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Personal Augmentation – The Ethics and Operational Considerations of Personal Augmentation in Military Operations

by Max Michaud-Shields

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Introduction

We stand at the dawn of an age when the confines of the imagination will be the only shackles barring the potential for increasing human performance. The resultant technologies will have the power to effect profound changes on military capabilities. They carry deep questions that should be addressed proactively. The question is no longer whether we can achieve military human enhancement. It is whether we should. This article highlights its attendant ethical and operational concerns. It seeks to serve as a guide to future capability development initiatives, and to initiate a discussion within the Canadian Armed Forces (CAF) with sufficient lead time to allow for conceptual and operational shaping to occur before we are left with no choice but to deal with these technologies. It therefore raises more questions than it answers, referring them to bodies that will be better placed to answer them. It also acts as a primer on the rapidly advancing technologies that could revolutionize the way the military operates.

Razor's edge: the future of soldier performance

Military forces have always sought an edge over opponents to ensure victory on the battlefield. Technological development has played a key role since the dawn of time, whether it was the use of bronze to forge stronger armour and better blades, or taking to the skies to gain a better vantage point from which to observe and attack the enemy. Western forces have embraced high technology, leading to the development of a plethora of capabilities designed to aid the warfighter. Unfortunately, they remain poorly integrated, leaving soldiers to bear increasing burdens as capability developers provide them with yet more means to detect and engage the enemy while being shielded by ever more layers of armour. Our soldiers carry far more into battle than is advisable for effective performance,[1] but have little choice if they wish to benefit from the capabilities

their advanced technology confers. Though much effort has been put into reducing the weight of carried loads through material sciences and clever engineering, it is unlikely that the advances will be made in the next two decades to reduce the loads by the 50–75 per cent needed to restore mobility to acceptable levels. Personal Augmentation (PA) may hold the key to allowing soldiers more easily transport loads, and even to provide them with capabilities hitherto unimagined.

DND photo AR2010-0320-33 by Sergeant Daren Kraus

The U.S. Army Natick Soldier Systems Center has defined PA as:

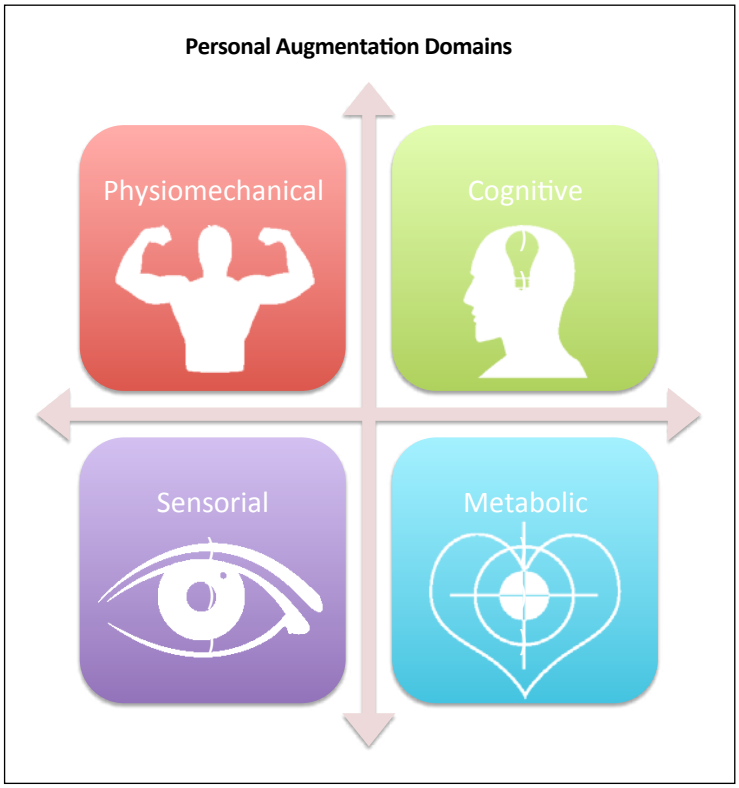
> *Technologies and concepts that provide improvements in strength, endurance and/or ergonomics while maintaining user safety and reducing muscular fatigue, physical injury, and soreness during various load carriage and various tasks, are of interest. Example load carriage tasks include heavy and repetitive lifting, load transport, and difficult load tasks in unique environments.*

A related terminology is "human enhancement," which bioethicist Eric Juengst defines as: *…a medical or biological intervention introduced into the body designed to improve performance, appearance, or capability besides what is necessary to achieve, sustain, or restore health*."[2] This definition is in keeping with previous bioethics literature.[3] However, the US military appears to favour alternative terms in order to reduce the risk of resulting adverse reaction to the studies in the field. Herein, we will mainly refer to the concept as PA to facilitate future interoperability and to retain all possible options. PA can be further subdivided into four domains:[4]

1. ***Physiomechanical***: Increase a user's strength, mobility, or protection. These generally focus on improving load carriage and endurance over long distances. Non-invasive methods can be simple, such as a knee brace, or extremely high technology, such as emerging exoskeletal and dermoskeletal systems.[5] Invasive measures could include strengthening bones.[6]

2. ***Cognitive***: Allows the user to better store, understand, and manage information in a timely and operationally pertinent manner, affecting awareness, attention, memory, planning, learning, language, and communication. Non-invasive solutions include meditation, and decision support systems. Certain pharmaceuticals, such as Modafinil, have demonstrated some positive effects upon the mind's function.[7] Recent work suggests that implanted chips may allow individuals to alter their recollection of events, or even to improve it.[8]

3. ***Sensorial***: Allows the user to perceive with greater accuracy, sensitivity, or in ways that would not otherwise be possible. Research is already under way to provide improved smell, hearing, touch, and taste. Current examples include night vision goggles and thermal weapon sights. Development efforts are continually and aggressively



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pursuing non-invasive sensors, but as improvements in nanotechnologies become available, the systems to ensure detailed and continuous biomonitoring,[9,10] discrete communications,[11] provide lighter displays,[12] and offering less cumbersome means to control the many systems at our soldiers' disposal, [13] these systems will come closer to the skin or eventually merge with the operator.

4. ***Metabolic***: Enhances a subject's physiological processes. They improve the subject's endurance, requirement for food and sleep, and their health. Some better-known examples include caffeine and anabolic steroids. They act over short, well-defined durations. Emerging methods can allow the body to continue functioning normally for moderate durations without breathing.[14] Other technologies require single or limited numbers of applications to effect permanent or prolonged changes to a subject's physiology. Examples include the Human Growth Hormone surreptitiously used by some athletes, and gene therapy, which is beginning to treat a wide variety of ailments, but can conceivably be used to enhance capabilities beyond the natural baseline, or even generate new ones altogether.[15] Synthetic biology provides the ability to synthesize completely novel genes, or indeed entire living organisms, and in the coming decades, it could lead to currently unimaginable paradigm shifts.[16] The Defence Advanced Research Projects Agency (DARPA) stood up the Metabolic Dominance project in 2004 to explore metabolic enhancement.[17]

Current capability development efforts pursue incremental improvements of diminishing margins, given the proximity in which we find ourselves with humanity's maximal potential performance curve. There is nowhere left to go without the aid of genetic variation or a 'helpful nudge' from pharmaceuticals. Soldiers will find themselves confronted with the same issue as athletes as they attempt to overcome an increasingly lethal and precise engagement space.[18]

Revision Military of the B-Temia Exoskeleton

Human enhancement can be achieved through biological means, those that affect the warfighter at the cellular level, or technical means, which are the result of the mechanical or electronic interface of man and machine. The Oxford English Dictionary defines cybernetics as: "…the science of communications and automatic control systems in both machines and living things." The Merriam-Webster dictionary offers the following medical definition: "…the science of communication and control theory that is concerned especially with the comparative study of automatic control systems (as the nervous system and brain and mechanical-electrical communication systems)." These definitions remain broad and transdisciplinary. In such terms it can apply to everything from engineering and biology all the way to management, art and education.[19] In some ways, it can even apply to the pen and paper.[20] It is not very helpful in framing the ethical considerations for military applications. We shall therefore define it as follows: *Cybernetic technologies are non-biological systems that require some degree of invasive interface with a human being in order to achieve their intended performance. They must provide enhanced or altogether novel performance that would be unachievable by a person in her natural state.* Military cybernetics is the set of technical solutions that lie in the invasive portion of the spectrum of PA.

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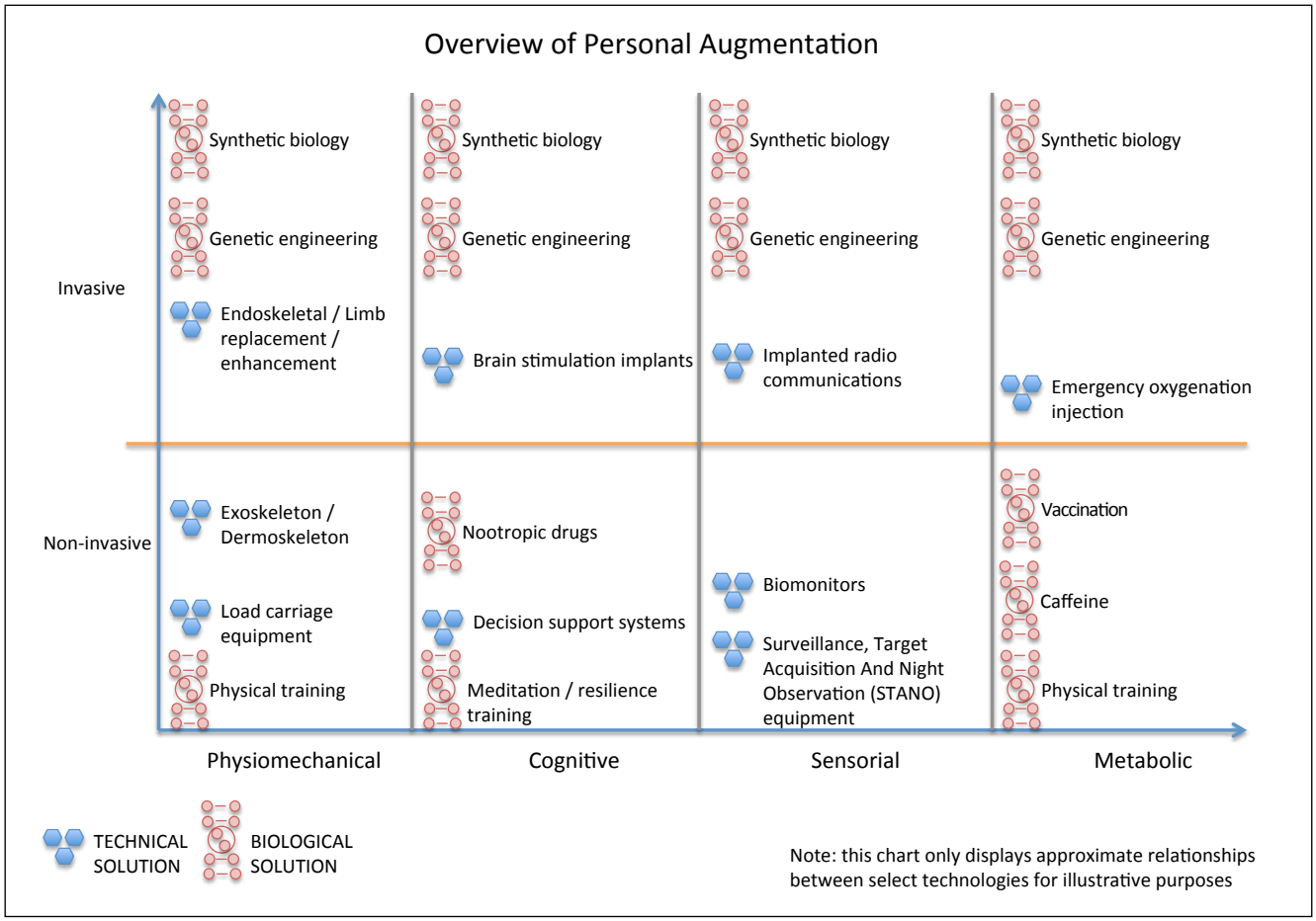
Enhancement technologies manifest themselves with varying levels of invasiveness. In order to properly frame the discussion, "invasive" will mean: *…tending to have an impact upon a subject through the procedural effect on her or his body or through social impact, affecting the ability to pursue life, liberty, the pursuit of happiness, and to live in the greater society without affect or stigma.*

These definitions focus us upon those technologies that will require the closest ethical examination before pursuing their development and fielding them, and help to discern from simple prosthetics that do not provide increased performance to the user, and therefore are not likely to be deemed desirable



additions to a human in their natural state. These domains may be blended to derive the optimal solution to any given problem. In developing future soldier systems, biological treatments may be developed to enhance a soldier's ability to operate while deprived of sleep and food while maintaining a superior level of cognitive function as he/she wears an exoskeleton that will provide enhanced strength, endurance, and sensorial capabilities. The chart below highlights the approximate relationship between the domains and the relative invasiveness of different technologies.

Down the rabbit hole: where is technology leading us?

Although humanity has been making use of minimally-invasive PA for more than a thousand years in the form of inoculation[21] to improve our immune systems in preparation for contact with pathogens, the first mainstream exposure to the controversy that enhancement may pose is the case of the South African runner Oscar Pistorius. He was almost prevented from attending the London Olympics, due to the concern that his carbon fibre legs would provide an unfair advantage over other runners.[22] Although it is debatable that current technology is capable of providing record-setting performances,[23] the rate of technological development suggests that this may change soon enough.[24] It is easy to dismiss this example as a one-off event, but cybernetics are becoming widespread, and their potential to profoundly affect humankind is beginning to creep from science fiction to becoming science fact.[25]

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The growing presence of PA technologies, and their move beyond the natural human's performance,[26] suggests an imminent military application. If there is any lesson to be drawn from the military employment of chemical and nuclear weapons, unmanned systems,[27] as well as the recent revelations of the US PRISM program,[28] it is that we first employ disruptive technologies before the frameworks are in place to manage and integrate them into their arsenals. Such soul-searching usually happens long after a capability first trickles into service. The US military has been employing primitive cyborgs in combat theatres since at least 2006. A US Army Ranger has even returned to full combat duty after the amputation of his leg below the knee. He carries a spare prosthetic with him so that he can switch his leg out, should it be damaged in battle.[29] Although soldiers currently prefer simple, rugged, and reliable prosthetics during combat operations,[30] the barriers to implementing military cybernetics posed by the state of hardware, materials, and artificial intelligence are quickly fading. Only power supply refinement is lagging, but significant strides are now being made, suggesting that developmental vectors will converge within the next five-to-fifteen years so as to create systems that may be desirable to soldiers.

The pace of development in the fields of molecular and synthetic biology is accelerating, allowing biological augmentation to dovetail with technical augmentation in the coming decades. Indeed, the Central Intelligence Agency foresees such augmentation being widely available by 2030, albeit most likely constrained by high cost to the privileged and the wealthy.[31]

The three scenarios below illustrate PA's possibilities. Sooner or later, we will encounter one or all of these, and we need to be prepared to handle them.

1. ***Mild***: Friendly force tracking through implanted radio frequency identification (RFID) chip.[32] Technological advances in the next five-to ten-years[33] could achieve force tracking's quintessential objective to track personnel without observable sign of a device on an individual. A small chip, embedded in a soldier's dermis, could enable commanders to track personnel across the battlefield, securely store passwords, and act as replacement for identification disks, even carrying their Personnel Evaluation Reports with them, to the delight of staff officers everywhere. Such minimally-invasive PA would be low cost, have minimal health risks and support requirements,[34] and would yield many advantages in terms of security and human resource management. Advanced medical implants that provide advanced remote monitoring of heart function, and even implanted defibrillation, already demonstrate some militarily desirable characteristics.[35, 36] There is promising work being accomplished in developing prophylactic inoculations against hearing loss.[37] Such developments in life-sustainment, injury prevention, communications, and personnel location would be the most likely vector for invasive technologies in the near-to-mid-term.

2. ***Moderate***: Electronic telepathy[38] and thought controlled unmanned systems.[39] Surgically implanted biofuel cells can generate small amounts of electricity by transforming the blood glucose into electrical power,[40] coupled with an implanted transceiver,[41] could provide the means for soldiers to maintain discrete communications, albeit over short distances.[42] This leads to the question of what happens to augmented soldiers if an opponent that is aware of their capability captures them? Implanted receivers may enable soldiers to operate the wide variety of unmanned systems 'hands free,' and perhaps more intuitively than is currently possible,[43] allowing them to maintain better situational awareness, and also to improve their safety as they operate the systems. Such an option would probably be in the upper range of what Canadian values would allow in the next two decades, and would likely be achievable without requiring a staggering overhaul of the current medical and technical support services required to field them.

3. ***Extreme***: Molecular/synthetic biology with cybernetic augmentation. This scenario sees PA taken to its conceptual limit, fielding bespoke and novel human biology created specifically to meet the requirements of military operations. These soldiers then undergo a range of cybernetic augmentation in an attempt to squeeze every possible ounce of performance out of the human form factor. The barriers to entry for such a scenario are tremendous, but it allows us to scope out the limits of PA. The use of such technologies within the Canadian Armed Forces is likely so ethically repugnant in the medium term that the likelihood of its occurrence is practically nonexistent. However, it would be possible that Canadian firms produce and export the technologies required to achieve this end state.[44] This would beg the discussion of the appropriate regulation of exportation of these technologies to countries that do not demonstrate the same level of restraint that we do.

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Opening Pandora's Box

The high likelihood that invasive PA in general, and cybernetics in particular, will eventually become a viable capability development pathway raises several weighty ethical and operational questions. While the CAF does have a Human Research Ethics Committee (HREC), its mandate is focused upon the ethical conduct of experimentation involving humans.[45] Defence Research & Development Canada (DRDC) Toronto has retroactively studied the ethical impacts of decision-making on operations,[46] but has not proactively examined operational ethical issues before they arise. Efforts to characterize the ethical requirements of human performance enhancement technologies for research purposes lay out four key considerations that must be met to ethically conduct human enhancement experimentation: pre-trial animal and other surrogate testing, informed consent, privacy, and confidentiality, and monitoring of both the research and the participants.[47] Although useful, on their own, these do not provide sufficient definition of the issues relating to the operational fielding of PA technologies.

The other major player in shaping ethics within the CAF is the Army Ethics Program. It seeks to provide a framework for ethical behavior within the Canadian Army. The program's current investigative thrusts are focused upon the human dimension of why decisions are made on the battlefield. Examining the ethical impacts of military human enhancement fall outside its mandate and resources.[48]

PA will carry a wide range of thorny issues that will have to be addressed before being fielded. Given the lack of existing structures within the CAF to tackle these issues, it is essential to begin the discussion in a forum that will allow commanders to become engaged in a timely manner. Some salient questions are highlighted below:

1. ***Moral and Legal Authority***. Who has the moral authority for PA? Perhaps the most pressing question to answer at this point, identifying the appropriate personnel with the level of authority required to truly parse the question of appropriateness for given PA vectors will be essential to ensure a definite ability to pursue or to shut down avenues of exploration. While the HREC may have significant insight into the ethical questions pertaining to human experimentation, and therefore have input in the developmental stages of these technologies, it does not have an operational mandate, and therefore, it cannot authoritatively shape capability fielding.[49] The CAF Code of Conduct offers some insight on the legal aspect of PA by highlighting the requirement for authorizing the use of weapons and ammunition.[50] Augmentation technologies could be

Hybrid Assessment Model	
Legitimate military purpose	the enhancement must be in support of a legitimate operational objective
Necessity	an enhancement's use must reasonably be expected to be necessary in order to achieve an objective
Benefits outweigh the risks	the operational benefits, as well as those to the warfighter, must outweigh the risks the enhancements pose
Maintenance of dignity	the enhancement must be implemented and operate in such a manner as to ensure that the warfighter may continue to live and operate in a manner that does not negatively affect his or her self-esteem
Minimization of burdens	the long-term burdens to the soldier must be minimized. Ideally, this requires enhancements to be reversible
Consent	candidates for enhancement must be volunteers and properly informed of the nature of the procedures to be undertaken, their effects, and long term consequences
Transparency	although security considerations may prevent the disclosure of the details relating to human enhancement, its pursuit should be disclosed to the public so as to ensure their understanding of the procedure's necessity and ensure that appropriate oversight is maintained
Fair distribution of risks and benefits	where possible, enhancements should be equitably distributed to ensure that no advantage is conferred in such a manner as to be deemed unfair by the greater military community, thereby adversely affecting morale, cohesion, and operational effectiveness
Chain of command accountability:	the chain of command must be held accountable for the processes that implement soldier enhancements so as to prevent abuses

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considered as a weapon system, and therefore approved for use by a board with legal standing, in the same manner as an Ammunition Safety and Suitability Board (ASSB) is called for the fielding of new natures of ammunition and weapon systems. The authority for approval to field these systems for regular use lies with the environmental chief of staff.[51] A multi-disciplinary team consisting of operators, scientific, engineering, medical, bioethical, and legal experts may be sufficient to form a Personal Augmentation Safety and Suitability Board (PASSB). A similar board has already been proposed to support human performance enhancement research.[52] It would be advisable to either integrate operational input during research and development to address questions about the fielding of emerging technologies early in the process, or to draw upon this body during capability development reviews to complement the board's operational representatives with technical expertise. The board should assess warfighter enhancement procedures using the hybrid assessment model.[53]

Enhancements of cross-environmental interest could lead to procedural complications, requiring a separate PASSB to evaluate a technology for employment within each service. Alternatively, a centralized PASSB could be responsible for all augmentation within the CAF. This centralization would offer greater control, but also carries the risk of becoming mired in branch-specific requirements and constraints. A final possibility is that the moral authority for PA could rest beyond the environmental chiefs of staff. As the Deputy Minister and Chief of the Defence Staff approve the terms of reference for the Defence Ethics Program, it may be that the final approving authority for invasive PA should lie with these positions.

2. ***Canadian Values***. When examining the operational potential of invasive PA, one must consider how it relates to core Canadian values. The *Values and Ethics Code for the Public Sector* lays out the core values that public servants are to internalize. A key value to this discussion is respect for the people: "…treating all people with respect, dignity and fairness is fundamental to our relationship with the Canadian public and contributes to a safe and healthy work environment that promotes engagement, openness and transparency. The diversity of people and the ideas they generate are the wellspring of our spirit of innovation." It does not disallow the concept of PA, so long as an individual's wishes are respected, and the procedures relating to its implementation are conducted in a medically sound manner and properly maintained. With sufficient clinical trials to confirm a high level of safety and reversibility for a given technology prior to fielding, it could be acceptable to implement certain invasive forms of PA. When CAF values[54] are layered onto this assessment, we find that loyalty, courage, and excellence may be regarded allowing the sacrifices needed to proceed with invasive PA. While the medical community would be understandably reluctant at first to operate on healthy individuals,[55] there are no fundamental barriers to fielding enhancement technologies in the long term.

"When examining the operational potential of invasive PA, one must consider how it relates to Canadian core values."

3. ***Eligibility***. Clear eligibility criteria for invasive PA will help drive the scope of future augmentation efforts. The impact

could be limited, augmenting specialized volunteers for focused mission sets, or it could be profound, becoming a mandatory gateway during the enrolment process, fundamentally changing who may be recruited into the CAF. Recruits could have to undergo an augmentation pipeline during recruit school, much as they undergo the battery of vaccinations before graduating from training. The applicant's mental, emotional, and moral suitability for enhancement needs to be assessed to mitigate the risks of problems developing later in their careers, or in retirement. [56] Potential recruits need to be informed if augmentation became mandatory. Off-ramps must be identified for serving personnel that decide to surrender their enhancements. Should enhancements become widespread, could an individual join the military while not volunteering for augmentation? If current practices with vaccination are used as a guideline, this is likely.[57] Will certain augmentations become prerequisites to qualify for operational deployment? Personnel tracking technologies would appear desirable to implement on each person deploying to a high-risk theatre. What of our wounded? Is it acceptable to augment their performance in the process of treating their injuries and potentially return them to operations more rapidly? Do we rebuild them better than they were before? Among the wounded, there appears to be a willingness to explore this possibility, as long as the technologies, procedures, and risks are well explained to the patient.[58] How do these soldiers then re-integrate into units with un-augmented soldiers? Will this lead to soldiers willing to harm themselves in order to be augmented, if only the wounded are allowed to undergo such procedures? What happens in the improbable event of another total war? Would individual rights be curtailed in order to ensure maximal fighting effectiveness? In essence, would we be willing to mutilate a soldier in order to save his life?

"Russia, and most prominently, China, have displayed the drive to win at all costs at sporting events, such as the Olympics, leading them to devise training pipelines that would be deemed abusive by Western observers."

4. ***Time***. Where possible, cybernetics would have to be 'future-proofed' in order to avoid burdening the individual and the system with onerous upgrade procedures, also limiting the impact upon the member's health and safety while reducing the project overhead to maintain a given capability. How do we treat the augmented individual? Military equipment is highly controlled. The most sensitive and expensive is stored in vaults when not in use. Enhancements by definition will have to move with the soldier at all times. Will tighter off-duty controls be needed, affecting soldiers' quality of life? Will augmentations need to be rendered non-functional, or set to perform at natural levels when soldiers are off duty? What if the augmentation requires some degree of consumable resource to function? Is consumption while off-duty the member's responsibility? More importantly, how are invasive technologies handled at the end of a soldier's career? Can the member transition to civilian life with augmentations? Will they be able to remove them at cost to the CAF or Veterans Affairs at a later date? Will they be forced to have the augmentations extracted? What if they refuse and are no longer willing to volunteer for surgical procedures for removal? How are matters of synthetic biology addressed when a member's very DNA may have been altered to meet mission requirements? Can these matters be dealt with without infringing upon respect for the person?

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Future soldier in advanced armour.

5. ***Canadian Society***. It is possible that by 2030, a certain level of invasive PA may have become mainstream in the civilian population. A few decades ago, tattoos and body piercings were not popular outside a limited population subset. They are quite prevalent today. These individuals have decided to undergo very limited invasive PA to alter their appearance. Potential recruits may already have augmentation technologies that have a cosmetic effect,[59, 60] or increase elite athletic performance prior to their enlistment. Will they be required to remove their augmentations, particularly if they do not meet military specifications and put the individual at risk in their workplace?

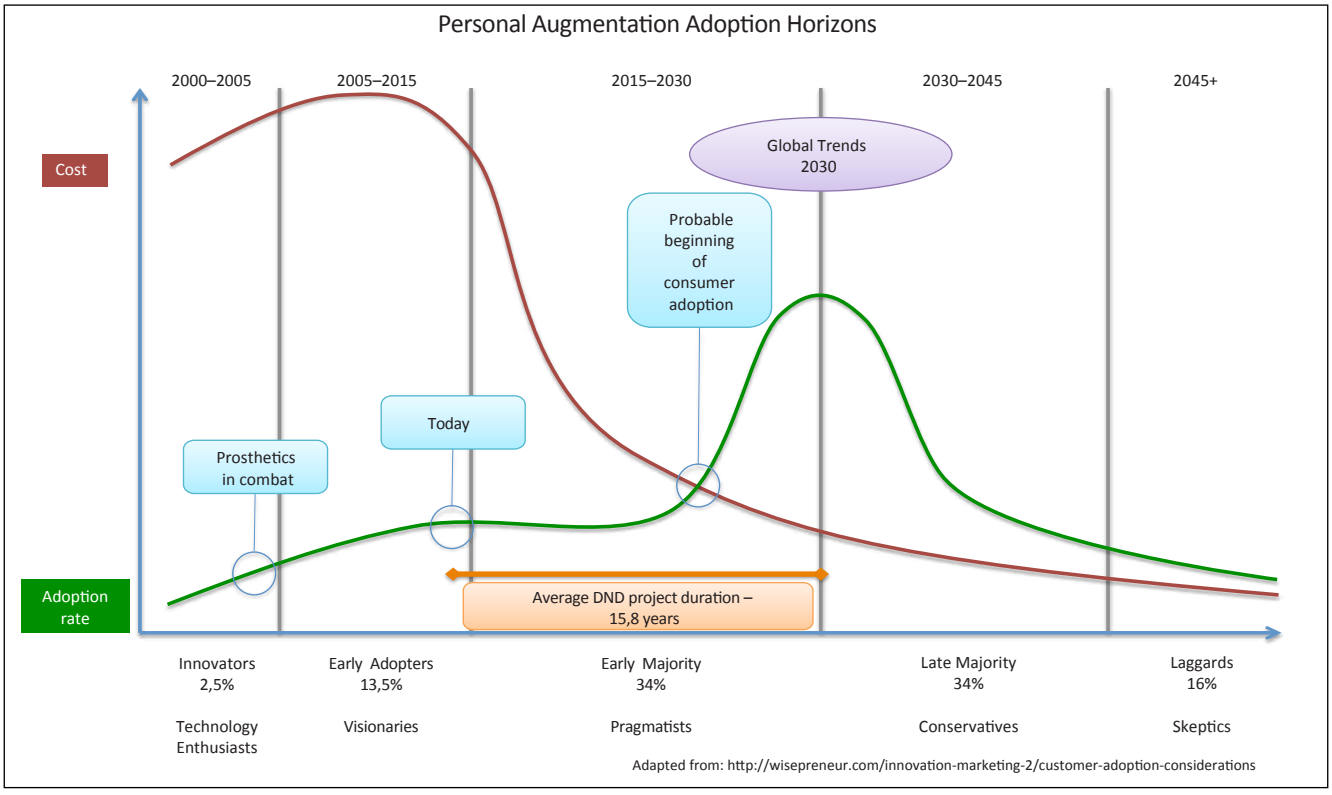
6. ***Opposing Forces***. Should Canada deem invasive PA abhorrent, it may still have to contend with opponents that have augmented their combatants. If recent experience with the proliferation of unmanned

systems is any indication, once human enhancement begins to take hold in one country, others will follow suit in short order.[61] Certain countries have demonstrated their inclination to take extraordinary measures to obtain the maximum possible performance out of their elite athletes. Russia, and most prominently, China, have displayed the drive to win at all costs at sporting events, such as the Olympics, leading them to devise training pipelines that would be deemed abusive by Western observers.[62, 63, 64, 65] If they are willing to invest such tremendous effort into selecting and training their athletes, they may be willing to do so in the interest of national security. Although the probability of a direct clash with another major global power remains unlikely in the mid-term, the global sale of advanced military hardware[66] suggests that next-generation military hardware may be encountered in secondary theatres of conflict, and that there can be no expectation of absolute technological overmatch over threat forces.[67] Therefore, PA capabilities could be present in opposing forces in the coming decades. Western-supplied PA could make its way into the hands of combatants in proxy conflicts as a result of insufficiently-regulated trade in arms, or through the covert acquisition of technology via cyber espionage or industrial theft. Strong regulations may lessen the likelihood of leading-edge technologies falling into threat forces' hands. Furthermore, should we explore the means to attack cybernetic systems independently from their biological host? If an opposing force augments their soldiers' hearts to obtain higher cardiovascular performance, and a vulnerability was exposed by which a computer virus could attack and cause a heart attack,[68] would this be an acceptable use of force under the Laws of Armed Conflict, or would it be deemed to cause unnecessary suffering? What do we do with augmented prisoners of war and detainees? Under the Geneva Convention (III) of 1949 relative to prisoners of war, we are responsible to provide a level of care that is commensurate with that provided to our own soldiers within a theatre of operations. How do we handle soldiers for whom we may not have the medical or technical wherewithal to treat? Will we need to develop the technical means to support augmented systems that are not in our inventory to ensure the safety of detainees?

"Unlike the fielding of a major weapon system, enhanced soldiers would probably trickle into the ranks."

The treatment of our enhanced soldiers, should they become prisoners of a force or organization whose respect for the Geneva conventions is questionable, is a concern. Captors could attempt to forcefully extract augmentations to gain a better understanding of their function, or to obtain them for their own use or profit.[69] This risk needs to be evaluated, not only in fielding the technology, but also in the operational planning process before deploying augmented soldiers on a given mission. Augmentations should be designed to reduce their attractiveness once removed from their intended host, reducing interest in their extraction, and mitigating the risk of their employment against friendly forces, either directly or as bait for a trap, in the case of implanted geo-location reporting, for example.

7. ***International Law***. Under the Geneva conventions, weapons and tactics must respect the following principles: distinction, proportionality, and prohibition with respect to superfluous injury or unnecessary suffering. Military enhancement must adhere to these principles or be held in violation of international humanitarian law. Augmentation initiatives must allow our combatants to maintain a clear sense of judgment. A hypothetical 'berserker' drug that incidentally inhibited its subject's ability to discern combatant from non-combatant, or increased aggressiveness beyond where it can be controlled, would be prohibited.[70]



Adapted from: http://wisepreneur.com/innovation-marketing-2/customer-adoption-considerations.

Making Them Better: Who builds the Six Million Dollar Man?

The CAF have a strong capability development structure under the Chief of Force Development, supported by the various elemental directors of requirements and directors of program management. This allows us to adjust to the changing paradigm, but we must still decide who shall be the primary authority for these technologies. As these will inherently involve medical procedures, will the medical community be the lead? This model would be similar to the manner in which we have chosen to develop our command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) capabilities, where the signals community has the lead on developing and implementing our networked technologies, but carries the risk of not effectively delivering capabilities that directly support operational requirements. It is essential that operational commanders and force employers take the lead and drive their requirements to dominate in their future engagement spaces. I propose that the Directorate of Land Requirements (DLR) and the Directorate of Soldier Systems Project Management should be the lead directorates for CAF PA as a whole, since most PA will have some tie-in to soldier systems. However, specialized air, maritime, and other special applications will emerge that will doubtless also necessitate the involvement of other environmental project offices.

Although considerations relating to military PA seem reserved for the distant future, the reality is that the average CAF procurement cycle for major projects is 15.8 years.[71] Even if the duration of projects relating to PA were streamlined to five years per iteration, we stand today, at best, only two-to-three project cycles away from when PA is expected to be commonplace. At worst, the projects needed to deliver these cutting edge technologies must be established up now to meet the 2030 timeframe. DLR's planning horizon already points beyond 2020 as a target to deliver the next generation of soldier systems with a vision of leveraging novel materials and technologies. It has also provided as part of the Soldier Systems Technology Roadmap capability targets for industry to meet by 2030. The capabilities identified to date are non-invasive.

123RF, Jesse-lee Lang, ID 27503273

Advanced super soldier.

Prime Directive: Who controls the Cyborg?

Where and how to employ enhanced warfighters will become a significant issue for commanders.[72] Unlike the fielding of a major weapon system, enhanced soldiers would probably trickle into the ranks. Assigning an augmented soldier in the same section as normal soldiers could lead to issues when meriting for career progression. Would an enhanced soldier be automatically considered more devoted to his duties? Would special measures be put into place to favour retention of those in which tremendous resources have been invested? Would cognitive enhancements unfairly advantage the augmented in their ability to progress in relation to their un-enhanced peers? A fundamental shift may need to take place in military career management to eventually integrate the augmented warfighter.

Conclusions

Some have argued that the military's human enhancement efforts could fundamentally alter the fabric of society.[73] However, there are good chances that the inverse will be the case. The pace of development, due to commercial market pressures, will lead to enhancement technologies cropping up in civilian circles with a greater preponderance than in the military, as is currently the case with information technologies. These will force the military to adapt to PA, regardless of whether it has pursued their development. This is an imminent issue; we have not begun to identify requirements, secure funding, put in place the required infrastructure, and to develop the skills and human resources to support it.

Human enhancement's ethical effect upon military operations raises many questions for which a definitive answer cannot be established at this time. There are early adopters: cyborgs have already begun to walk among us.[74] The genie of military human enhancement will inevitably be let out of the bottle. We will have to ask how far we are willing to go in order to ensure the success and safety of our troops. Let us begin this discussion, priming the field for others far better equipped to study the question before we are caught unaware and unprepared for another technology that is fielded before it is suitably evaluated. The solution will not likely involve a binary outcome. It will most likely comprise a 'blend of greys' that will allow flexibility, while providing constraints to prevent excesses and abuses.

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