law as three-fold: to enable innovation – by creating legal certainty about what can and cannot be done; to mitigate risks and protect fundamental rights – in the case of HPE, especially the rights to life, bodily integrity, and privacy; and to create conditions for fair competition and choice – which is relevant from economic or business perspectives, for example to organize a common market in the EU (Van Veenstra, Van Zoonen, and Helberger 2021, 6). We view legal aspects as helpful in finding ways to develop and deploy HPE technologies or applications that are both permissible and effective.

4.6. An example: vagal nerve stimulation (VNS)

We can apply these four legal aspects in the practical case of VNS; see Box 2.

Box 2: Legal aspects

☐ **Legality:** What is the legal basis for using this HPE technology or application? Does it impinge on the right to life? If that is the case, is there sufficient basis to justify this?

The legal basis for deployment and application of VNS is the mandate to promote effective military operations – of course, under the assumption of a “just war.” The right to life is not at stake for VNS.

☐ **Necessity:** Is this HPE technology or application necessary, in terms of effectiveness, subsidiarity, and proportionality?

VNS is meant to boost soldiers’ alertness; we can look at clinical studies to assess its effectiveness. Furthermore, its impact on people and their functioning and health is very low; there are no substitutes that offer similar effectiveness with less impact, and VNS is proportional in terms of benefits against costs.

☐ **Autonomy:** How does this HPE technology or application affect individuals’ autonomy? Notably, we can look at soldiers’ dignity and rights to privacy and to bodily integrity (see also section 5.3, Ethical: Agency).

The way that VNS is envisioned (see Box 1), soldiers can, at any time, decide to use it or not use it; in such cases, it has very limited or no effect on people's autonomy. Their autonomy is, however, restricted in that commanders can monitor individual soldiers' usage of VNS, and can override the minimum or maximum dosage. Other aspects of autonomy are dignity, privacy, and bodily integrity; none of these are seriously at stake in applications of VNS.

□ **Accountability:** How does this technology affect the accountability of the military organization (top-down, backward in time) (see also section 5.4, Ethical: Responsibility)?

VNS has very limited or no impact on processes of accountability. This could, however, be different if the VNS is deployed differently. Imagine that commanders are fully in charge of administering the VNS, without any transparency or autonomy for the soldiers; in such cases, it would be unreasonable to hold individual soldiers accountable – there would be an “accountability gap.”

5. Ethical aspects

There are various approaches to integrating ethical aspects in the development and deployment of technologies. We can look at bioethics, notably at the four principles that Beauchamp and Childress (2013) discuss: *beneficence* (“do only good”; respect for human dignity); *non-maleficence* (“do no harm”); *respect for people's autonomy*; and *justice* (prevent discrimination).⁵ For the case of HPE, we modified these principles into four ethical aspects that we propose to focus on: *beneficence* into *dignity*; *non-maleficence* into *fairness*; *autonomy* into *agency* (also to distinguish agency, as an ethical aspect, from autonomy as a legal aspect; see above); and *justice* into *fairness*.

In addition, we can look at VSD, which was developed, some 20 years ago, in the field of human–computer interaction (Friedman and Hendry 2019; Friedman and Kahn 2003; Friedman, Kahn, and Borning 2013). They discuss the following values: *human welfare*; *ownership and property*; *privacy*; *freedom from bias*; *universal usability*; *trust*; *autonomy*; *informed consent*; *accountability*; *identity*; *calmness*; *environmental sustainability*; and *courtesy*. For HPE, some of these values are relevant. And, conversely, for HPE we may need values that VSD does not normally include. To cast a wider net, we looked at Frankena (1973), who compiled a list of values, ordered into six categories (building on and extending the “classic triad” of beauty, goodness, and truth): *Beauty*, *harmony*, *proportion*, *aesthetic experience*; *moral disposition*, *virtue*, *pleasure*, *happiness*, *contentment*; *truth*, *knowledge*, *understanding*, *wisdom*, *honour*, *esteem*; *life*, *health*, *strength*, *peace*, *security*; *love*, *affection*, *friendship*, *cooperation*; *power*, *achievement*, *freedom*, *adventure*, *novelty*. Out of these two lists, we chose to focus on the following values, and grouped these under the four aspects we already mentioned:⁶

- Human welfare (Friedman, Kahn, and Borning 2013), and honour, esteem, life, health, strength, peace, and security (Frankena 1973), under *dignity*;
- *Ownership and property* and *freedom from bias* (Friedman, Kahn, and Borning 2013), under *fairness*;
- Privacy, autonomy, informed consent, and identity (Friedman, Kahn, and Borning 2013), and moral disposition, virtue, friendship, cooperation, power and freedom (Frankena 1973), under *agency*;
- *Trust* and *accountability* (Friedman, Kahn, and Borning 2013), and *knowledge*, *understanding*, and *wisdom* (Frankena 1973), under *responsibility*.

Below, we will discuss these four ethical aspects, based on the literature, and also based on conversations we had with people from the military.

5.1. Dignity

By dignity we refer to human dignity: first, of the soldiers who use, or undergo, some HPE technology; and, second, of the various people they interact with – fellow soldiers, combatants, non-combatants or civilians, and their family and friends outside military contexts, when they are off duty. We can envision the practical usage of some HPE application and then assess whether human dignity is promoted or sustained, or whether it is diminished or corroded. For example, an HPE that supports soldiers' abilities to act with empathy and care towards others would promote human dignity, both their own and these other people's. Conversely, an enhancement that involves soldiers acting like a "cog in a larger machine" could corrode human dignity. Dignity is also key in Immanuel Kant's categorical imperative to treat people never only as means, but always also as ends in themselves. A litmus test would be whether a specific HPE application allows the person using it to act humanely towards others.

5.2. Fairness

Fairness refers to a fair distribution of benefits and risks, and to the minimization of burdens. It deals with *distributive justice* – with distributing plusses and minuses fairly. We can look at the military organization, and assess how plusses and minuses are distributed among different units or groups of soldiers; or at individual soldiers, and assess how plusses and minuses are distributed among them. It would be unfair if one group or person bears all the risks, while another group or person receives all the benefits. Typically, distributive justice is at play when resources are limited and decisions need to be made about how to distribute these resources – as is the case, for example, in health care.⁷

Fairness can refer to issues like stigmatization, discrimination, and exclusion: when one group or person is more or less forced to use some HPE application and therefore is stigmatized, discriminated against, or excluded, or (the other way around) when the HPE technology offers benefits and one group or person has access to it, and others do not. Fairness is also at play in (legal) discussions of proportionality. Think of the question whether a specific military application is fair, which is evaluated in terms of its benefits for one group; for example, the safety of own troops or of one group of civilians, and its costs for other groups, or the damages to opponents or to another group of civilians.

5.3. Agency

We already discussed autonomy as a legal aspect (above). Here, we use a different term, *agency*, to refer to a person's ability to act, and to similar aspects, like *freedom*, *self-determination*, and *privacy*.

For *agency*, we look primarily at the soldiers who use or undergo some HPE application. Critically, we focus on their roles and tasks in a military organization and operation, which are very different from those of civilians (non-soldiers). To a large extent, the agency of soldiers is shaped and bounded by the military organization and operation. Moreover, *agency* does not happen in a vacuum; rather, it interacts with the environment; there is agency "versus" structure (Bovens, van Baarle, and Molewijk 2023).

We therefore need to look also at social norms, organizational culture, the practical context of battle, and other factors in the soldiers' context. Likewise, we need to consider not only an individual soldier's agency, but also the agency of a team or group of soldiers. We can evaluate the *agency* aspect by assessing whether a specific HPE application will promote or diminish the involved soldiers' agency.

If we understand agency in terms of freedom, we can use Isaiah Berlin's (1969) distinction between positive and negative liberty: *positive* liberty is the ability to take control of one's life and realize one's goals; whereas *negative* liberty refers to the absence of obstacles, barriers or constraints. A specific HPE application can thus affect soldiers' *positive* liberty, if it enables them to do something, or, conversely, if it prohibits them from doing something; or it can affect their *negative* liberty, if it takes away obstacles or barriers, or, conversely, if it creates barriers to doing something.

Agency can also be understood in terms of privacy, as an ethical aspect. We can evaluate a specific HPE application by looking at the ways in which it invades the soldiers' bodies, or the effects it can have on their private, family, or social lives, outside the context of military service, during weekends or after service. For example, a pill that works for only 30 min and has no side effects would not violate soldiers' privacy. However, a device that merges with the body and has significant side effects will very likely violate their privacy. Lastly, we could mention that diverse other terms can be used to discuss agency; for example, *human autonomy*, in reference to interactions between people and AI systems (High-Level Expert Group on Artificial Intelligence 2019); or *self-determination*, in self-determination theory (Ryan and Deci 2017), which looks at autonomy, competence, and relatedness.

5.4. Responsibility

We already discussed how with *accountability* we refer to a legal aspect, and with *responsibility* we refer to an ethical aspect. We proposed to use the term *responsibility* to look at the level of individuals and to look ahead in time – for example, to discuss soldiers' responsibility in military operations that they plan to conduct. Critically, it is only in rare cases, notably of misconduct by individual soldiers, that such soldiers are held accountable as individuals; normally, soldiers' responsibility and accountability are understood on the level of the larger military organization.

An ethical perspective on responsibility involves two components: knowledge and control (Van de Poel and Royakkers 2011). One can be responsible only if one has some *knowledge*, about the current situation and about potential future situations, and some type or level of *control* – that is, some way to act and influence the situation. We already discussed *control* under *agency*. Now, knowledge needs to be understood in the military context, which requires, on the hand, intelligence ("situational awareness"), and, on the other hand, secrecy. Here, knowledge is not one-dimensional; more knowledge is not always better (or worse). Furthermore, knowledge is related to aspects like transparency. We can evaluate the aspect of responsibility thus by looking at whether a particular HPE application increases or decreases transparency. Moreover, responsibility is related to *dignity* and *agency*; soldiers' experiences of responsibility can affect their experiences of *dignity* and *agency*. Not understanding how an HPE application works can corrode one's experiences of dignity and agency. Finally, *responsibility* is associated with

decision making. We can look at how the deployment of a specific HPE application can affect decision-making processes, and how this can lead to more or less transparency, or to more or less agency.

5.5. Discussion

For all these ethical aspects, we gave examples of first-order effects. In addition, it may be worthwhile, in some cases, to look also at second-order effects. For example, if a military organization procures an expensive HPE application and provides it to particular soldiers, then we can compare that to providing an expensive training to particular soldiers, and expect that the organization can require that these soldiers do something “in return” – for example, that they tolerate some discomfort or give it back after service.

Furthermore, we expect that for these ethical aspects, medical personnel can play a critical role. We expect that they will have conversations with soldiers, either as part of some (legally required) informed consent procedure, or in the context of confidential (medical) conversations. Either way, medical personnel will need to be prepared to handle these conversations appropriately.

Moreover, it can be useful, in more elaborate analyses, to use different ethical perspectives to look at a particular case; notably, we can draw from *consequentialism*, *duty ethics*, *care ethics*, and *virtue ethics*.⁸ Virtue ethics may be especially relevant (De Vries 2020; LaCroix et al. 2014), because it can help to look at how a particular application can either help or hinder soldiers to cultivate relevant virtues (Vallor 2016), like courage or justice (classic virtues) or loyalty (military virtues) (Skerker, Whetham, and Carrick 2019).

5.6. An example: vagal nerve stimulation (VNS)

We can apply these four ethical aspects in the practical case of VNS; see Box 3.

Box 3: Ethical aspects

□ **Dignity:** How does this technology impinge on the **human dignity of soldiers** who use/undergo it – does it promote or sustained human dignity? Or diminish or corrode it?

The VNS device can be attached and removed easily, like a band-aid. Furthermore, its effects are relatively modest; it makes people feel less tired and more alert, like drinking coffee. It has no side effects. We estimate it will have very limited effects on human dignity. Moreover, we can organize its application in a way that enables agency (see below), which supports dignity.

□ **Fairness:** Are benefits (plusses) and costs (minuses) of this technology **distributed fairly** – between different units of the military organization, or between individual soldiers?

Both benefits and costs of using the VNS device are relatively small; comparable to those of drinking coffee. Also, VNS brings no side effects or harm or risks of dependence or addiction. As a result, questions concerning a fair distribution of benefits and costs (distributive justice) are not applicable.

□ **Agency:** How does this technology affect the **agency of soldiers** (ability to act; different from civilians)? Also: How does it affect their freedom, privacy, autonomy, self-determination (see also section 4.3, Legal: Autonomy)?

On the one hand, an individual soldier can choose to use the VNS or not, which supports their agency. The device can give a maximum number of doses per day/hour, to prevent abuse or dependence and thereby protect dignity and agency. On the other hand, a commander can monitor soldiers' usage and can modify the maximum (increase or decrease); this brings some questions about agency: the commander interferes with the soldier's freedom (but this is not unusual when one works in a military context).

□ **Responsibility:** How does this technology affect the **responsibility of soldiers**, during an operation (bottom-up, forward in time; in an organization) (see also section 4.4, Legal: Accountability)?

We expect that the VNS will have some effects on soldiers' responsibility. One can imagine that taking the VNS becomes part of working in a specific type of context or during a specific type of operation – soldiers are then effectively required to use VNS. This also brings questions about responsibility on the level of those in charge. Did they enable “their soldiers” to use the VNS? If not, they may be held accountable.

6. Societal aspects

In addition to the legal and ethical aspects, it makes sense also to look at the societal aspects of HPE. Some of the first things that come to mind here are the anticipation and assessment of potential impacts of a specific technology on society, which has been a concern in TA. This field has developed over the years, via constructive TA (Rip and Robinson 2013; Rip, Misa, and Schot 1995) and participatory TA (Joss and Bellucci 2002), into a cousin of RI (Fisher 2017; Van Est 2017). We need to acknowledge also that compared to ethical theory, which goes back to ancient Greece, and legal theory, which was largely developed in the eighteenth and nineteenth centuries, the study of *societal* aspects of technology is a relatively young field; it was developed in the second half of the twentieth century, by people like Lewis Mumford (1967) and Neil Postman (1993), under the heading of science and technology studies (Jasanoff et al. 1995). One theme that is typically addressed in such analyses of societal aspects is *power* – and the unequal distribution of power, often together with legal (Jasanoff 2016) and ethical (Haraway 2004) considerations. As a consequence, our discussion of societal aspects is relatively exploratory (compared to the ethical and legal aspects). We propose to focus on four aspects: *impact and spill-over*; *democratic control*; *alignment*; and *support*.

6.1. Impact and spill-over

The impact of HPE in military contexts will be limited to the lives of (hundreds or thousands) of soldiers, and, potentially, the people they interact with. This is different from the application of AI in health care or education, which can affect entire populations, i.e. millions of citizens. Quantitatively, the impacts are thus limited. We must, however, not underestimate the qualitative impacts of HPE on soldiers' lives. One can imagine all sorts of spill-over effects. Soldiers could take pills into the civilian context and share them with friends, as recreational drugs, on the weekend. Moreover, some HPE applications can have irreversible effects: when a modification to a soldier's body cannot be (easily) undone, or can raise issues regarding ownership; or when soldiers have used a prosthesis for years – can they keep these after their service ends? We can look at such impacts and spill-over effects, both on the level of society and on the level of the lives of soldiers and other people involved. These can be positive and desirable (and foreseen) or negative and undesired (and unforeseen). Furthermore, we may need to look both at short-term, foreseen or first-order effects, and at long-term, unforeseen or higher-order effects – where the former is easier than the latter.

6.2. Democratic control

Democratic control refers to the extent to which democratic institutions, notably the legislature and the executive branch,⁹ i.e. ministers, members of parliament, and government officials, can review and steer the development and deployment of HPE applications,¹⁰ in directions that are better aligned with values and norms in society (see below for *alignment*).

We propose that democratic control has at least two components. First comes the question whether, for example, a member of parliament can ask questions about a

specific HPE application. This depends on the level of secrecy around it. If there is a great deal of secrecy, it is hard to ask questions and exercise control. Second comes the question whether it is possible, for example, for a minister of defence, to exercise control over development and deployment. Can they have a meaningful discussion about legality and necessity, or about proportionality and subsidiarity, of a specific HPE application, and balance benefits and costs?

Some HPE applications require secrecy, which can be different towards soldiers versus towards the general public, to prevent military opponents, adversaries, or bad actors from obtaining sensitive information. This has an impact on transparency or communication, which can have an impact on public support for such HPE applications (see below for *support*). We can understand *democratic control* in terms of whether citizens, NGOs, or CSOs are effectively able to influence the development and deployment of a specific HPE application (see below for *alignment*).

6.3. Alignment

Alignment has been a key concern for RI (Von Schomberg and Hankins 2019); it refers to the alignment between, on the one hand, the development and application of a specific technology, and, on the other hand, concerns, needs, and values that are broadly endorsed in society.

Here, we can look at *public values*, like privacy, safety and security, human autonomy, control over technology, human dignity, equity and equality, and balance of power (Est et al. 2018). We can assess the degree or the quality of such alignment, for example by identifying values that are relevant to this technology (for HPE, this could be the *effectiveness* and the *safety* of soldiers), and by identifying values that are broadly endorsed in society (for HPE, this could be public *safety* and *human dignity*). In this example, there is alignment for *safety* (although we would need to explore what safety means in both perspectives), but there is possibly tension between *effectiveness* and *human dignity*. A very invasive HPE application, on the one hand, makes soldiers effective but, on the other hand, corrodes their dignity. RI can help to bring more clarity, and potentially also alignment, between these.

Critically, values can change over time. Notably, the relative weights of different values may change over time (Van de Poel 2018). At the moment (2023), national security is relatively important in Europe, due to the 2022 invasion by Russia into Ukraine, possibly at the cost of sustainability, in cases of shutting off gas supplies from Russia, in the 2022–2023 winter, which made many European countries turn to coal for energy. In the future, this prioritization or ordering of values may change. In the context of the climate crisis, for instance, countries can prioritize domestic and renewable energy, to protect national security.

6.4. Support and trust

We can look at *support* in two ways. First, we can assess whether there is support for a specific HPE application in society. This could involve an empirical and descriptive study. It can, however, also be approximated through a thought experiment: *Imagine that a journalist writes about this technology; how would the larger public*

react to that? Here, a complicating factor is that, in the last decennium or so, many people have lost trust in institutions and are vulnerable to disinformation or polarization – think of the distrust in governments that advised vaccinations in the recent Covid-19 pandemic.

If support is currently lacking, the people involved in development or deployment may look for ways to better align the technology to concerns in society (above), by organizing citizens' involvement (Steen and Nauta 2020) and using their findings to do so.¹¹

This brings us to the second way to look at *support*. One can organize interactions between government and society,¹² by involving citizens or societal actors (CSOs or NGOs) who speak on their behalf, during development or deployment, as forms of societal engagement (Grunwald 2014) or mission-oriented innovation (Mazzucato 2018). Such interactions can draw from participatory design, human-centred design, or VSD (Steen and Nauta 2020).

6.5. Discussion

Because the societal aspects are relatively new, we would like to make several remarks about the interactions between these aspects – also in order to facilitate further discussion and development of these aspects. We can illustrate the different aspects by imaging different arrows: for *impact*, you can imagine an arrow *from technology to society*; for *democratic control*, an arrow *from society to technology*; for *alignment*, you can imagine *two arrows* that point in the same direction (or not), one for society and one for the technology; and for *support*, an arrow *from society to technology*, also to illustrate the impact of citizens on technology development and deployment.

Moreover, *alignment* and *support* can be relevant for *recruitment of people* to join the military. They currently are citizens and will likely take their values with them when they become soldiers; they will expect some alignment between these values and the technologies they will use in the military. Second, one can involve potential recruits in discussions of HPE applications; if executed well, this can help to improve alignment, and motivate them to join the army because they experienced a positive example of alignment – which may be an important value for the current generation of recruits.

6.6. An example: vagal nerve stimulation (VNS)

We can apply these four societal aspects in the practical case of VNS; see Box 4.

Box 4: Societal aspects

□ **Impact:** What are the technology's positive or negative **effects** on the broader society, through spill-over effects into the private, family or social lives of soldiers, outside or after service?

We estimate that impact will not be a problem, since the effects of VNS are rather modest. However, measures will need to be put into place against spill-over (taking VNS devices into society; selling these devices). There are questions about ownership, but not about invasiveness or about irreversibility.

□ **Democratic control:** To what extent and how can democratic institutions, notably the legislature and the executive branch, **review and steer** the development and deployment of this technology?

There is little secrecy or sensitivity around VNS, so members of parliament or government officials can ask questions about it and exercise control over its application. What would be sensitive depends on the way in which it is administered – for example, if commanders can administer VNS remotely (instead of only modifying dosage), especially if “informed consent” is unclear.

□ **Alignment:** To what extent is this technology **aligned with values** in society, with public values, and to what extent can the technology be modified to better align with these values?

We estimate that VNS is aligned with values like safety and security, control over technology, and human dignity. Human autonomy and balance of power, however, can be of concern. They depend on the details of how the administering of the VNS is organized, notably on how “informed consent” is organized and on any “peer pressure” to use it.

□ **Support:** Is there support for this technology in **society**? And can we organize societal engagement, so that citizens (or CSOs or NGOs) can influence the development and deployment?

We would expect that there can be support for the deployment of VNS, especially if “our soldiers” use it in a just war situation. However, one piece of investigative journalism may bring the risk of corroding support; it is probably wise to communicate transparently about it (to avoid “scoops” or “sensation press”).

7. Discussion and conclusion

We can plot the legal, ethical, and societal aspects into one diagram: see [Figure 1](#). The aspects are placed so as to indicate overlaps. For example, the legal aspect of accountability is close to the ethical aspect of responsibility, and likewise for autonomy and agency. Furthermore, we can collate the questions that we articulated for the different aspects into one list, which could function as a worksheet; see Box 5. Note, however, that our advice is to use the items in this worksheet in a series of meetings with diverse people, in a participatory and iterative process (Steen 2023a, 2023b) – *not* in a one-off evaluation effort.

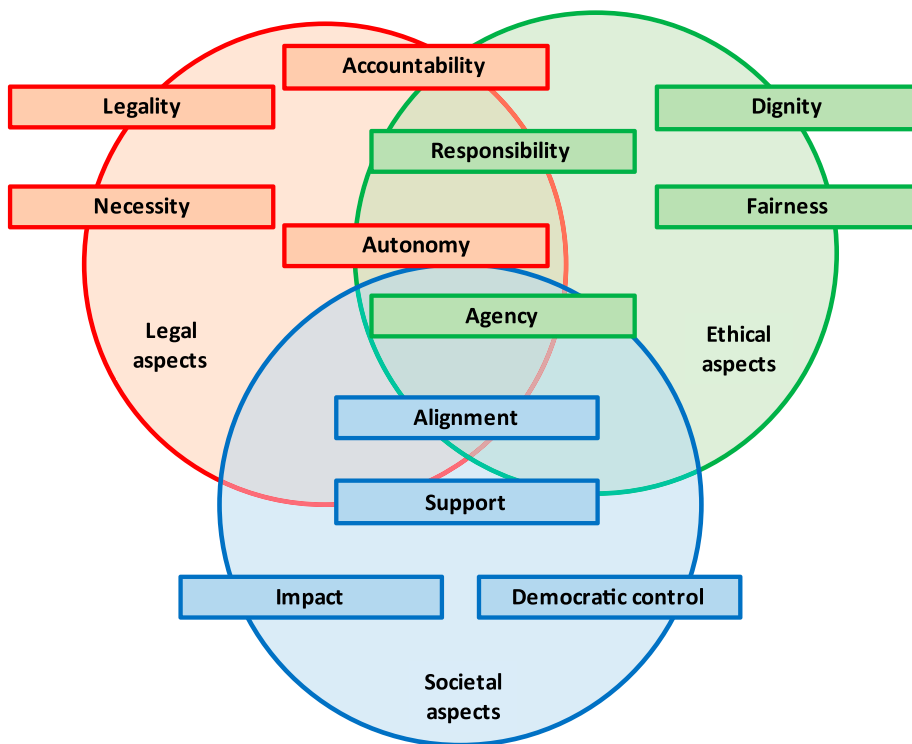


Figure 1. Legal, ethical, and societal aspects would need to be taken into account in the development and deployment of human performance enhancement in a military context.

Box 5: Worksheet: Ethical, Legal and Societal Aspects (ELSA) of Human Performance Enhancement (HPE)

Is there a focus for this particular discussion? On legal or ethical or societal aspects? On other topics?
.....

Legal Aspects: Is this permissible? What needs to be done to comply with the relevant legislation and rules?

- ☐ **Legality:** What is the legal basis for using this HPE technology or application? Does it impinge on the right to life? If that is the case, is there sufficient basis to justify this?
- ☐ **Necessity:** Is this HPE technology or application necessary, in terms of effectiveness, subsidiarity, and proportionality?
- ☐ **Autonomy:** How does this HPE technology or application affect individuals’ autonomy? Notably, we can look at soldiers’ dignity and rights to privacy and to bodily integrity (see also: Ethical: Agency).
- ☐ **Accountability:** How does this technology affect the accountability of the military organization (top-down, backward in time) (see also: Ethical: Responsibility)?

Ethical Aspects: Do we want this? How can we better align this technology with our values?

- ☐ **Dignity:** How does this technology impinge on human dignity of soldiers who use/undergo it – does it promote or sustained human dignity? Or diminish or corrode it?
- ☐ **Fairness:** Are benefits (plusses) and costs (minuses) of this technology distributed fairly; between different units of the military organization, or between individual soldiers?
- ☐ **Agency:** How does this technology affect the agency of soldiers (ability to act; different from civilians)? Also: How does it affect their freedom, privacy, autonomy, self-determination (see also: Legal: Autonomy)?
- ☐ **Responsibility:** How does this technology affect the responsibility of soldiers, during an operation (bottom-up, forward in time; in an organization) (see also: Legal: Accountability)?

Societal Aspects: Effects on society? Is there support? How can we align this technology with values in society?

- ☐ **Impact:** What are the technology’s positive or negative effects on the broader society, through spill-over effects into the private, family or social lives of soldiers, outside or after service?
- ☐ **Democratic control:** To what extent and how can democratic institutions, notably the legislature and the executive branch, review and steer the development and deployment of this technology?
- ☐ **Alignment:** To what extent is this technology aligned with values in society, with public values, and to what extent can the technology be modified to better align with these values?
- ☐ **Support:** Is there support for this technology in society? And can we organize societal engagement, so that citizens (or CSOs or NGOs) can influence the development and deployment?

Summary of (tentative, interim) findings:

Main concerns:
Action points:
Next steps:

Moreover, we can compare our framework with other frameworks, notably with the aspects that Lin, Mehlman, and Abney (2013) identified,¹³ and those that Whetham et al. (2022) identified;¹⁴ see Table 1.

From Table 1, we can draw several conclusions. First, our frameworks cover all the topics that Lin, Mehlman, and Abney (2013) and Whetham et al. (2022) identified. Second, we can look at the three parts of our framework:

- The *legal* aspects in our framework are (almost) identical to the other, existing frameworks;
- Our *ethical* aspects largely concur with the other, existing frameworks – but our understanding of (“bottom-up”) responsibility, on the level of individuals in a military organization or operation, and as consisting of knowledge and control, in contrast to our understanding of the legal (“top-down”) aspect of accountability, is new, which we propose is an added value;
- Our *societal aspects* include several relatively new topics: democratic control, alignment, and support. Some of the topics and concerns that we discussed under

Table 1. Comparison of aspects in our framework to aspects in frameworks by Lin, Mehlman, and Abney (2013) and Whetham et al. (2022).

Our framework	Lin, Mehlman, and Abney 2013	Whetham et al. 2022
Legal: Legality (and right to life)	Legitimate military purpose	Necessity/adherence with just war theory Compatibility with international legal frameworks
Legal: Necessity, proportionality (and right to bodily integrity)	Necessity Benefits outweigh risks	Necessity/adherence with Just War Theory Harm minimization Proportionality
Legal: Autonomy (and right to privacy)	Consent	Autonomy and consent Privacy
Legal: Accountability ("top-down")	Transparency Superiors are accountable	Accountability and transparency
Ethical: Dignity	Dignity is maintained	Humanity/human dignity
Ethical: Fairness	Burdens are minimized Fair distribution of risks and benefits	Fairness and justice Harm minimization
Ethical: Agency	Consent	Autonomy and consent Privacy
Ethical: Responsibility ("bottom-up")	Transparency Consent Superiors are accountable	(Possibly: accountability and transparency)
Societal: Impact	Fair distribution of risks and benefits	Restriction to military domain Broad societal implications
Societal: Democratic control	Legitimate military purpose Transparency	Accountability and transparency
Societal: Alignment	(Possibly: necessity)	(Possibly: broad societal implications)
Societal: Support	(Possibly: necessity)	(Possibly: broad societal implications)

democratic control are covered by legitimate military purpose and transparency (Lin, Mehlman, and Abney 2013) or accountability and transparency (Whetham et al. 2022). Possibly, some of the topics and concerns that we discussed under *alignment* and under *support* are covered by necessity (Lin, Mehlman, and Abney 2013) or by broad societal implications (Whetham et al. 2022).

Probably, compared to existing frameworks, our framework offers several opportunities to promote the active and creative involvement of diverse societal actors in development and deployment processes (democratic control, alignment, support) – indeed, that is our ambition, also in future research.

Lastly, we can discuss the practical application of our framework. First, we would like to reiterate that, ideally, our framework will be used as part of a participative and iterative process (Steen 2023a, 2023b) – *not* as a one-off evaluation, only at the start of research or only at the end of development. Second, we suggest that the distinctions we propose, among ethical, legal, and societal aspects, can help to organize conversations with different interlocutors at different moments in time: *legal* aspects with people in strategy or management roles, and with legal and medical departments, *from the start of the project*; *ethical* aspects with people in operations, medical, and training roles, during *development*; and *societal* aspects with people in communication and personnel roles, during *deployment*. The practical value of using these aspects – and, indeed, of the distinctions that we propose – will need to be tested and evaluated in practice. This will be a next step of our research. It will also involve explorations of

ways to practically implement and deploy such a framework within a military organization.

Notes

1. We conducted a series of interviews with diverse experts from the Dutch military, to understand their current ways of taking into account ethical, legal, and societal aspects in research, development, procurement, and deployment of new technologies: with a senior military staff advisor (OF-4), with military physicians (OF-4 and OF-5), with legal advisors within the military (OF-4), with an integrity expert within the military, and with academic experts in military law and military ethics. Moreover, to discuss an early version of our framework, we organized a creative workshop with diverse (other) experts from the Dutch military including military officers (special operations command, senior staff advisor, legal advisor – all OF-4), military physicians within land, air-assault brigade and air domain (all OF-4), an integrity expert within the military and academic experts in military law and military ethics. All these discussions helped to modify and further develop the framework that we present in this paper.
2. Other biological techniques, such as the gene-editing CRISPR-Cas, may not be used (yet) for HPE, but potentially could have an overwhelming impact on our world (Randhawa and Sengar 2021).
3. Note that we focus on HPE technologies and applications that *cannot* be used as weapons. Therefore, we can leave legislation for weapons out of our analysis and discussion.
4. Article 36 (see International Humanitarian Law Databases [n.d. b](#)): “In the study, development, acquisition or adoption of a new weapon, means or method of warfare, a High Contracting Party is under an obligation to determine whether its employment would, in some or all circumstances, be prohibited by this Protocol or by any other rule of international law applicable to the High Contracting Party.”
5. In the context of *information technologies*, notably of AI, Floridi et al. (2018) added a fifth principle: *explicability*, which includes intelligibility and accountability. We propose to leave out *explicability*, as it is not immediately relevant for HPE. It can, however, play a role in the larger sociotechnical system in which the HPE technology is used, when decisions on the application of HPE are made based on data and machine learning. In such a case, *explicability* can be included in the other aspects, notably dignity and agency.
6. Note that we found the following values not sufficiently relevant for HPE and therefore excluded them from our discussion: *universal usability*, *calmness*, and *environmental sustainability* (from Friedman, Kahn, and Borning 2013); and *beauty*, *harmony*, *proportion*, *aesthetic experience*; *pleasure*, *happiness*, *contentment*; *Truth*, *Love*, *affection*, *achievement*, *adventure*, *novelty* (from Frankena 1973).
7. When decisions need to be made about who should receive a costly medical procedure (or, in our case, an HPE technology or application), we can look at what type of person would benefit most; this can be expressed in terms of optimizing the number of quality-adjusted life years (QALY) vis-à-vis the costs involved. This may sound at odds with human dignity, but it may be practically necessary, if resources are scarce.
8. It can be worthwhile to use different ethical perspectives (Van de Poel and Royakkers 2011; Steen 2023b), where each offers a unique perspective, and together can create a more holistic view:

Consequentialism, to anticipate and assess diverse advantages and disadvantages, also across different groups or individuals: What are potential *positive* and *negative* outcomes? Which system boundaries are used; what aspects are included/excluded? How are positive and negative outcomes divided over different people or groups? What could be unintended and undesirable side effects?

Duty ethics, to identify duties and rights that are at stake, and find ways to combine and balance these: Does the organization have specific duties in this context? Does the innovation

align with these duties? How does the innovation impact on people's fundamental rights – for example, regarding human dignity, human autonomy, freedom, equality, and solidarity?

Care ethics, to acknowledge the importance of relationships, care, and justice, and to understand how technologies impact distributions of power between groups or individuals (Held 2006; Van Baarle et al. 2022): Which relationships or interactions are affected? In what ways could these relationships or interactions change – for better or for worse? What effects might there be on power distributions and differences, and on communication, collaboration, empathy, and care?

Virtue ethics, to evaluate how technologies can affect people's practical abilities to cultivate relevant virtues, like courage, justice, and self-control (Vallor 2016; Steen, Sand, and Van de Poel 2021): Which virtues are at play? For example, justice, courage, self-control, loyalty, care or obedience? Does it support people to cultivate these virtues? Or does it corrode or undermine them? Does it contribute to creating a society in which people can flourish and live well together?

9. Judicial institutions can also be very relevant when a court rules against some law or policy – see, for example, the ruling of The Hague District Court against the use of the SyRI (System for Risk Indication) algorithm to detect fraud of citizens: <https://www.rechtspraak.nl/Organisatie-en-contact/Organisatie/Rechtbanken/Rechtbank-Den-Haag/Nieuws/Paginas/SyRI-legislation-in-breach-of-European-Convention-on-Human-Rights.aspx>, accessed 2 December 2024.
10. We refer to the *quality of the process* via which democratic control can be exercised; the *content of such control* involves legal aspects, such as legality and necessity, and ethical aspects, such as dignity and autonomy.
11. Note that we do *not* recommend that governments use propaganda or “ethics washing”; rather, we would advise organizing careful interactions.
12. We could also have grouped *citizen involvement* under *democratic control*; we believe, however, that it makes more sense to put it here: as aiming to understand and promote support by the public.
13. Lin, Mehlman, and Abney (2013): Legitimate military purpose; necessity; benefits outweigh risks (“benefits ... must be greater than the risks to the warfighters and non-combatants”, 67); dignity is maintained; burdens are minimized (“burdens that an enhancement imposes on the warfighter”, 71); consent; transparency (“The military should inform the public about enhancement research and development, including the reasons why the military believes that the risks of the experiment or use are outweighed by the known or potential benefits”, 75); fair distribution of risks and benefits; and superiors are accountable (“the system by which the military holds superiors accountable for unreasonable acts must keep a lookout for unethical or illegal command decisions concerning enhancement use”, 76).
14. See Whetham et al. (2022), based on an analysis of various frameworks, notably with an international scope, including perspectives from Canada, France, the UK, the USA, and Israel: necessity/adherence to just war theory; humanity/human dignity; harm minimization; autonomy and consent; fairness and justice; accountability and transparency; restriction to military domain; privacy; proportionality; broad societal implications; and compatibility with international legal frameworks.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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References

- Beauchamp, T. L., and J. F. Childress. 2013. *Principles of Biomedical Ethics*. New York: Oxford University Press.
- Berlin, Isaiah. 1969. *Four Essays on Liberty*. Oxford: Oxford University Press.
- Billing, D. C., G. R. Fordy, K. E. Friedl, and H. Hasselström. 2021. "The Implications of Emerging Technology on Military Human Performance Research Priorities." *Journal of Science and Medicine in Sport* 24 (10): 947–953. <https://doi.org/10.1016/j.jsams.2020.10.007>.
- Binkley, C. E., M. S. Politz, and B. P. Green. 2021. "Who, If Not the FDA, Should Regulate Implantable Brain-Computer Interface Devices?" *American Medical Association Journal of Ethics* 23 (9): E745–E749. <https://doi.org/10.1001/amajethics.2021.745>.
- Bovens, Dave, Eva van Baarle, and Bert Molewijk. 2023. "Personal Health Monitoring in the Armed Forces – Scouting the Ethical Dimension." *BMC Medical Ethics* 24 (1): 21. <https://doi.org/10.1186/s12910-023-00899-9>.
- Bower, E. A., and J. R. Phelan. 2003. "Use of Amphetamines in the Military Environment." *Lancet* 362 (Suppl): s18–s19. [https://doi.org/10.1016/S0140-6736\(03\)15060-X](https://doi.org/10.1016/S0140-6736(03)15060-X).
- Brunye, Tad T., Monique E. Beaudoin, Kathryn A. Feltman, Kristin J. Heaton, Richard A. McKinley, Oshin Vartanian, John F. Tangney, et al. 2022. *Neuroenhancement in Military Personnel: Conceptual and Methodological Promises and Challenge*. Brussels: NATO Science and Technology Organization.
- Davidovic, Jovana, and Forrest S. Crowell. 2021. "Operationalizing the Ethics of Soldier Enhancement." *Journal of Military Ethics* 20 (3-4): 180–199. <https://doi.org/10.1080/15027570.2021.2018176>.
- De Boisboissel, Gérard, and Magdalena Revue. 2020. *Enhancing Soldiers: A European Ethical Approach* (enriched proceedings of the Euro-ISME symposium held on October 16, 2019 in Paris). Saint-Cyr: The Saint-Cyr Military Academy Research Centre and Euro-ISME.
- De Vries, Peer. 2020. "Virtue Ethics in the Military: An Attempt at Completeness." *Journal of Military Ethics* 19 (3): 170–185. <https://doi.org/10.1080/15027570.2020.1814048>.
- Est, R. van, E. de Bakker, J. van den Broek, J. Deuten, P. Diederén, I. van Keulen, I. Korthagen, and H. Voncken. 2018. *Waardevol digitaliseren: Hoe lokale bestuurders vanuit publiek perspectief mee kunnen doen aan het 'technologiespel'*. Rathenau Instituut: The Hague.
- Faller, J., J. Cummings, S. Saproo, and P. Sajda. 2019. "Regulation of Arousal via Online Neurofeedback Improves Human Performance in a Demanding Sensory-Motor Task." *Proceedings of the National Academy of Sciences* 116 (13): 6482–6490. <https://doi.org/10.1073/pnas.1817207116>.

- Feltman, Kathryn A, Amanda M Hayes, Kyle A Bernhardt, Emmanuel Nwala, and Amanda M Kelley. 2019. "Viability of tDCS in Military Environments for Performance Enhancement: A Systematic Review." *Military Medicine* 185 (1–2): e53–e60. <https://doi.org/10.1093/milmed/usz189>.
- Fisher, Erik. 2017. "Entangled Futures and Responsibilities in Technology Assessment." *Journal of Responsible Innovation* 4 (2): 83–84. <https://doi.org/10.1080/23299460.2017.1372061>.
- Floridi, Luciano, Josh Cowls, Monica Beltrametti, Raja Chatila, Patrice Chazerand, Virginia Dignum, Christoph Luetge, et al. 2018. "AI4People—An Ethical Framework for a Good AI Society: Opportunities, Risks, Principles, and Recommendations." *Minds and Machines* 28 (4): 689–707. <https://doi.org/10.1007/s11023-018-9482-5>.
- Frankena, W. K. 1973. *Ethics*. Englewood Cliffs: Prentice Hall.
- French Ministry of the Armed Forces Ethics Committee. 2020. *Opinion on the Augmented Soldier*. Accessed December 3, 2024. <https://finabel.org/wp-content/uploads/2022/07/IF-13.07.pdf>.
- Friedl, Karl E. 2015. "U.S. Army Research on Pharmacological Enhancement of Soldier Performance: Stimulants, Anabolic Hormones, and Blood Doping." *The Journal of Strength & Conditioning Research* 29 (Supplement 11): S71–S76. <https://doi.org/10.1519/JSC.0000000000001027>.
- Friedman, Batya, and David G. Hendry. 2019. *Value Sensitive Design: Shaping Technology with Moral Imagination*. Cambridge: MIT Press.
- Friedman, Batya, and Peter Kahn. 2003. "Human Values, Ethics, and Design." In *The Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies and Emerging Applications*, edited by Julie Jacko, and Andrew Sears, 1177–1201. Mahwah: Lawrence Erlbaum Associates.
- Friedman, Batya, Peter Kahn, and Alan Borning. 2013. "Value Sensitive Design and Information Systems." In *Early Engagement and New Technologies: Opening up the Laboratory*, edited by Neelke Doorn, Daan Schuurbiers, Ibo Van de Poel, and Michael E. Gorman, 55–95. Dordrecht: Springer Science + Business Media.
- Girling, Kimberly, Thorpe Joelle, and Auger Alain. 2017. *Identifying Ethical Issues of Human Enhancement Technologies in the Military* (Scientific Report. DRDC-RDDC-2017-R103). Ottawa: Defence Research and Development Canada.
- Grunwald, Armin. 2014. "Technology Assessment for Responsible Innovation." In *Responsible Innovation 1: Innovative Solutions for Global Issues*, edited by Jeroen Van den Hoven, Neelke Doorn, Tsjalling Swierstra, Bert-Jaap Koops, and Henny Romijn, 15–32. Dordrecht, The Netherlands: Springer Science + Business Media.
- Haggenmiller, Christian. 2021. *Human Performance Optimization and Enhancement*. Accessed December 3, 2024. https://gids-hamburg.de/wp-content/uploads/2021/04/2021-03-22_MCDC_HPEO_Project_Report_final-1.pdf.
- Haraway, Donna. 2004. *The Haraway Reader*. New York: Routledge.
- Held, Virginia. 2006. *The Ethics of Care: Personal, Political, and Global*. New York: Oxford University Press.
- High-Level Expert Group on Artificial Intelligence. 2019. *Ethics Guidelines for Trustworthy AI*. Brussels: European Commission.
- Howell, Alison. 2017. "Neuroscience and War: Human Enhancement, Soldier Rehabilitation, and the Ethical Limits of Dual-Use Frameworks." *Millennium: Journal of International Studies* 45 (2): 133–150. <https://doi.org/10.1177/0305829816672930>.
- ICRC. n.d. *Fundamental Principles of IHL*. Accessed December 3, 2024. https://www.icrc.org/sites/default/files/topic/file_plus_list/4046-the_fundamental_principles_of_the_international_red_cross_and_red_crescent_movement.pdf.
- International Humanitarian Law Databases. n.d. a. *Saint Petersburg Declaration*. Accessed December 3, 2024. <https://ihl-databases.icrc.org/en/ihl-treaties/st-petersburg-decl-1868/declaration>.
- International Humanitarian Law Databases. n.d. b. *Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I)*. Accessed December 3, 2024. <https://ihl-databases.icrc.org/en/ihl-treaties/api-1977?activeTab=1949GCs-APs-and-commentaries>.

- Jasanoff, Sheila. 2016. *The Ethics of Invention: Technology and the Human Future*. New York: Norton.
- Jasanoff, Sheila, E. Gerald Markle, C. James Petersen, and Trevor Pinch. 1995. *Handbook of Science and Technology Studies*. Thousand Oaks: Sage.
- Joss, Simon, and Sergio Bellucci. 2002. *Participatory Technology Assessment: European Perspectives*. London: Centre for the Study of Democracy.
- Kiran, Asle H., Nelly Oudshoorn, and Peter-Paul Verbeek. 2015. "Beyond Checklists: Toward an Ethical-Constructive Technology Assessment." *Journal of Responsible Innovation* 2 (1): 5–19. <https://doi.org/10.1080/23299460.2014.992769>.
- Kotchetkov, I. S., B. Y. Hwang, G. Appelboom, C. P. Kellner, and E. S. Connolly, Jr. 2010. "Brain-Computer Interfaces: Military, Neurosurgical, and Ethical Perspective." *Neurosurgical Focus* 28 (5): E25. <https://doi.org/10.3171/2010.2.FOCUS1027>.
- LaCroix, Alexandre R., Michael Burnam-Fink, Jai Galliot, Shannon Vallor, Shannon French, Keith Abney, Max Mehlman, and Patrick Lin. 2014. "Super Soldiers: The Ethical, Legal and Operational Implications (Part 2)." In *Global Issues and Ethical Considerations in Human Enhancement Technologies*, edited by Steven J. Thompson, 139–160. Hershey: IGI Global.
- Levasseur-Moreau, Jean, Jerome Brunelin, and Shirley Fecteau. 2013. "Non-invasive Brain Stimulation Can Induce Paradoxical Facilitation. Are These Neuroenhancements Transferable and Meaningful to Security Services?" *Frontiers in Human Neuroscience* 7. <https://doi.org/10.3389/fnhum.2013.00449>.
- Lin, Patrick, Maxwell J. Mehlman, and Keith Abney. 2013. "Enhanced Warfighters: Risk, Ethics, and Policy." *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.2202982>.
- Mazzucato, Mariana. 2018. *MISSIONS: Mission-Oriented Research & Innovation in the European Union: A Problem-Solving Approach to Fuel Innovation-led Growth*. Brussels: European Commission.
- McIntire, L., C. Goodyear, and A. McKinley. 2019. "Peripheral Nerve Stimulation to Augment Human Analyst Performance." 2019 IEEE Research and Applications of Photonics in Defense Conference (RAPID), August 19–21.
- McIntire, L. K., R. A. McKinley, C. Goodyear, J. P. McIntire, and R. D. Brown. 2021. "Cervical Transcutaneous Vagal Nerve Stimulation (ctVNS) Improves Human Cognitive Performance Under Sleep Deprivation Stress." *Communications Biology* 4 (1): 634. <https://doi.org/10.1038/s42003-021-02145-7>.
- Mumford, Lewis. 1967. *The Myth of the Machine (vol. I) - Technics and Human Development*. New York: Harcourt.
- NATO. 2023a. *Biotechnology and Human Enhancement Technologies: Transformational Innovation*. Brussels: NATO. Accessed December 2, 2024. <https://www.act.nato.int/article/biotechnology-and-human-enhancement-technologies-transformational-innovation/>.
- NATO. 2023b. *Emerging and Disruptive Technologies*. Brussels: NATO. Accessed December 2, 2024. <https://www.ncia.nato.int/about-us/technology-and-innovation/emerging-and-disruptive-technologies>.
- Postman, Neil. 1993. *Technopoly: The Surrender of Culture to Technology*. New York: Vintage.
- Raisamo, Roope, Ismo Rakkolainen, Päivi Majaranta, Katri Salminen, Jussi Rantala, and Ahmed Farooq. 2019. "Human Augmentation: Past, Present and Future." *International Journal of Human-Computer Studies* 131:131–143. <https://doi.org/10.1016/j.ijhcs.2019.05.008>.
- Randhawa, Shubhchintan, and Shatakshi Sengar. 2021. "The Evolution and History of Gene Editing Technologies." In *Progress in Molecular Biology and Translational Science*, edited by Dipanjan Ghosh, 1–62. Cambridge: Academic Press.
- Reijers, Wessel, David Wright, Philip Brey, Karsten Weber, Rowena Rodrigues, Declan O'Sullivan, and Bert Gordijn. 2018. "Methods for Practising Ethics in Research and Innovation: A Literature Review, Critical Analysis and Recommendations." *Science and Engineering Ethics* 24 (5): 1437–1481. <https://doi.org/10.1007/s11948-017-9961-8>.
- Rice, Gareth, and Jason Selman. 2022. "Sola Dosis Facit Venenum: The Ethics of Soldier Optimisation, Enhancement, and Augmentation." *Journal of Military Ethics* 21 (2): 97–115. <https://doi.org/10.1080/15027570.2022.2133372>.

- Rip, Arie, Thomas J. Misa, and Johan Schot. 1995. "Constructive Technology Assessment: A New Paradigm for Managing Technology in Society." In *Managing Technology in Society*, edited by Arie Rip, Thomas J. Misa, and Johan Schot, 1–12. London: Pinter Publishers.
- Rip, Arie, and Douglas K.R. Robinson. 2013. "Constructive Technology Assessment and the Methodology of Insertion." In *Early Engagement and New Technologies: Opening up the Laboratory*, edited by Neelke Doorn, Daan Schuurbijs, Ibo Van de Poel, and Michael E. Gorman, 37–53. Dordrecht: Springer Science + Business Media.
- Ryan, Richard M., and Edward L. Deci. 2017. *Self-determination Theory: Basic Psychological Needs in Motivation, Development, and Wellness*. New York: Guilford Publishing.
- Saniotis, Arthur, and Jaliya Kumaratilake. 2020. "Amphetamines, Cognitive Enhancement and Their Implications for Medical Military Ethics." *Journal of Military Ethics* 19 (1): 69–75. <https://doi.org/10.1080/15027570.2020.1776479>.
- Santoni de Sio, Filippo, and Giulio Mecacci. 2021. "Four Responsibility Gaps with Artificial Intelligence: Why They Matter and How to Address Them." *Philosophy & Technology* 34 (4): 1057–1084. <https://doi.org/10.1007/s13347-021-00450-x>.
- Sattler, Sebastian, Edward Jacobs, Ilina Singh, David Whetham, Imre Bárd, Jonathan Moreno, Gian Galeazzi, and Agnes Allansdottir. 2022. "Neuroenhancements in the Military: A Mixed-Method Pilot Study on Attitudes of Staff Officers to Ethics and Rules." *Neuroethics* 15 (1): 11. <https://doi.org/10.1007/s12152-022-09490-2>.
- Schot, Johan, and Arie Rip. 1997. "The Past and Future of Constructive Technology Assessment." *Technological Forecasting and Social Change* 54 (2-3): 251–268. [https://doi.org/10.1016/S0040-1625\(96\)00180-1](https://doi.org/10.1016/S0040-1625(96)00180-1).
- Skerker, Michael, David Whetham, and Don Carrick. 2019. *Military Virtues*. Havant: Howgate.
- Steen, Marc. 2021. "Slow Innovation: The Need for Reflexivity in Responsible Innovation (RI)." *Journal of Responsible Innovation* 8 (2): 254–260. <https://doi.org/10.1080/23299460.2021.1904346>.
- Steen, Marc. 2023a. "Ethics as a Participatory and Iterative Process." *Communications of the ACM* 66 (5): 27–29. <https://doi.org/10.1145/3550069>.
- Steen, Marc. 2023b. *Ethics for People Who Work in Tech*. Boca Raton: Routledge / CRC Press.
- Steen, Marc, Jan Buijs, and Doug Williams. 2014. "The Role of Scenarios and Demonstrators in Promoting Shared Understanding in Innovation Projects." *International Journal of Innovation and Technology Management* 11 (1): 1–21. Accessed December 2, 2024. https://marcsteen.nl/docs/Steen_Buijs_Williams_The%20role%20of%20scenarios%20and%20demonstrators_2014.pdf.
- Steen, Marc, and Joram Nauta. 2020. "Advantages and Disadvantages of Societal Engagement: A Case Study in a Research and Technology Organization." *Journal of Responsible Innovation* 7 (3): 598–619. <https://doi.org/10.1080/23299460.2020.1813864>.
- Steen, Marc, Martijn Neef, and Tamar Schaap. 2021. "A Method for Rapid Ethical Deliberation in Research and Innovation Projects." *International Journal of Technoethics* 12 (2): 72–85. <https://doi.org/10.4018/IJT.2021070106>.
- Steen, Marc, Martin Sand, and Ibo Van de Poel. 2021. "Virtue Ethics for Responsible Innovation." *Business and Professional Ethics Journal* 40 (2): 243–268. <https://doi.org/10.5840/bpej2021319108>.
- Steen, Marc, Jurriaan van Diggelen, Tjerk Timan, and Nanda van der Stap. 2023. "Meaningful Human Control of Drones: Exploring Human–Machine Teaming, Informed by Four Different Ethical Perspectives." *AI and Ethics* 3 (1): 281–293. <https://doi.org/10.1007/s43681-022-00168-2>.
- Stilgoe, Jack, Richard Owen, and Phil Macnaghten. 2013. "Developing a Framework for Responsible Innovation." *Research Policy* 42 (9): 1568–1580. <https://doi.org/10.1016/j.respol.2013.05.008>.
- United Nations. 2005. *Articles on the Responsibility of States for Internationally Wrongful Acts*. New York: United Nations. Accessed December 3, 2024. https://legal.un.org/ilc/texts/instruments/english/draft_articles/9_6_2001.pdf.
- Vallor, Shannon. 2016. *Technology and the Virtues: A Philosophical Guide to a Future Worth Wanting*. New York: Oxford University Press.

- Van Baarle, Eva M., Carlijn Damsté, Sanne A. J. de Bruijn, and Gwendolyn C. H. Bakx. 2022. "Moral Issues in Soldier Enhancement: Military Physicians' Perspectives." *Journal of Military Ethics* 21 (3-4): 198–209. <https://doi.org/10.1080/15027570.2023.2175861>.
- Van de Poel, Ibo. 2018. "Design for Value Change." *Ethics and Information Technology* 23:27–31. <https://doi.org/10.1007/s10676-018-9461-9>.
- Van de Poel, Ibo, and Lambèr Royakkers. 2011. *Ethics, Technology, and Engineering: An Introduction*. Chichester: John Wiley and Sons.
- Van Est, Rinie. 2017. "Responsible Innovation as a Source of Inspiration for Technology Assessment, and Vice Versa: The Common Challenge of Responsibility, Representation, Issue Identification, and Orientation." *Journal of Responsible Innovation* 4 (2): 268–277. <https://doi.org/10.1080/23299460.2017.1328652>.
- Van Puyvelde, Martine, Jeroen Van Cutsem, Emilie Lacroix, and Nathalie Pattyn. 2021. "A State-of-the-Art Review on the Use of Modafinil as A Performance-Enhancing Drug in the Context of Military Operationality." *Military Medicine* 187 (11-12): 1286–1298. <https://doi.org/10.1093/milmed/usab398>.
- Van Veenstra, Anne Fleur, Liesbet Van Zoonen, and Natali Helberger. 2021. *ELSA Labs for Human Centric Innovation in AI*. Netherlands AI Coalition. Accessed December 3, 2024. <https://nlaic.com/wp-content/uploads/2022/02/ELSA-Labs-for-Human-Centric-Innovation-in-AI.pdf>.
- van Velthoven, E. A. M., O. C. van Stuijvenberg, D. R. E. Haselager, M. Broekman, X. Chen, P. Roelfsema, A. L. Bredenoord, and K. R. Jongsma. 2022. "Ethical Implications of Visual Neuroprostheses - A Systematic Review." *Journal of Neural Engineering* 19:2. <https://doi.org/10.1088/1741-2552/ac65b2>.
- Verdiesen, Ilse, Filippo Santoni de Sio, and Virginia Dignum. 2021. "Accountability and Control Over Autonomous Weapon Systems: A Framework for Comprehensive Human Oversight." *Minds and Machines* 31 (1): 137–163. <https://doi.org/10.1007/s11023-020-09532-9>.
- Von Schomberg, Rene, and Jonathan Hankins. 2019. *International Handbook on Responsible Innovation: A Global Resource*. Cheltenham: Edward Elgar.
- Walzer, Michael. 2015. *Just and Unjust Wars*. 5th ed. New York: Basic Books.
- Whetham, David, Duncan Purves, Lorenzo Neruccio, Margaux Auzanneau, and Anicée Van Engleland. 2022. "Ethical Human Augmentation in the Military: A Comparison and Analysis of National and International Frameworks, Regulation, and Approval Processes." Research Square Preprint, posted July 20. Accessed December 2, 2024. file:///C:/Users/henri/Downloads/Ethical_Human_Augmentation_in_the_Military_-_A_Com.pdf.