Professional Ethics and Social Responsibility: Military Work and Peacebuilding

Marion Hersh

Biomedical Engineering, University of Glasgow G12 8LT, Glasgow Scotland.
(email: marion.hersh@glasgow.ac.uk)

Abstract: The paper considers a number of important questions related to the involvement of engineers in peacebuilding and military work, including the preference of many countries for high tech weapons based security over peacebuilding, whether and in what circumstances, if any, it is justified for engineers to be involved in military work; and how engineers can persuade their colleagues to apply their skills to support peacebuilding**.** It is introduced by an overview of what is meant by the term military work and the extent and consequences of the use of military technology worldwide. This is followed by the applications of different approaches and theories of ethics to discuss the questions presented in the introduction. The approaches and theories applied include considerations of micro-and macro-ethics, codes of ethics, virtue ethics, considerations of gender and paradigms and the ethical imperative. Initial insights include the importance of considering the associated context and the need to avoid othering, which can make different treatment of minority groups, including the use of high tech weapons against them, seem acceptable.

Keywords: peacebuilding, military work, context, othering, macroethics, ethical theories.

1. INTRODUCTION: MILITARY WORK

The term ‘military work’ will be used rather than the more commonly used term 'defence' work to try and avoid any assumptions about the nature of this work. It has been categorised both by the type of work and the degree of military involvement, with the latter categorisation giving (Hersh, 2000).

- Direct military applications paid for or funded by military sources.
- Dual purpose military and civilian applications.
- Civilian work with military funding.
- Research with unknown applications, some of which may be military.
- Work for a firm with some military contracts.
- Collateral work on devices that are not themselves weapons, but which support weapons use.

Military installations and suppliers have been categorised as follows (Ullmann, 1991):

- Firms that sell some of their usual products to the military.
- Contractors with up to 500 employers doing specialised work, for instance producing electronics and electromechanical components, that sell a significant proportion of their products to the military.
- Large companies with both military and nonmilitary divisions.
- Large military companies that almost exclusively produce military hardware such as weapons, naval vessels and military aircraft.
- Military bases.

In addition military research is carried out in universities and technical schools in many countries and many military establishments have research agreements with them covering a wide range of science and engineering areas (Hersh, 2000).

Unfortunately there has been a tendency for national security to focus on military preparedness, including advanced weapons systems (Jackson, 2011) rather than peacebuilding and resolving problems which lead to instability (Abbott et al., 2006). The critical role of engineers and scientists in developing weapons technologies and maintaining military preparedness raises important ethical issues related to military research and development, the division of resources from civilian technologies and the contribution of these technologies to arms races. Despite the diversity and range of destructive power from small arms to nuclear armed and powered submarines and of existing military technologies, scientists and engineers are researching and developing new military systems. They also have significant involvement in the production and maintenance of existing weapons and other military systems (Hersh, 2015a).

Despite austerity measures in some countries global military spending remains high at about $1756 billion and an estimated 2.5% of global GDP in 2012 (Perlo-Freeman, 2013; Perlo-Freeman et al., 2013). Despite the slow decline in the number and scale of conflicts and the resulting deaths, the rate of successful conflict resolution has also dropped leading to increasing numbers of protracted or recurring conflicts (Melvin, 2012). There were 248 armed conflicts in 153 locations in 1945 - 2011, an estimated 50-51 million deaths, including of civilians, in 1945-2000 and an estimated 214-226 million deaths due to national political decision making, including genocide, starvations and deaths in prison

camps and conflict in the twentieth century (Leitenberg, 2001). Clearly nuclear and other weapons systems have not kept the peace or prevented human rights abuses.

At one end of the scale are nuclear weapons, including the Trident nuclear missiles stationed at Faslane about 45 kilometres north west of Glasgow (where I live and work). They are aimed at 'flattening Moscow at the press of a button'. Using all the 40 nuclear warheads normally carried by a Trident submarine would result in 5.4 million deaths, with 95% casualties within 1.6 kilometres of each explosion. Nearly 800,000 of the deaths would be children and young people under 18. Since the casualties would include large numbers of doctors and nurses and most large hospitals would either be destroyed or severely damaged, there would be little if any medical aid within the city. Very high levels of radioactivity and extensive fires would make it very difficult and hazardous to bring in medical or other aid from outside (Ainslie, 2013).

All armed forces use small arms and light weapons, of which there are more than 600 million in circulation worldwide (Pike, 2013), particularly in Africa, with most of the weapons used there imported from outside (IANSA et al,. 2007). They have been responsible for the majority (60 - 90%) of direct conflict deaths (Wille with Krause, 2005) and contributed to disease, starvation and the destruction of health service infrastructure, resulting in a large number of indirect conflict deaths (Krause with Mutimer, 2005). It is also largely guns that have been used to force villagers from their homes (Shah, 2006). This implies that engineers in other countries, including Europe and the USA, have had a significant role in the development and manufacture of the small arms and light weapons used to such devastating effect in Africa and elsewhere, including in significant numbers of homicides in the USA.

The three-component model of the causes of violent conflict (Hersh, 2013) has the components of an issue of dispute, a context which favours instability and discourages peaceful settlement and a trigger event or circumstance. This shows the importance of both resolving the underlying issues which could lead to conflict and working on the context to discourage conflict as an approach to resolving problems. Climate change; competition over resources particularly oil and water; growing inequality and marginalization; and global militarism have been considered the main threats to global security (Abbott et al., 2006). However, rather than building peace or trying to resolve the problems that cause instability many countries, including the USA, are continuing to base their security on high technology weapons. This is despite evidence of the inadequacies of this approach for long term security, avoiding the development of current problems into violent conflict or resolving current major (violent) conflicts. Instead, real security will require the solution of the serious problems that contribute to instability, including climate change, global poverty, access to clean water and energy sources, loss of biodiversity and environmental degradation (Langley et al., 2005). Engineers clearly have experience and expertise to contribute and can play an important role, but a change of political priorities will be required to make the necessary resources available. This does not mean that engineers cannot work on these problems at a smaller scale. They can also join campaigns with engineers and others to support peacebuilding and provide their knowledge, experience and expertise, as well as the support of their institutions, to solve problems relating to the environment, resources and inequalities.

This gives rise to a number of important questions for ethical engineers interested in world peace and social justice:

1. How best can they use their experience and expertise to support peacebuilding?
2. What role, if any, do weapons systems have in maintaining stability and peace?
3. In what circumstances, if any, is it justified for engineers to be involved in military work and, if any, what type of work?
4. Why do many countries prefer security based on high technology weapons rather than peacebuilding and resolving problems?
5. How can engineers convince their colleagues of the need to use their expertise and experience to support peacebuilding?

The paper will apply a number of different theories and approaches to ethics to investigate these questions and obtain insight into them. However, considerable further work will be required to obtain more definitive answers.

2. ETHICAL ENGINEERING, MACRO AND MICRO ETHICS

The terms micro- and macro-ethics have been used to indicate respectively a focus on the ethical issues involved in relationships between individual engineers and their clients, colleagues and employers; and the collective social responsibility of the engineering profession (Ladd, 1980). This could also be conceptualised as process related issues resulting from the day-to-day practice of the profession and the wider social, environmental ethical issues and responsibilities of engineering and engineers. It should include decisions on which projects should not be undertaken either by society as a whole or by individual engineers.

Engineering ethics research and teaching have generally focused on microethics and individual issues rather than macroethics and wider issues (Herkert, 2001; Winner, 1990), including those related to the implications of the development and use of particular technologies and the role and (social and environmental) responsibilities of engineering. In the context of professional ethics, there is increasing awareness of ethical and social responsibility issues with regard to how engineers carry out their jobs, but considerably less so with regard to the nature of these jobs and what jobs are and are not ethical. The nature of the jobs engineers do relates to the wider issues of the role of engineering and technology in society. 'Ethical responsibility ... must ... include a willingness to engage others in the difficult work of defining what the crucial choices are that confront technological society and how intelligently to confront them' (Winner, 1990, p. 62). I would suggest that these crucial choices include how to use technology to encourage and support social justice and peaceful coexistence without the need for weapons systems.

An example of the limited focus on microethics is given by one of the case studies produced by a US National Science Foundation funded project on introducing ethics into engineering teaching. The case involved three civilian chemical engineers convicted for illegally storing, handling and disposing of hazardous waste while developing a new chemical weapon. Despite discussing a range of ethical issues associated with hazardous chemicals, the case study totally ignored the ethics of developing or using chemical weapons. While the Chemical Weapons Convention had not yet been signed and ratified when the case study was written, its subsequent signing and ratification show the extent of societal concern about chemical weapons and the very limited nature of ethical discussion which does not consider this issue.

There is still a tendency for engineering (and other professional) ethics to focus on legality and ignore the wider ethical implications of activities which may be legal, but which are not necessarily moral (Seedhouse, 1988). As in the chemical weapons case, what is legal changes over time. The general tendency is to increasing strict regulation and more restrictive limits. This indicates that activities which are currently legal, but ethically questionable or unacceptable, may become illegal in the future. Concern about ethics for its own sake should be encouraged. However, as indicated by the case of chemical weapons, there is generally the possibility of stricter regulation in the future with changes n what is permitted. Awareness of wider ethical issues could therefore be beneficial to engineers by alerting them to controversial areas where strictly regulation is likely and therefore, for instance, allowing them to manage a planned withdrawal from controversial areas before being forced to by a change in legislation.

The discussion of micro- and macroethics illustrates the importance of engineers and engineering considering the wider ethical context of what they are doing in addition to behaving with integrity and competence in their daily dealings. It is this wider microethics perspective that is relevant to the questions in section 1. Consideration of this wider perspective will show, as discussed briefly in section 1, that the way to improve international stability and security is peacebuilding and the resolution of the problems that lead to conflict not the development of new high tech weapons. Many of the countries with the best developed weapons systems are the more powerful countries, including the USA and many of the European countries, Japan and China, which do not have any enemies really able to threaten them, whatever they may claim. These countries use the possession of advanced weapons systems including in some cases nuclear weapons, to maintain their power and prestige and to make a profit. The very limited regulation of the arms trade means that the majority of arms sales, including to conflict areas or countries with serious human rights abuses, are legal (Hersh, 2015a). Invasions of other countries by these richer and more powerful nations have frequently had disastrous results. For instance, there have been between 151,000 and 655,000 violent deaths in Iraq between March 2003 and June 2006, over three million people have been displaced as refugees or internally since 2003, basic services such as electricity are still disrupted, public health has deteriorated and unemployment is about 28% (Perlo Freeman and Solmirano, 2012).

Armed conflict is increasingly within rather than between states. It is beyond the scope of this paper to detail the variety of types of conflict and issues involved. However, it should be noted that this includes armed struggles by liberation groups and against injustice. In this case it is almost always the (unjust) regimes which have access to better weapons and more engineers. There are also still cases of attempted expansionism and conquest by military force, which are often accompanied by extensive human rights violations, such as the attacks by Islamic State (IS). In this case many countries which purport to deplore IS are supplying them with weapons and other aids, often through third parties and by clandestine routes (Cartalucci, 2014). Ending this would have a significant positive impact. The ethics of manufacturing and maintaining weapons intended for the opposition to IS is a more complex question. There is considerable evidence of the difficulties in controlling who has access to weapons introduced into a conflict and that they may be used by the other side. Therefore, discussion of the ethical issues should include consideration of the likelihood of the weapons being used as intended and not being diverted to IS. Equally important is consideration of approaches based on peacebuilding and resolving the underlying issues. The latter requires an indepth contextual understanding of the factors that have led to the growth of IS and the willingness of people to support it, both militarily and otherwise. This would facilitate political and other changes to resolve the various injustices which have contributed to the growth of IS. It would also have some impact on reducing IS's support and the willingness of people to fight for it and consequently curtail its ability to engage in conquest and expansion.

The lack of awareness of wider issues and consequences is probably an important contributory factor in engineers participating in military work. By drawing attention to these wider issues and consequences engineers can help their colleagues consider whether they do indeed want to engage in military work or seek other and better uses for their talents and expertise.

Another factor to be taken into account is the precautionary principle (Dethlefsen et al., 1993; Hersh, 2006; Raffensperger and Tickner, 1999). It should be interpreted in its widest sense of the need for precautionary action and to avoid implementing activities with uncertain consequences rather than related purely to emissions, as in the original version. Engineers also need to recognise the importance of public concerns about particular types of risk, even if they are considered acceptable by scientists or system designers and that the lack of firm evidence of risk should not be mistakenly equated to lack of risk or used to belittle public concerns. Technologies with clear and valued benefits generally have much wider public acceptance even if there are potential risks, such as possible health risks for mobile phones (Blettner and Berg 2000), than those with uncertain if any benefits, such as genetically modified organisms (Gaskell et al., 2004).

This requires engineers to consider the wider and long term consequences of their work and both act to reduce any likely negative impacts and not undertake work where there are likely to be significant negative impacts the effects of which cannot be mitigated. They should also at the least be very cautious about undertaking work the future or wider impacts of which are uncertain. This implies that engineers should try to find out the intended destinations and applications of any military technologies they are considering working on and be very suspicious of any proposed areas of work where this information is refused.

3. CODES OF ETHICS

The existence of codes of ethics of professional societies indicates some degree of support for ethical issues. However, in practice this support has been relatively limited. The Institute of Electrical and Electronic Engineers (IEEE), one of the largest professional engineering organisations, suspended its Ethics Hotline after less than a year of operation. Concerns about the IEEE's charitable and tax exempt status prevented implementation of suggestions for an ethics support fund financed by voluntary contributions of IEEE members, though operation of a hotline has not led to questioning of the tax exempt status of the American Association of University Professors during its 40 years of operation (Unger, 1999). Assistance may be offered to members 'placed in jeopardy as a consequence of adherence to the IEEE's Code of Ethics' if it is 'warranted' 'in the opinion of the Board of Directors or its designated representative' (http://ewh.ieee.org/cmte/pa/Status/Ethics.html). However, it is not clear what criteria are used to determine this. Investigation of ethics violations has been found to be rare and sanctioning of violators even more so, though small numbers of members have been expelled. Other societies, such as the Association of Computing Machinery (ACM) have been criticised for their lack of commitment to members with regard to support for ethics (Rosenberg, 1998).

It has been suggested that the reluctance of professional societies to support ethical engineers may be due to engineers being in the middle between science professionals who value autonomy, collegial control and social responsibility and business which aims primarily at profit and values loyalty and confidentiality, particularly as many of the leaders of professional engineering societies have moved from engineering into business management roles (Herkert, 2001). Engineers are considered effective problem solvers, but less adept at the social and ethical dimensions of engineering (Herkert, 2001), including of the problems they are solving, their wider significance, whether they should be solved and the consequences of doing so. This may be particularly significant in the context of military work, where it may be easy to become absorbed in the interesting technical problems and the expensive equipment generous military funding has allowed.

Codes of ethics have been criticised on several grounds, including (Jamal and Bowie, 1995), a focus on public relations rather than changing behaviour, protecting the economic interests of the profession rather than the public, and differences between the moral views of the profession and the wider community, particularly with regard to confidentiality duties to clients, when this may be against the public interest. However, particularly in the USA, the courts have sometimes intervened against the public interest, for instance in preventing engineers imposing standards considered to restrain trade on hot water heaters. I would suggest that stricter safety standards are more important for the public interest than competition. This prioritisation of business over other interests is not universal. However, it should be noted that military systems of all types are very big business, as indicated by the data in section 1. This preference for commercial over wider interests and the vast amounts of money to be made from sales of military technologies may be one of the reasons for the preferences of many countries for high tech weapons rather than peacebuilding.

Dated, but still generally valid analysis (Oldenquist and Slowter, 1979) shows that codes can be divided into three main categories: (i) the public interest (ii) desirable qualities and (iii) professional performance. However, as indicated by the above discussion, the approach to the public interest is freqently very limited and rarely, if ever, touches the wider issues of the social and political responsibilities of engineering and what its underlying aims should be. Therefore analysis of professional codes of ethics is unlikely to give much insight into questions about peacebuilding, stability and military work. There would be value in work to strengthen the public interest aspects of codes to include the treatment of the social and political responsibilities of engineering. However, care would be required to avoid being over-prescriptive, while providing support for ethical behaviour and encouraging engineers to think about the wider consequences of their work.

4. PARADIGMS, GENDER, FEMINISM AND ETHICS

One of the paradigms cited in the engineering ethics literature is that of the heroic engineer (Broome and Peirce, 1997). While some degree of moral courage is probably necessary for ethical behaviour, this paradigm could easily discourage engineers and make them feel inadequate and unable to respond to ethical challenges since they are not (sufficiently) 'heroic'. It has also been criticised as being very individualistic and having masculine connotations (Adam, 2001) and counterpoised to the paradigm of the responsible engineer (Basart and Serra, 2013). Responsible engineering is generally perceived as being at a more human level than heroic engineering. It is therefore feasible for all engineers and better suited to encouraging ethical engineering as the norm. It also fits better with collective approaches which are more likely to be successful and have less risk of victimisation, due to the strength in numbers. The 'heroic' paradigm frequently implies a showy adventuring kind of heroism rather than the type of quiet heroism many women have to show in their daily lives in response to the challenges of combining full time employment with caring for a family with insufficient support and/or feeding and clothing this family on a minimal income. This type of quiet heroism is more compatible with consideration of the questions in the introduction, whereas the more showy kind could be too busy

with being out there in the world doing things to stop and think. Peacebuilding also frequently requires a more collective philosophy than the individualistic approach of the heroic engineer.

The need to counteract male dominance in engineering and to challenge and replace gender stereotypes has also led to consideration of gender in engineering ethics (Adam, 2001). The best known approach is the ethics of care (Gilligan, 1982). It is a context based approach to preserving relationships and has five main principles: attending to the situation in its complexity; sympathising and identifying with other people in the situation and their wishes and interests; awareness of other people's relationship to you; accommodating both your and other people's needs; and responding to need and showing caring. Implicit in the ethics of care is acceptance and acknowledgement of other people, their humanity, their differences and their diversity. Once you fully recognise and acknowledge someone else's humanity and differences, it becomes difficult to marginalise and exclude them. The ethics of care encourages peacebuilding, as it encourages engineers to be aware of others, identify with them and try to work out their needs, without denying their own needs, and show caring. This identification and caring makes it difficult to develop military systems since they could be used against other people, who you are identifying with and whose needs you have recognised. The focus on high tech weapons rather than peacebuilding could be explained using the ethics of care as a lack of relationships with others, a lack of identification and sympathising with them, accommodating and responding to their needs and showing caring. In order to encourage other engineers to support peacebuilding the ethics of care would encourage learning about them to understand their needs and relationships and to encourage the building of relationships with others, including across binary divides and with those who are very different from them.

Feminist ethics has tended to focus on relationships and context, frequently through the construction of narratives and been critical of approaches which ignore context (Riley, 2013). The contextual focus also makes morality political. This potentially enables political considerations to influence awareness and understanding of morality. Concerns about power, linked to identity categories, including gender, race, disability, sexuality and class, which determine experiences of oppression and privilege (Crenshaw, 1991) and may affect the person's moral agency, are central to feminist approaches to morality (Riley, 2013). There are feminist ethics traditions in other professions, but this is generally lacking in engineering, despite the involvement of feminists in engineering ethics. Applying this type of feminist approach leads to challenges to existing power structures and inequality gradients and the recognition that (high tech) weapons system are used as a threat to maintain power structures and inequalities.

It also leads to recognition that many of the problems that lead to conflict are the result of or related to inequality and oppression, including poverty, environmental degradation, climate change, biodiversity loss and lack of access to clean water, energy sources and other resources. This leads to solutions based on resolving these problems (Langley et al., 2005). In the case of access to resources, one of the contributory factors is excessive resource consumption by those at the top end of the inequality gradient, thereby reducing the resources available to the rest of the world. For instance, 80% of malnourished children in the majority world (developing) countries in the 1990s were from countries with food surpluses (World Bank, 2001). Thus, feminist ethics would lead to approaches based on conflict resolution and measures to reduce inequality rather than reliance on (high tech) weapons and military work, due to recognition that they contribute to maintaining existing inequalities and power imbalances.

5. THE ETHICAL IMPERATIVE

Whistleblowers are often seen as part of the heroic paradigm and unfortunately whistleblowing can have very severe consequences with regard to loss of job, family and home (Alford, 2001; Hersh, 2002). Whistleblowers' conversations indicate that they engage in whistleblowing 'because I had to ... because I had no other choice ... because I could not live with myself if I had not done anything ... What else could I do? I have to look at myself in the mirror every morning (Alford, 2001). The same motivation has been observed in rescuers of Jews in the holocaust (Monroe, 1996). This is what I am calling the ethical imperative, the need to take ethical action in response to concerns of awareness of issues, because it is part of who you are and you could not live with yourself otherwise. However, this does not mean that this action cannot be collective rather than individual or that it has to be expressed in a particular way which involves whistleblowing. The requirement is to speak out and/or take action and not to remain passive or silent and allow injustice to continue rather than to do this in a particular way. Engineering education could have an important role in developing the ethical imperative so that acting ethically became automatic and instinctive. This ethical behaviour would, however, be informed and made effective engineering by training, experience and expertise.

The ethical imperative is not necessarily linked to a particular value system. However, in practice, many whistleblowers speak out against powerful companies and in support of those who lack power. Applying the ethical imperative leads to a very critical analysis of the preference for military technology to peacebuilding, as well as severe criticism of high levels of corruption in the arms trade, estimated at 40% of the total corruption in world trade (Roeber, 2005). The extent of corruption could lead to the conclusion that it is intrinsic to the arms trade and a resulting rejection of military technologies, because it is almost impossible to market them honestly. Encouragement to engineers to engage in peacebuilding and reject military work would then be based on appeals to their integrity.

6. VALUES AND THE OTHER

There is evidence from several studies e.g. (Marquez et al., 1998; Tajfel and Turner; 1979) of the importance of group identification, including to arbitrarily assigned groups. Expressed beliefs may be strongly affected by social group identification and change when this changes. For instance, science students' expressed attitudes to study motivation and animal research were found to depend on assignment to a 'student' or 'scientist' group (Marquez et al., 1998). This indicates that engineers, both as individuals and collectively, may be influenced by the apparent or expressed views of others and groupthink.

This may raise particular issues in the case of military work which has a very long history of engineering involvement and is responsible for a significant proportion of world GDP. In addition, many universities are involved in military research and development. In some countries, such as the UK, universities have significant military links and several studies have not yet managed to identify any university which definitely receives no military funding (Langley et al., 2008). This means that the majority of engineers in the UK and other countries with close university-military links are likely to have been educated in departments with military links. In some cases there will be strong involvement, including, for instance, prizes sponsored by firms with a high percentage of military output. These factors may lead to a normalisation of military work, with student and early career engineers considering involvement in it natural, making it difficult to question it and recognise that it does raise ethical issues.

For a given individual their in- and out-groups are the social groups with which they respectively do and do not identify psychologically. At a societal level the in-group may be the putatively normative and superior group to which an individual belongs or aspires to belong, with out-groups automatically considered to be inferior (Hersh, 2013). Individuals have been found to generally assume they are more similar to members of in- than out groups and give greater weight to information from the former (Robbins and Krueger, 2005). Shared beliefs are generally a key component of group membership, leading to both shared understandings which can facilitate group working and possibly reinforcing stereotypes about out-group members (Fiske 2000). Assumptions of out-group homogeneity may be one of the factors which leads to the devaluing of outgroups and ascribing less humanity to them as it may be related to assumptions that significant individuals are distinct, whereas the differences of insignificant individuals, such as those in out-groups, are not worth paying attention to.

Positive intergroup contact may lead to positive relationships, a reduction in stereotypes and changes in behaviour and/or attitudes as a result of learning about the out-group (Islam and Hewstone, 1993; Pettigrew 1997ab). The greatest readiness for out-group contact has been found to be shown by majority groups with values based on universalism and the least by those with traditional values (Sagiv and Schwartz, 1995).

Another factor is honesty in how one views oneself and others and a lack of what has been called doubling. This is a type of intellectual and moral dishonesty which allows behaviour based on different principles and values in different contexts. For instance a female whistleblower commenting on the reason for her action stated that she was not good at 'doubling'. 'at home at night I was supposed to love and care about my family ... at work in the morning I was supposed to regard everyone else's family as expendable' (Alford, 2001). However, it took her ten years to make the connections between her and other people's families and stop 'living in two different worlds'.

One of the justifications for (high tech) weapons based approaches to security is that these weapons are necessary for defence, though it is often not clear against what enemies. Honesty, self-questioning and a lack of 'doubling' would lead to recognition that weapons considered necessary for defence are generally more likely to be used in aggression than defence and against others with just as great a right to peace and security as you have. Recognition of the rights and humanity of other people and that they are not intrinsically 'other' than oneself brings into question the ethics of involvement in the development, manufacture and maintenance of high tech weapons systems, since they will be used against other people who have equal rights not to suffer and have their lives disrupted.

Considerations based on values and awareness of the problems of othering (Hersh, 2015b) indicate that engineers should in general avoid involvement in military work. In discussing the issue with other engineers they could draw attention to the greater likelihood of the use of weapons for offence than defence and try to make links and help their fellow engineers see their similarity to those the weapons might be used against.

7.VIRTUE ETHICS

In virtue ethics, which dates back to Aristotle (Koehn, 1995) the focus is on the relationship between action and character and the effects of the action on the person carrying it out. However, virtue ethics can be linked to other types of ethics and, for instance, classifications of the relationship between particular moral obligations and specific virtues have been both drawn up and criticised (Beauchamp, 2001). The underlying premise is that a morally virtuous person is more likely to behave ethically than someone who purely follows rules. This is possibly a development of the fact that people are generally more motivated and more successful working on a project they believe in, in this case virtuous behaviour, than one they have been assigned to without consulting their interests. Behaviour often has an impact on character. Therefore in addition to virtue ethics being defined in terms of the expected behaviour of a person with particular virtues, virtue ethics can also be seen as the type of behaviour which will promote the development of particular virtues. Although various suggestions for appropriate virtues have been made, it may be difficult to determine the appropriate list of virtues without wider consideration, including of the relationship between desired virtues and group values. Thus, there are often differences in the sets of virtues valued by different cultural, ethnic and other groups.

Application of virtue ethics to the questions in section 1 then leads to considerations of what would a virtuous person do and what the impacts of different actions would be on the character of a virtuous person. This leads to the further question of how a virtuous person should be defined in this context. It is always tempting to define a virtuous person in line with one's own values and I would therefore define a virtuous person to support peacebuilding and the resolution of the problems which lead to be conflict and to be opposed to weapons-based security. It is easy to produce logical arguments for doing this, including the relationship between virtue and caring, creativity (peacebuilding and problem resolution) rather than destruction (weapons based security) and peaceful solutions which do not threaten others. However, it would doubtless be possible for an engineer who believed in weapons-based security to generate arguments to show that this was linked to virtue.

It is also useful to consider the impact of different courses of action on the character of the engineers (and others) carrying them out. Peacebuilding and solving global problems which lead to conflict are inherently positive and consequently likely to have a good effect on character, despite whatever frustrations or even tantrums occur during the process. On the other hand, involvement in military work requires either acceptance that the resulting military technologies could be used, leading to death and destruction, or what I would consider the ability to be not totally honest with oneself, for instance through arguments about deterrence, since deterrence needs to be backed up by a willingness to use the deterring technology as a last resort. I would suggest that working with technologies designed to lead to death and destruction will almost certainly have a negative effect on character. Mental dishonesty will also have negative effects on character, particularly if practised frequently. Engineers and others who prefer weapons-based security to peacebuilding and solving problems may be unaware of these effects. Alternatively, they may support different sets of virtues, which are aligned to the use of force to maintain security.

8. THE IMPORTANCE OF CONTEXT

Consideration of the context in which engineering (projects) take place is important from both a technical and an ethical perspective. From the technical perspective technologies need to take account of and be designed for the context, cultural factors and the needs and wishes of local-end-users. In addition, their design and maintenance requirements should be compatible with the local availability of skills, tools and components, so that the technologies can be maintained and repaired locally. Alternatively, where the provision of technology is part of a technology transfer process, this should including appropriate training for local people in maintenance, repair and the local production of components. Unfortunately, many otherwise well-designed technologies are left to rot after the first malfunction, as they cannot be repaired locally.

From an ethical perspective different contexts, including different power relationships, raise different ethical issues, and engineers have a responsibility to the other stakeholders involved in a given situation. On the one hand there is a very welcome increase in the recognition of the importance and value of environmentally and socially responsible engineering (Moriarty, 2001), though this may sometimes be motivated by concerns about image and public relations rather than a real commitment. On the other, social, environmental and other contextual factors are frequently treated as an add-on rather than integral components of engineering (Moriarty, 2001).

Two examples which show the importance of conceptual factors will now be presented. Both of them raise important issues of responsibility to both the self and others and the need for a holistic approach

8.1 Example 1: A Narrative Exercise

The first example draws on a narrative exercise used in teaching. Such narratives are common**,** presumably to make the problem seem more realistic and relevant. Narratives should be chosen to be realistic and meaningful and take account of the wider context. These narratives are not necessarily neutral and can convey learning messages of their own in addition to the ones associated with the exercises embedded into them. Unfortunately teachers and lecturers sometimes seem unaware of the need to choose appropriate narratives.

To illustrate the potential problems, a computer science exercise used in spring 2016 in a small prestigious US university and reflected on and critiqued by Bucciarelli (2016) will be discussed. The exercise is presented as a solver for a reduced order selection problem. Students are told that Mary, an IT engineer in a small company, has found out that the company plans to lay off every kth person on a number list of the people in her department each week until only the single best person is left. They will choose the 'best' by allowing each person to pick their place on the list. Students are told that Mary knows she can find the best solution to keep her job and are asked to do likewise. This information is followed by a brief presentation of appropriate technical approaches, but there is no discussion of the context or underlying ethics or lack of them of asking people to help decide the order in which they and their colleagues are sacked.

Bucciarelli (2016) reflects on the problem from the perspective of gender and the culture of male dominated environments (Cech et al., 2011), the emotions of both those who are sacked each week and those who remain and what would happen if two people chose the same position on the list. He also draws attention to the fact that exercises of this type encourage students to divorce technical problems from their wider social and political context.

Exercises of this type are problematical because they present the illusion of being set in the real world, while discouraging thinking beyond the narrow confines of finding the technical solution. Particularly when exercises are assessed and contribute to their final mark, students understandably focus on obtaining a good mark and might be worried about the effect on their assessment if they objected to the proposed behaviour. By totally ignoring the needs of Mary's putative

colleagues, this type of exercise also encourages othering and objectifying. Students who are discouraged from emphasising with those presented as their close colleagues, are unlikely to have much interest in others who are significantly different from them. It is unfortunately not unsurprising that engineers and computer scientist educated on problems of this type do not question the need for military work or the consequences of the deployment of advanced weapons systems.

Students are not asked, 'how would you react, what would you feel in this situation? Would you feel anger and outrage? Would you be frightened? Would you really want to treat your colleagues like this? Would you want them to treat you like this? And, if you did, do you think your job would be secure? What would prevent a management this arbitrary from deciding to sack everyone and bring in a new workforce or replace the last person by a robot or expert system without worrying too much about whether or not they could do the job satisfactorily? And, assuming you retained your job, would you really want to single-handedly do not just your own job, but also those of all your sacked colleagues?

Job loss frequently has devastating impacts for workers and their family and friends. It also makes work more difficult for those remaining, due to a combination of increased workloads and stress. Many, though not all countries, have legislation which gives workers rights and does not permit their arbitrary dismissal. The process proposed seems particularly cruel and an abrogation of management responsibilities. It also implies that management is out of touch with reality, since it is unlikely that one person would be able to do the work previously done by the whole workforce. Colluding with this process could also be seen to be unethical on the part of the workers, particularly since there are other options involving collective resistance and creative compliance or non-compliance with the scheme. The workers need to participate or the process will not work. They could collectively solve the problem and then all take the winning job-saving position on the list. They could also join a trade union and threaten and, if necessary, go ahead with legal action, (bad) publicity, and/or industrial action. This threat could be sufficient in itself to make management withdraw its job loss proposals.

Problems of this type do not just depoliticise students, they encourage them to turn off the majority of their cognitive facilities and stop thinking in any meaningful way. They present the illusion of being set in the real world and encourage engineering, computing science (and other) students to consider technology development in isolation from its real world consequences. In the context of military work engineer(ing students) could consider the following questions. How would you feel if the particular weapons system you are considering working on was used against you, members of your family or your friends? Do you know what countries and organisations it will be sold to? What measures, if any, are in place to prevent it being used to prolong existing conflicts or prevent sales to countries with poor human rights records? Do you have confidence in these measures? What do you feel about your share moral responsibility if a weapons system you have contributed to developing is used to kill or injure other people?

8.2 Example 2: A Stranded Hiker

The second example is based on an actual experience (McCoy, 1983). McCoy was hiking in the Himalayas with a friend and supported by bearers and Sherpas. Half way through the 60 day trip they were close to the highest point, a pass at about 5500 metres on the way to an ancient holy place. They and two other groups left at 3.30am to complete the steep part of the climb before the sun melted the steps in the ice. One of the other groups that had gone ahead brought done another hiker who was in a very bad state, but did not want to take them any further. McCoy's friend and the third group stripped off their outer clothing for the person and also provided them food. McCoy, concerned about the possibility of altitude sickness, left following some of the porters. A fourth group arrived with a horse, but did not allow it to be used to transport the hiker (who was still unable to walk) to a hut 300 metres below. The bearers, concerned about making the pass, carried the hiker half the distance to the hut and left them there. The nearest village was two days distance down the mountain.

McCoy discussed what had happened over several days with his friend, who felt that the issue was the breakdown between the individual and group ethic, with no-one accepting responsibility and everyone willing to provide support as long as it did not inconvenience them. McCoy considered that the different cultures involved further complicated things. In addition, the situation was (physically) stressful and there were time pressures. However, stress and time pressures are typical of many of the situations associated with ethical dilemmas.

McCracken et al. (1998) have critiqued the narrative using a number of different ethical theories. They suggested that the hikers' actions will generally be considered justified if rule based ethical approaches are applied and that virtue ethics is required to really understand that the salient distinction is not between right and wrong actions, but between those that are sufficient and those that are excellent. They considered that the hikers should have gone beyond their merely sufficient actions to act with 'heroism' and 'sacrifice', as required by someone of virtuous character.

While valuing virtue ethics and the insights it provides and recognising the importance of collective support, my interpretation is somewhat different. The story illustrates the very human tendency to focus on and become engrossed in your own activities and desires and consequently to lose your sense of priorities and perspective. Rather than recognising the privilege of saving a human life, even if it came at an inconvenient time, McCoy and the other hikers focused on the inconvenience and disruption of their activities and the loss of a unique opportunity.

Application of the ethics of care would have encouraged the groups of hikers to accompany the stranded hiker, not as a heroic sacrifice, but as an act of caring and responsibility to another human being. It would have also led them to look for ways to meet their own needs without having to desert the

hiker. For instance, they could have reached the holy place on a lower path. In the case of McCoy and his friend, their greatest previous experiences in the Himalayas had involved staying with local people and participation in a funeral ceremony respectively, not climbing high passes. This indicates, that accompanying the hiker could have been the source of further interesting experiences rather than a sacrifice. However, while ethical behaviour does not always required sacrifice, it is equally true that this is not always the case and that behaving ethically may demand hard choices between what you want and what you believe to be right.

I have deliberately initially not provided any information about the different groups of hikers, but it is possible that a degree of othering took place, as the person was a sadhu or Indian holy man (barefoot, almost naked and malnourished) and clearly very different from everyone else involved (US, Swiss, Japanese, New Zealanders and Nepalese). McCoy's friend even asked him whether it would have made a difference if instead of a half-naked sadhu the person had been a well-dressed western woman, Nepali or Asian. It is unfortunately frequently easier for many people to really perceive another person and their needs if the are from a similar ethnic group or background to themselves and not poor and marginalised.

The narrow intense focus of the hikers that I have critiqued also has advantages and can enable the solving of problems which otherwise would prove intractable and great achievements of different types. However, it is important that this focus does not result in a loss of awareness of the context to enable engineers and others to work on projects which are contrary to their beliefs and values. The question could be posed as to whether, for instance, any of the engineers and others involved in developing the Nazi gas chambers became so focused on the technical problems of their day-to-day work that they ceased to think about or possibly never even found out the intended applications of their work. The same question could be asked of engineers involved in military work. While a deep focus on the professional activities can be admirable, engineers and other professional still have a responsibility to consider the applications of their work and whether this is consistent with their core values and beliefs. They also have an ethical responsibility to consider whether they are unconsciously othering particular groups and treating them in ways in which they would not want their own families to be treated. These are also issues which engineers can raise with their colleagues. Awareness of context implies that engineers wishing to engage in peacebuilding should involve and work with stakeholders, including local people, try to learn their culture and if possible their language; and respect them; and work in ways which build local capacity.

9. CONCLUSIONS

One of the oldest narratives of killing is the biblical story of Cain killing his brother Abel. He feels shame afterwards and is physically marked to indicate his separation from the rest of humanity as a result of the act of killing. Engineers have contributed to the development of weapons which enable killing from a distance and consequently without shame or the need for the killers to see and recognise the humanity and kinship with them of those they are killing.

The use of armed 'drones' increases this distancing and removing both government and the military from feelings of responsibility for the consequences of the use of military force. They are robotic planes flown by ground-based pilots and guided by space satellite technology from computer terminals, possibly at distances of several million kilometres from the conflict site and the resulting deaths and injuries. The larger US drones are armed with cluster bombs and missiles and there are plans to use then to replaced bombers (Webb et al., 2010). Since they generally identify people using heat sensors they are unable to distinguish between civilians and combatants. Therefore their increasing use is likely to increase the number of civilian casualties. There are also moves to one person monitoring a large number of drones with little power to intervene and this may be the first stage in totally phasing out human controllers (Sharkey, 2008). Engineers have had a major role in developing armed drones and the other technologies which are continuing to change the nature of war and violent conflict. Engineers have also had a significant role in developing and maintaining, for instance, systems for generating energy from renewable sources, producing and distributing clean water and sanitation systems. Thus engineers face both serious challenges, ethical as well as technical, and great opportunities to make a real contribution. Their experience and expertise could have a significant impact on resolving the serious problems that lead to violent conflict and war and thereby support peacebuilding.

The five questions presented in the introduction and a number of different theories of and approaches to ethics have been used to explore the associated issues, including those related to the preference of many countries for security based on high-tech weapons rather than peacebuilding and resolving underlying problems. Although important as an indication of support for ethical principles, codes of ethics have been found to lack the relevant details, particularly on resolving conflicts between different principles, to provide useful insights on these issues. All the other theories and approaches provided useful understanding of the issues, supported the value of peacebuilding and indicated arguments that engineers could use to convince their colleagues. Further development of codes of ethics will be necessary to make them relevant to contentious issues such as military work. Particular insights relate to the importance of context and the role played by othering and doubling in making different treatment of different groups of people, including the use of high tech weapons against them, acceptable.

However, the work presented here is only a preliminary and partial attempt to answer the five questions in the introduction. Considerable further and more in-depth discussion is still required, using both the theories and approaches presented here and others not considered. In addition there is a need to investigate the views of engineers and how these are correlated with factors included those related to personal characteristics, experience and areas of expertise.

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