

REVIEW PAPER

Study of environmental management systems on defence

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ABSTRACT: The effective and sustainable environmental performance of a business is a result of various factors and most important the integrated outcome of the environmental management. Likewise, the integration of environmental protection into the armed forces functions has also gain interest for the military sector internationally. Therefore, the environmental management system (EMS) is recognized as one of the most widely used tools. This study provides a review on environmental management issues related to the military activities and their assessment globally. The multitasking characteristics of the defence sector result in the need for the eco-friendly related issues to be directed in a holistic and integrated way, with the help of a certified environmental management system. North Atlantic Treaty Organization (NATO) itself and NATO countries, like USA, UK, Canada, Holland, Denmark, Czech Republic, Greece, as well as non-NATO countries like Sweden and Australia have an environmental management system structure in place to assist military environmental management and studies reveal that the armed forces could anticipate positive outcomes from environmental management system. A case-by-case approach, of the above, is examined and based on the results, appropriate recommendations are presented, which may contribute to the environmental management system considerations as the most important tool for effective management framework and most importantly to evaluate its effectiveness as a structure for the defence sector's activities.

KEYWORDS: *Armed Forces; Defence; Environmental management system (EMS); Environmental protection; Military; North Atlantic Treaty Organization (NATO)*

INTRODUCTION

It is generally accepted that during the past few years, there has been a great interest in environmental management, resulting a number of relevant frameworks and tools (Kolk and Mauser, 2002). The need for addressing environmental management issues in a holistic manner has increased significantly, due to various reasons, such as growing complexity and uncertainty in environmental situations with a broad range of effects, introduction of relevant legislation, constant environmental pressure and request for more effective management of the non-renewable resources, public participation in environmental decision making (Rao, 2005; Reed, 2008).

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Environmental management as a concept is consisted of multidimensional and complex characteristics and targets and includes a variety of domains, such as technologies, products, processes, activities, management and strategies tools (Wang and Wu, 2013). It is a framework for effectively managing the activities of an organization in order to secure performance in an environmentally responsible manner. Moreover, it is a set of processes and strategies that assist the management of all resources in an organization, so as to reduce the environmental burden while improving economic performance (Iraldo *et al.*, 2009). Nowadays, environmental management systems (EMS) among other tools like environmental impact assessment (EIA), cost-benefit analysis (CBA) and life-cycle

assessment (LCA) ensures public environmental performance information, and also an organization's board's decisions to be eco-friendly (Wang and Wu, 2013). Thus, the Environmental Management System approach is recognized worldwide to be one of the most effective tools (Wang and Wu, 2013). It has been adopted by many firms and organizations influencing their structure and procedures so as to achieve their environmental goals and improve management control at the same time (Nishitani, 2010). Up until today, there have been two major environmental management systems. First of all, the ISO14001:2015 is the most widely used global standard providing guidelines for an EMS implementation (NHDES, 2002; (Wang and Wu, 2013; Morrow and Rondinelli, 2002), which has gained global recognition. Secondly, the EMAS (Eco-Management and Audit Scheme), which is a state run system introduced by the European Union and therefore mainly applied in the countries of the European Community. Those two systems present a lot of similarities in that they are both formalized standards that do not substitute national laws and regulations (Honkasalo, 1998, Freimann and Walther 2001; Rennings *et al.*, 2006).

ISO 14001, as an established framework for an EMS is a holistic approach which allows for environmental considerations to be integrated and incorporated into the everyday life and decisions of an Organization. It provides the directions and basic guidelines for the planning, doing, checking, monitoring, evaluating, communicating and updating of an environmental program. It assists an organization to control the impact of its activities, conform to current legal requirements, but as well as to identify and act proactively, thus, manage future sources that might have a negative impact. It is mainly based on four stages; Plan, Do, Check and Act, which is as well known as PDCA cycle (Ferro, 2012). Accordingly, the ISO model is considered to be one of the most suitable standards to be used by the Armed Forces internationally, so as to help the defence sector support environmental protection (Dawson, 2004; Ramos and Melo, 2005). However, it should be noted that just as every organization, the Army needs to establish their own EMS, adapted to their unique sole characteristics, since the ISO standard does not specify the criteria nor the aspects of environmental management of concern (Nawroka and Parker, 2009). The environmental management of the armed forces activities seems to be a growing concern for military

forces worldwide (Ramos and Melo, 2006; Anderson *et al.*, 2007; Bioce, 2007), The military sector and the Armed Forces are an essential and sensitive part of any nation incorporating multi-dimensional and complex characteristics. Apart from its strictly military activities, the army is also involved in a number of civil activities as well, the most important of which is the civil defence. The army usually cooperates with the local and federal authorities of each country in cases of threats or emergencies in order to protect people, land, buildings, industrial and telecommunication activities, public health and infrastructure. In fact, there are a lot of occasions during which the army is required to respond to environmental threats and natural disasters such as earthquakes, floods or oil spills providing personnel and specialized equipment and contributing to a series of efforts for special events. Naturally, the context and relevant legislative framework is different in every country, but the general purpose is common in the sense that the armed forces play a key role in the protection of the country from any external or internal dangers. However, this does not undermine the fact that their equipment, infrastructure and actions have significant impact on the environment, but rather complicates the issue of environmental strategy so as to combine the defence mission and the environmental protection.

Additionally, military authorities all over the world recognize that the effective environmental management is a key factor in order to ensure operations in the long run ((Wang and Wu, 2013). Thus, it is clear to everyone now, that environmental management is a necessity not just for the public, but also for the sustainability of military land and operations. However, the challenges presented in the military sector are enormous, and the integrated management of its activities should be a priority.

It is crucial to examine in depth the environmental impact of defence activities, because such an examination will provide the information required to form the baseline for the proper policies and measures. A usual mistake is to consider that measures are the result of the effective implementation of an EMS. The management system usually unveils their necessity early enough, so that particular actions can be decided by the military authorities proactively and not after the impacts result in inappropriate outside coercions. In addition, effective control-mechanisms and improved communications are required, which means greater efficiency in decision making (Zutsi and Sohal, 2004) and this is precisely the main advantage and the essence

of every environmental management system. Another important aspect regarding the EMS and in particular the ISO standard, is the evaluation of the effectiveness of its implementation, and the relationship between environmental management and improvement in the environmental and economic performance (Schylander and Martinuzzi, 2007). As far as the military sector is concerned, there are only few studies focusing on the successful implementation of environmental management systems. However these few studies illustrate that there are great benefits emerging from the combination of environmental awareness with military purposes (NATO-CCMS, 2000; Anderson *et al.*; 2007, Dawson, 2004). The EMS standards and guidelines secure continual environmental improvement of the military sector, ensuring that the environmental goals in the future will be met. However, implementing an EMS demands the top level management loyalty and relevant policies to be adopted. The needed procedures and the proper steps should be written and well documented while it is of utmost importance to carefully schedule the training sessions for each level, in order to ensure that everyone is capable and qualified to act effectively. Nowadays, several nations are carrying out studies in order to integrate an EMS into their defence sector, and the majority of them use the ISO 14001 or other similar EMS frameworks for their baseline structures. Several examples are reviewed in different studies. Unlike, in Greece, it was only in 2007 that the Ministry of Defence (MoD) announced its Environmental Policy and in 2010 a memorandum of cooperation was signed between MoD and the Ministry of Environment, Energy and Climate Change (MoEECC). This paper focuses on the environmental management of military activities using the tool of EMS. It will try to review the implementation levels of EMS as well as to evaluate its effectiveness in the military activities. From the literature review, it is clear that there are only a few studies of the EMS results and performance in the military activities. More research is, therefore, needed. Sustainable environmental management is a social responsibility, and defence is not exempt (Ramos and Melo, 2005). This study has been carried out in Portugal where a national survey was carried out, involving a representative sample of the armed forces and defence administration in 2016.

Environment and EMS in the international defence sector

Armed Forces' activities may have environmental consequences, including wastewater and solid waste

generation, water pollution, soil erosion, atmospheric pollution and many others which degrade the ecosystem and natural resources and / or harm the human health (Ramos and Melo, 2005, Doe *et al.*, 1999). Military camps and training areas may be situated in sensitive ecosystems, so their environmental management has gained public concern and has recently become a hot research topic (Wang and Wu, 2013; Rao, 2005). Moreover the army is using and handling various hazardous materials that need to be stored, transferred and managed properly. Some of the most commonly used appear in Table 1 (US Department of Labor, 2007, British Ministry of Defence, 2012; British Ministry of Defence, 2016). Naturally the purpose of this Table is not to demonstrate an exhaustive list of hazardous material found in military operations, but to show the basic categories. Moreover, the defence sector's environmental footprint is usually substantially bigger than other sectors', including public and commercial activities (Kreizenbeck, 2004).

A number of researches have been conducted regarding the defence sector's response to the environmental problems presenting several techniques and approaches to the environmental issue. (Wang and Wu, 2013). It seems that the most effective method in order to secure the environment and operational capabilities is the implementation of an EMS (Steucke, 2000 ; Rao, 2005). In 1996, after examining the baseline data, a NATO Pilot Study concluded that EMS implementation and especially ISO 14000 can produce benefits for military actions and reduce costs (Dawson, 2004).

The majority of the Armed Forces use the same or familiar tasks and infrastructure, with civilian activities so the demands are more or less related. But, their basic difference lies in the fact that the primary role of the military sector is the military defence; thus the primary consideration is to serve and protect the security and global peace. Therefore, other priorities like the environment will always hold less importance. As a result, the implementation of an EMS is a rather complex and extensive procedure, addressing far more legislative, administrative and practical difficulties and requirements, compared to the implementation on a firm or in the rest of the public sector (Sinclair and Tschirhart, 2001). But, it is up to the military authorities to take into account significant environmental aspects and combine the primary mission of the Army with sustainability, for

the following reasons:

- Sustainable approaches will ensure the long run of the military activities.
- Eco-friendly approaches will improve the image of the Armed Forces to the public and enhance their bounds.
- Reduced costs will be the outcome of the effective resources management.

North Atlantic Treaty Organization (NATO) itself and NATO countries, like USA, UK, Canada, Holland, Denmark, Czech Republic, Greece, as well as non-NATO countries like Sweden and Australia have an environmental management system structure in place to assist military environmental management and studies reveal that the armed forces could anticipate positive outcomes from environmental management system.

Table 1: Hazardous materials in the military

Compressed gases:	Gas or mixture of gases having in container a specific pressure. Usually stored under pressure in cylinders. liquefied, non-liquefied and dissolved gases
Acetylene	Dissolved, colorless gas widely used as a fuel and a chemical building block. It is unstable in its pure form and thus is usually handled as a solution. Pure acetylene is odorless, but commercial grades usually have a marked odor due to impurities
Hydrogen	Hydrogen is used in various forms such as gaseous hydrogen, cryoadsorbed or liquid as a fuel. At <u>standard temperature and pressure</u> , hydrogen is a <u>colorless, odorless, tasteless, non-toxic, nonmetallic, highly combustible gas</u> .
Oxygen	At <u>standard temperature and pressure</u> , it takes the form of <u>dioxygen</u> , a colorless and odorless <u>gas</u> . It is often used for medical purposes
Nitrous oxide	(laughing gas) At room temperature, it is a colorless, <u>non-flammable gas</u> , with a slightly sweet odor and taste. It is also a major <u>greenhouse gas</u> and <u>air pollutant</u>
Flammable liquids	Defined as liquids with a <u>flash point</u> below 100 degrees Fahrenheit (38 degrees celsius). They are basically used as fuel in military operations and sites.
Spray finishing	Powdered material that are used as coatings and include flammable and combustible material
Liquefied petroleum gases	Material that is composed predominantly of any of the following hydrocarbons: propane, butylenes, butanes, propylene. Basically used as fuel for machinery and vehicles.
Petroleum and products	Petroleum products include a large number of substances used in transportation fuels, fuel oils for heating and electricity generation, asphalt and road oil, distillates for making chemicals, plastics, and synthetic materials. The army is usually one of the main consumers of these products. There are many dangers stemming from handling various petroleum products, the most basic of which is fire or explosion, contamination of resources by leaks etc.
Explosives	Chemical compounds, mixtures or devices that have as a primary purpose to function by explosion with substantially instantaneous release of gas and heat. There are numerous substances belonging to this category, such as dynamite, black powder, blasting caps, fuse lighters, igniters, arms and ammunition, cartridges for industrial guns etc.
Toxic substances:	Substances made by humans or introduced <u>into the environment by human activity</u> which are poisonous to living <u>organisms</u>
Asbestos	A set of six naturally occurring <u>silicate minerals</u> , which all have in common thin <u>fibrous crystals</u> , with each visible fiber composed of millions of microscopic "fibrils". Prolonged <u>inhalation</u> of asbestos fibers can cause serious and fatal illnesses
Lead-based paints (LBP)	Lead is added to paint to speed up drying and increase durability. Although lead has been banned from household paints in the United States since 1978, paint used in road markings may still contain it.
Persistent organic pollutants (POP)	This is a general category of substances that includes insecticides and pesticides, PCBs etc. They are resistant to normal breakdown processes and are bio-accumulative
Batteries and battery fluids	Battery storage can present serious environmental problems and safety concerns. The electrolyte in most batteries is sulfuric acid, which is classified as a toxic substance. Moreover, they usually contain other hazardous substances such as cadmium, mercury, etc.
Radioactive waste	This does not apply to all countries, because not all countries MoDs have nuclear activities. The radioactive waste is the waste generated from atomic defence activities such as testing and developing of nuclear weapons as well as from uranium mining

Sweden (non-NATO)

In 1995, a report of the General Staff of the Swedish National Defence analysed for the first time the impact of its activities on the environment, taking into consideration the national policy. This report was based on the evaluation of 13 environmental risks, where the Swedish Environmental Protection Agency identified more than 170 environmental issues. All of the above led the Armed Forces of Sweden to present an integrated Environment Plan ([Sweden, Environmental Council, 1996](#)), with multiple objectives, goals and actions so as to reduce the impact of their activities on the environment. The basic components of the Plan are presented in the following paragraphs. Consideration of environmental aspect, when purchasing new vehicles.

Emissions to soil, water and air

- Minimise emissions of substances that deplete the ozone layer
- Reduce greenhouse gas emissions compared with 1995 levels, with
- Gradual change towards fuels with less impact on the environment
- Reduction of the Armed Forces's energy consumption, compared with that of 1995, with a survey of electricity consumption and local fuels
- Consideration of the environment aspect, when purchasing new vehicles

Materials and waste

- Minimise the use and environmental dispersion
- Creation of a list of items that harm the environment, and
- Development of procedures for the use of hazardous waste.
- Implementation of recycling principles, preventive principles and best available techniques, when material is purchased, to reduce (as much as possible) environmental impact -
- Guidance of manufacturers to conform to environmental requirements when purchasing.
- Introduction of lead-free, small-caliber ammunition in the training of personnel.
- Sketching the polluted area of waste ammunition in the shooting ranges of the Armed Forces.
- Introduction of processing methods to mitigate potential damage from these residues.

Using soil and water

Promotion of biodiversity and genetic differentiation through the:

- Investigation of soil degradation
- Processing of environmental projects for the exercises and shooting fields.

Noise

Control of the noise with:

- Reduction of sound propagation in small arms shooting fields, and construction of build halls to reduce noise, if necessary.
- Experiments and assessing performance of quiet equipment such as silencers pistols.
- Measurement of the noise at the airfields and elimination of problem areas.
- Development of a program to monitor and protect the personnel.

Environmental targets are not focused on environmental threats

Deepening of consciousness-waking about environment in the military sector, with:

- The continuous training for all environmental experts, as well as all the personnel, including the cadets of the military academies.
- Monitoring the national and international environmental conferences twice a year for professional and semi-professional environmental protection, and units' commanders.

Implementation of an EMS in the Armed Forces, with:

- Elaboration of the environmental plans for Branches of Headquarters.
- Elaboration of the environmental projects at local level.
- The Development of an environmental handbook.
- The Elaboration of an environmental inspection system.

Continuous promotion (marketing) of the environmental work of the Armed Forces in society, by:

- The conduct of annual conferences, with representatives of the Environmental Protection Agency, the Chemicals Inspectorate and all regional authorities.
- The participation in international environmental conferences and events.

Cooperation with regard to environmental work related to defence, with:

- USA
- Participation in the CCMS (Community on NATO the Challenges of the Modern Society).

The environmental policy is distributed to all employees, so as to inform everyone. This effort is supported by training and competence processes for assuring that each one is aware of and compliant with the policy. The Swedish National Defence General Staff (Sweden, Environmental Council, 1996) is responsible to decide about which part of the environmental policy will be presented to the public.

Defence Ministry stated about the environmental policy that:

The ultimate goal of the Armed Forces is to act against the war discouraging, avoiding in this way environmental destruction brought about by the war. In peacetime, the main objective of the Armed Forces will be done in accordance with environmental protection laws and with minimal impact on the environment by:

- Endorsement of the environment in all its plans and activities.
- Minimize the use of unknown substances in nature.
- Minimize the use of energy and finite resources.
- Minimum use of raw materials and minimize waste.
- Strive for continuous improvement in the environmental field.
- Reduction of sound propagation.
- Promotion of biodiversity.
- Involvement of all personnel in environmental work.

- Helping society to environmental disaster. “

Australia (non-NATO)

Regarding the practices and methods of environmental management, Australia’s Armed Forces have also gained concern and become increasingly aware. Like other countries, Australia has also adopted the ISO14001 standard in many governmental bodies (Wen *et al.*, 2010). By the end of 2003, it was required by the Australian government that all agencies implement a certified EMS. Accordingly, the Australian Defence Force (ADF), acknowledged its environmental responsibilities, and in 2001 developed and integrated EMS based on the ISO14001 standard, in order to comply with the national legislation and the governments’ requirements. The goal was to establish the proper framework for integrating environmental performance into every day and routine operations and military activities. Likewise, the ADF adopted relevant guidelines and measures accordingly to the EMS in order to facilitate environmental management (Wang and Wu, 2013). Australian’s MoD EMS model is presented in Fig. 1. It established a set of specific guidelines and measures accordingly to the developed EMS in order to facilitate effectively the management of environmental aspects.

NATO and EMS

NATO, as noted before, set the example during the 1990s and tried with a pilot study to initiate the

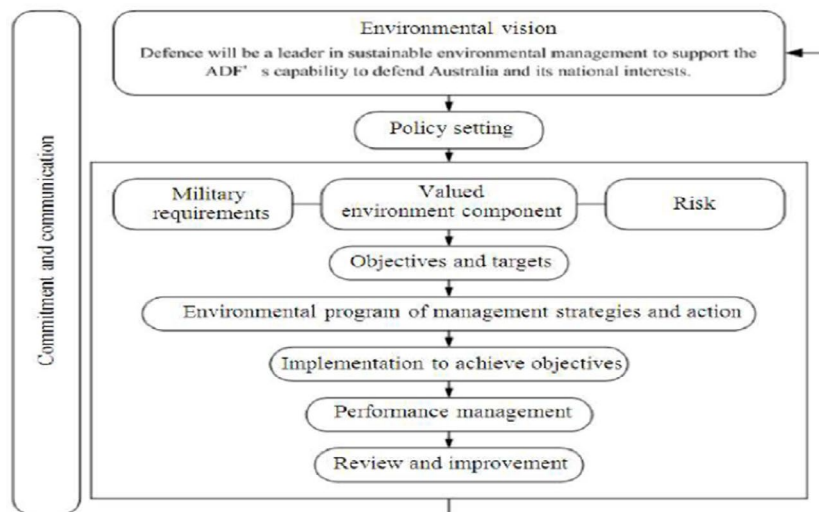


Fig. 1: The Australian Defence Force EMS model (Source: Wang and Wu, 2013)

process of the environmental protection in the defence sector, proposing the ISO 14001 EMS framework. The implementation of the international standard in military activities was recommended by the CCMS of NATO Alliance which emphasised its advantages. The pilot study, apart from establishing some basic guidelines for the incorporation of environmental considerations in the military sector (NATO-CCMS, 2000), concluded that EMS integration in Armed Forces would have better results, if the ISO14001 framework was implemented. In the following years, a lot of effort was put in order to transform the theoretical EMS into a viable one for the defence sector (Wang and Wu, 2013). Several NATO members MODs have tried to embody it in the defence activities and the relevant legislation. Moreover, these initial policy guidelines have been complemented with several NATO Standardization Documents (STANAG), such as STANAG 2583 (NATO, 2011) and STANAG 2582, published in 2011 and revised recently (NATO, 2016), that are considered today as the best practice handbooks for the headquarters (HQ) and also for the operational and theatre level staff.

Environmental policy for military operations in the NATO is characterized generally by a set of principles which promote environmental stewardship and protection and are described below:

- the ethic that everyone has the responsibility to protect the environment;

- regulatory compliance and respect of the relevant international agreements;
- include environmental planning in every planning process;
- the target to minimize the environmental impacts and damage at the least levels;
- setting environmental standards and measures to control the performance according to them;
- prioritize the waste management framework;
- ensure the effectiveness of handling and storage of hazardous substances and the response to environmental accidents or incidents as well as the report procedure of them in order to be secured from any hazard.

In order to ensure compliance with the standards, as stated above the leaders or the Commanding Officers of the units should always be aware of the environmental policies and be able to set and define the proper requirements through documentation like the MoI (memorandum of intent), SOP (standard operating procedures), or other Army Regulation Directives. Furthermore, the Environmental Officers need to be always aware of the mission objectives, be familiar with environmental protection standards, be the environmental planning leader and finally develop and implement the proper EMP (Environmental management plan). The key features and structure of the NATO EMS (NATO, 2008) are described in Fig. 2.



Fig. 2: NATO EMS structure planning (Source: NATO, 2008)

Denmark (NATO)

In 1993, a committee for the protection of the environment and nature of the Ministry of Defence (DMD) started its work (Alemany, 1995, Joseph, 1996). Its objective was to support efforts to protect nature and the environment, in collaboration with various principles of defence and the public.

At the initial stages, the Committee drafted a policy for the protection of the environment, which defined the areas for environmental efforts: policy, legislation existing situation of DMD, education and information. Defence Construction Service was assigned the task to develop and launch an EMS under the auspices of the DMD, based on the British Standard 7750, which was the world's first environmental management systems standard.

In 1996, the implementation of the new directive «Environmental Management in the Danish Defence» was accompanied by seminars for environmental engineers and heads of establishments. The directive had five chapters:

- a. Environmental Policy
- b. Design
- c. Implementation and operation
- d. Checking and corrective action
- e. Management review.

For each area of the above, the environmental managers wrote procedures. The structures of procedures were uniform and included purposes, references and action.

Later on, in 1997, a necessary modification of the initial EMS was made when it was decided to use ISO 14001.

According to the Danish experience in the implementation of an EMS, it is absolutely important to involve the top management of the Ministry. The commitment of the top leaders (Minister and Chief of Staff) can form the base of the environmental direction, which will incline all the officers involved to act accordingly. Of course, the structure and the discipline of the Defence section need to be followed as well, since this is one of the key features of an army and an EMS should not try to change it, but to take advantage of it and engage it in the implementation.

Another important issue to be taken into consideration is the selection of environmental managers that come from different grades and background. Unfortunately, the Armed Forces promotion system requires that some of them to be

moved to other locations, even if they are in the middle of a major step of installing the EMS of their facilities. Its importance cannot be displaced by environmental managers, perhaps because the role of environmental managers in the body has a low priority.

United Kingdom (NATO)

The Eco-Management and Audit Scheme (EMAS), has given the country an important experience in EMS, as it was adopted by many municipalities and communities. With the White Paper (Great Britain, 1990), which was the first effort to establish an environmental framework, the government set a target (commitment) for all ministries to develop strategies for environmentally sound management until 1992. In 1997, the Prime Minister committed personally and the responsible DETR (Department of Environment Transport and Regions) followed. The DETR then formulated a guide for ecological governance («greening government»), to be followed by all ministries (Department of Environment Transport and Regions, 1998). The guide is so structured, so as to help the Ministries to improve their environmental management strategies. The Ministry of Environment became the first Ministry, certified by BS 7750 and ISO 14001 and assisted other Ministries to introduce an EMS to manage their environmental agenda.

The Ministry of Defence, just as many other ministries in the government, based its own policy on the document “Implementing Environmental Management Systems: Guidance for Government Departments”. In order to ensure compliance with the general target of the government to promote environmental protection, the MoD set an action plan so as to achieve their objective. The Department needed to:

- follow the DETR lead in implementing an ecosystem management as the principle for the protection of natural resources in line with government policy
- introduce practices that sustain the integrity of land and natural resources
- evaluate economic costs and benefits emerging from this implementation
- maintain an environmental manual (JSP 418), to serve as a basis upon which the army can assess its strategic decisions embedding environmental considerations
- provide funds allocated through its budget.

- conduct training and awareness programs to educate all personnel on environmental management issues and verifying that everyone from simple officers to managers and high rank officials are competent and well aware of their responsibilities and accountabilities.

Czech Republic (NATO)

The Czech Republic became a member of the EU in 1995, but by then an environmental policy had been already been adopted while EMAS was chosen to be used for the protection of the environment. By now, most of the advanced companies in the country have been certified with EMAS or ISO 14001 standards. The Czech Armed Forces have already started the process of incorporating an EMS. According to the decision of the Minister of Defence in 1997, ISO 14001 was the EMS to be adopted by the Czech Republic Army (NATO-CCMS, 2000).

Holland (NATO)

The Dutch Ministry of Defence has initiated environmental policies and programs in compliance with national policy and has set twenty one targets according to the government’s policy. These targets reflect the effort to minimize emissions and generally substances and products that have a negative impact on the environment as well as disturbance on the land and natural resources. In order to monitor the success of the objectives of the environmental policy, the Defence Ministry established a working group to write down the main environmental indicators, which will illustrate the progress that has been achieved in comparison with the starting point (Holland Ministry of Defense, 1998).

A basic aspect of the fulfilling of the requirements and goals set by the Ministry of Defence was the proper collection and processing of environmental data. However, it is noteworthy to mention that the Dutch Army is engaged in various activities outside the country boundaries. To achieve reasonable limits for the range of measurement and data collection, the Ministry established the portion to which any environmental impact happens for every environmental objective. Only if the environmental impact is worldwide, then it will be measured worldwide. For the primary goals put Table 2 shows geographical limitations.

Another important issue is that raw data should be checked for their reliability before their announcement to the government. Verification will be completed when the data are consistent with the way collected, which is an essential step in the monitoring process. Verification is aimed directly at the raw data rather than the raw data collection method. The data will be checked for the below items:

- Range of details
- Units
- Update
- Reliability (followed the prescribed methodology when collecting data?)
- Accuracy (accuracy is consistent with the questions standards?)
- Avoiding mistakes (who collected and what?)

The collection method should be checked for:

- Integration (reached the desired level of integration?)
- Reproducibility (can the way collected data lead us to the sources?).

Table 2: Environmental impact consideration at the local and global level

Objective	Scale	Measurements and out of military area?
Use of water	Locally	No
Ozone reduction	Worldwide	Yes
CO ₂	Worldwide	Yes
Other greenhouse gases	Worldwide	Yes
Acidification	Worldwide	Yes
Waste	Locally	No
Waste management	Locally	No
Energy usage	Worldwide	Yes
Adequate energy	Worldwide	Yes
Sustainable energy	Worldwide	Yes
Noise (homes insulated out of bases (legal obligation)	Locally	Yes
Restoration of soil	Locally	No

Canada (NATO)

The Canadian Land Force (CLF) established the “*Army Environmental Strategy*” and the “*Army Environmental Policy*”, recognizing the importance of taking into account the environmental aspects in all decision making processes (Ferro, 2012). In 1992, the Canadian Army approved the initial “*Land Force Command Environmental Action Plan*” and revised it in 1995. In 1995, the federal Ministries and services were asked to establish an EMS and adopt an internal regulatory strategy in order to minimize their environmental impact. The “*Guide to Green Government*” was also released in 1995 (Auditor General of Canada, 1995). The Commissioner of Environment and Sustainable Development, was the responsible authority to monitor the progress of the Ministries towards achieving the objectives of sustainable development and implementation of their action plans to and report the results annually in Parliament. The Ministry of Defence as one of the ministries involved in this effort, introduced several programs which extended from the fitting of special structures for oil collection, under the parked cars, to providing emergency aid for flood victims. The readiness of the Canadian Department of Defence to environmental protection and the contribution to it was reflected in the first Sustainable Development Strategy. In 1997, the “*Leader’s Guide to the Environment*” was also published (Ferro, 2012).

Generally, the initial approach led to the integrated plan which provided the proactive actions and frameworks towards sustainability and ecosystem protection. The Canadian Army environmental experience showed that continual improvement is a fundamental aspect to be considered in an EMS process. It also illustrated the need for the master plan to be reviewed and updated if needed every three years (Privy Council Office and the Canadian Environmental Assessment Agency, 2004). As a result, the Land Force Command presented in 1999 its first EMS framework based on the ISO 14000 standard and so far it has been updated two times, in 2008 and 2011.

USA (NATO)

United State of America was the first country to integrate environmental tools in the Defence sector. The U.S. Department of Defence and the army in general is one of the largest land owners in the country

(more than 12 million acres) and has a critical need for space and waters, where it can facilitate its training activities (Doe *et al.*, 1999; Rao, 2005). Therefore, in order to maintain the integrity of the land and natural resources in general, the U.S. Department of Defence (DoD) was the first in the sector of Defence worldwide to establish a formal structure in order to implement an EMS in 1970. Ever since the 1970’s, various environmental policies, directives, army regulations, and systems have been instituted by the U.S. Army to ensure its compliance with national policy and to reduce impacts and effects on the environment. In recent years, there has been an effort on behalf of the DoD to conform to the ISO 14000 standard, which has been considered to be the most suitable systematic approach (Sinclair and Tschirhart, 2001; Beal, 2002).

In early 1996, the Minister of Defence acknowledged the need to introduce environmental management systems in accordance with ISO 14001, to enhance maturation of the environmental DoD program. After conducting a conference with the participation of industry and key people from the General Staff, the Defence Ministry decided to comply with ISO 14001 in fifteen bases, in order to decide on the implementation or not of ISO 14001 principles.

This phase started in 1997. After two years, it was found that the application of the standard upgrades environmental projects and helps environmental managers to recognize more easily the effect of the Armed Forces on the environment. Consequently, the Defence Ministry decided to encourage the adoption of ISO 14001 as a good practice.

The U.S. Army Environmental Strategy into the Twenty-First Century, published in 2004, presents the guidance for achieving the environmental objectives set by the Department (Fig. 3).

This strategy (Fig. 4) consists of four environmental areas which are *compliance, restoration, prevention, and conservation* and each area has relevant objectives (US-Army Environmental Center, 2004; Sinclair and Tschirhart, 2001).

The Strategy summarizes an action plan to develop a long-term sustainability in order to achieve the following aims and targets:

- Sustain and even strengthen contribution to joint operational capability,
- To achieve the present and future training, testing, and mission objectives and requirements,



Fig. 3: Continuous improvement of the US Army EMS (Source: US Army-Environmental Center, 2004)



Fig. 4: The US Army Environmental Strategy (Source: US Army-Environmental Center, 2004)

- Increase abilities to run installations, including growing interdependency,
- Minimize impacts and reduced costs,
- Improved human health and safety.

While providing incentives for innovative actions. The strategy presents the long-term vision, founded on sustainability that demands from the army to accomplish its mission in the long run.

In December 2005, “*The Environmental Management System–Implementers Guide*” was published, whose purpose was to provide personnel with a comfort, easy to follow tool for implementing the Armed Forces’ EMS (US-Army Environmental Center, 2005).

In March of 2007, “The Commander’s Guide for Mission-Focused Environmental Management System” was published so as to give the primary directions to commanders (US-Army Environmental Center, 2007).

During the past 30 years, the U.S. Army has continually focused its efforts to sustainability so as to be finally fully aligned with ISO 14001. Just as many other EMSs, the ISO 14001 is directed on development of systems, which help to achieve the objectives that have been set in the environmental policy. Most of the existing systems are designed to be performed according to the same Plan-Do-Check-Act (PDCA) cycle (Fig. 5).

The U.S. Army before the implementation of the ISO standard, had already adopted a series of global environmental standards, therefore had all the major components for an ISO registration. However, it was required to increase the level of commitment and to improve the specific requirements for environmental performance. The relevant Armed Forces regulations which provided the guidelines and the general structure in accordance with ISO 14001 can be categorized as following: Army regulations (AR), plans and strategies and management processes, reports, and databases. But as it was mentioned earlier, additional documentation were needed to meet the exact ISO requirements.

The “US Army Environmental Management System – Implementers Guide” describes 30 EMS implementation steps (Fig. 6). After the implementation of the basic elements of the EMS, the Army can focus on continual improvement, continuing to operate and examine the EMS and its methods, finding ways to make diagnostics in order to increase both effectiveness and ease of use.

Hellenic (Greek) Armed Forces (NATO)

In 2007, The Hellenic MoD published its first environmental policy while trying to incorporate and comply with the relevant European legislation, as well as the NATO released doctrines and STANAGs. It was based in four basic principles:

- Compliance with Legislation
- Prevention and Proactive action
- Restoration
- Conservation

Under those principles’ structure, the primary objectives and main tasks of the 2007 Environmental

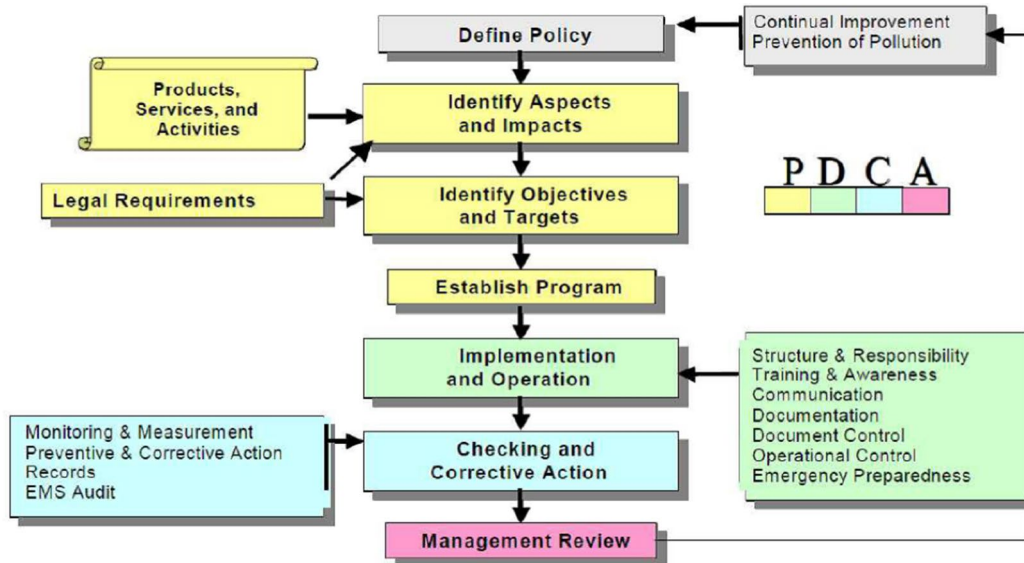


Fig. 5: PDCA cycle of the US Army EMS
(Source: US Army-Environmental Center, 2005)

Policy can be categorized as below:

- Prevent and reduce environmental damage.
- Conduct waste management.
- Achieve energy efficiency.
- Reinforce recycling.
- Reduce noise
- Collaborate with academic or research institutions.
- Protect Maritime habitats
- Recover from negative environmental effects.
- Training of Military Environmental Officers.
- Training of military personnel and take measures to increase environmental awareness.
- Protect EP installations and resources (including cultural property and biodiversity).

Therefore, in 2010 a Memorandum of Co-operation (MoC) was signed between the MoD and Ministry of Environment, Energy and Climate Change, covering the majority of the aforementioned areas and as a result, the MoD planned and applied a series of initiatives:

- The “Green Armed Forces” webpage of the Hellenic MoD, which covers environmental protection and energy efficiency issues related to the activities of the Armed Forces. Currently the webpage is under development hence its content is limited. However, it is planned that, in the near future, it will be enriched with a variety of relevant

information. The webpage is mainly addressed to the staff of Hellenic Ministry of National Defence; nevertheless all other interested parties including the public may obtain useful information associated with environmental protection and energy efficiency.

- Memorandums of cooperation on the fields of environmental protection and energy efficiency.
- Environmental training and knowledge.
- Environmental and energy management issues.
- Database of environmental protection and energy legislation, standards, best available techniques and practices (including other countries’).
- Sustainability in defence initiative.
- Contests among the military personnel for the best proposal / study on the development of environmental / energy infrastructures within the Hellenic Armed Forces.
- Environmental events and presentations.
- The development and implementation of energy management system to three “pilot study” camps of the armed forces started since 2012.

To achieve these initiatives and objectives, the MoD’s projects, among others, include the development of energy policy in the Armed Forces, the interaction of each project with other co-financed programs within the camps and other facilities of the MoD.



The elements shown in the blocks provide a logical sequence for planning and implementing EMS, starting at the left side of the page and following the arrows. You may also choose to revise this sequence to accommodate specific situations at your installation. We recommend you carefully read the entire guide before choosing an alternative sequence.

31 December 2005 Milestone:
At a minimum, the Army metric elements (in yellow) must be completed and an annual management review performed before 31 December 2005 in order to satisfy Army Policy and EO 13148 requirements.

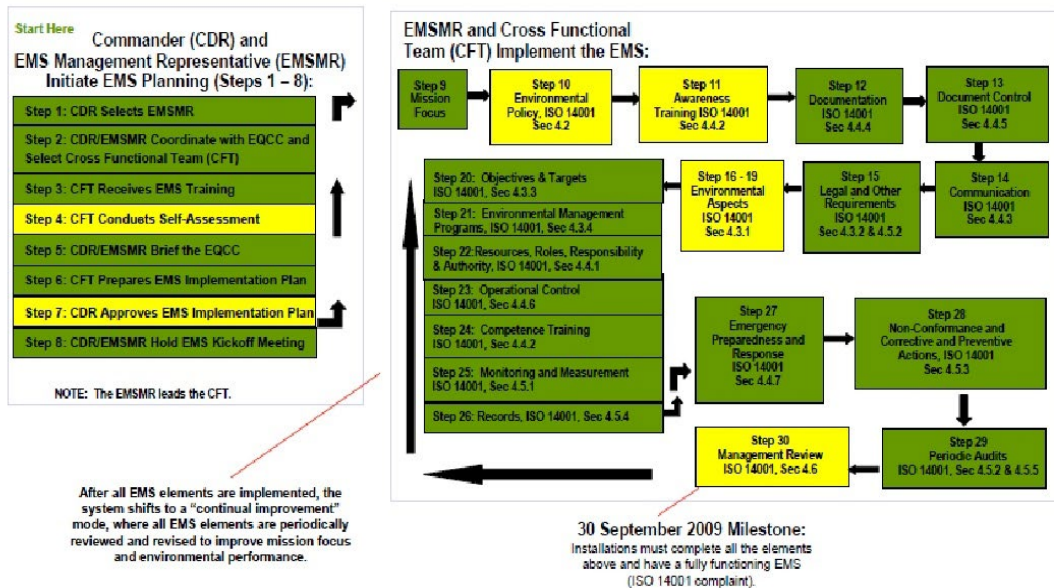


Fig. 6: US Army EMS implementation steps
(Source: US Army-Environmental Center, 2005)

DISCUSSION

The evaluation of the benefits and costs of the implementation of an EMS has been a basic concern in the private sector, that has been focused on the way EMSs contribute to a firm's enhanced environmental and financial performance. Furthermore, a lot of research has been done to investigate if and in what level the respective standards are met and whether the improved or not environmental effectiveness is correlated to the EMS itself (Wang and Wu, 2013; Sroufe, 2003; Hertin *et al.*, 2008; Nawroka and Parker, 2009, Daddi *et al.*, 2011; Feng and Wang 2016). The Ministry of Environment in Indonesia, developed in 1995 the "Proper Prokasih", which is a rating system recognized as "the first central government program in the world to publish a single index of industrial environmental performance (Edwards *et al.*, 1999). At this point, it is noteworthy to mention that the International Standard 14031 has adopted the concept of Environmental Performance

Evaluation (EPE) as a separate managerial tool, whose purpose is to select appropriate indicators to measure environmental improvement, implying that environmental performance is becoming another major issue regarding environmental management practices.

As far as the public sector is concerned, the literature on assessing environmental performance achieved through the use of an EMS is a lot less compared to the one applying to the corporate context (Poister 2003; Ramos *et al.*, 2009; Lundberg *et al.*, 2009). The main characteristics of public organisations include more complex and often conflicting goals as well as rigid hierarchical structures combined with a lot of bureaucracy and slow operating mechanisms. Due to this particularity of the public organizations, it has been rather unsuccessful to project fully the strategies and tools used in the commercial businesses, whose main aim is the increase of profit (Lundberg *et al.*, 2009). The Defence sector that is an essential and

significant part of the public sector has been one of the last sectors to comply with environmental management policies adopted by governments. The Defence has been largely exempted from environmental regulations, due to its mission to protect national security (Light, 2014, Gould, 2007). It has been only recently that various DoD's have considered environmental protection as a necessity and a priority, which is to be actively promoted through appropriate laws and practices. This was the main objective of an EMS, to offer an integrated framework for effective environmental management by the different nations' Defence Ministries. It is because of the complex and multidimensional nature of military actions and operations that environmental issues need to be addressed systematically and in a holistic way provided by an EMS (Diecidue, 2008) and not in fragmented policies and rules to be adhered.

There are very few previous studies on the effectiveness of the implementation of an EMS in the Defence sector (Steucke, 2000; Beal, 2002; Ramos *et al.*, 2009). These studies are mainly examining the implementation of an EMS and its implications on a particular military site or activity and do not address the issue of environmental performance of the Department of Defence as a whole. However, these few research efforts illustrate that there are many positive outcomes accruing from an EMS implementation. The most notable are legal compliance and improvement of the environmental awareness of employees and the public image of the Army.

There are a lot of questions regarding the success of the EMSs not only in the Defence and general public sector, where the scientific literature is poor, but also in the private business field. The factors which result in a successful implementation or the level of effective performance remain unclear. There are many studies that support that significant improvement in environmental performance can be achieved as a result of EMS implementation. On the contrary, other conducted surveys presented that the EMS did not contribute in any improvement of the environmental performance (Edwards *et al.*, 1999).

These controversial study results can be explained by several reasons like the following: To begin with, an approved and precise definition of the environmental performance does not exist. Many different definitions can be found that agree upon the assessment of actual results obtained from the implementation of a policy,

but this includes significant variations depending on the system applied (Srebotnjak, 2007). Moreover, the EMS merely establishes the framework, while the results regarding the respective objectives, targets and other requirements (ISO 14001, 2015) need to be evaluated in the context of the specific organization's documented policy. The measurement of the relevant environmental performance may significantly differ, especially when it comes to measurement of compliance with regulatory requirements, or minimization of the impacts. Therefore, the EMS results in performance remain questionable, and the adoption of an EMS seems not the guaranteed "medicine" for maximum environmental performance: there are many factors that define and affect the levels of efficient EMS implementation. To continue with, the selection of the tools and methods which are used by the researchers, often result in different procedures and affect the respective results. Thus, it is considered difficult to evaluate an EMS using quantitative methods. Previous studies, have illustrated that all the methods that have been used were based on quantitative methods that require high quality and expensive to obtain precise quantitative data. Finally, as far as developing countries are concerned, research has demonstrated that there are major impediments in the conforming to an ISO standard or any other environmental standard in countries that lack basic infrastructure, sound policies, coordination of authorities and funding (Steger, 2000; Massoud *et al.*, 2010).

Another highly debatable topic is the adequate understanding of an EMS's effect into the military sector, which is still something not feasible. Up until now, there has only been self-assessment by Commanders, while it is recognized that what is needed and suggested is an independent evaluation from external authorities, in order to deliver safe, objective and transparent conclusions. The internal approaches have the tendency to bias assessments and positive results, and this is the reason that they are considered subjective. Moreover, data and high-quality information are required to establish a sufficient international database, to improve impact assessment and communicate effectively the relevant measuring, monitoring and reporting procedures.

Although it can be argued that there are several drawbacks in the EMS approach, it is generally accepted that a successful implementation has the ability to affect in a positive way many internal

and external elements of the organizations, such as the management and personnel attitude and ethic, the respective policy as well as the stakeholder contribution and response.

Among the various factors stated by (Petroni, 2001; Sambasivan and Fei, 2008; Wang and Wu, 2013).

- Management commitment and integrated approach to cover the majority of environmental aspects
- Integrated and holistic plans and strategies, goals
- Targets and objectives, to identify early enough the most serious environmental impacts
- Present the needed response and accordingly with the needed technical support
- Policy and guidelines documentation
- Reviewing
- Reporting and communication processes, transparent follow-up actions and measures, personnel and board commitment into everyday.

The aforementioned features are considered crucial for an EMS framework and are recognized as the basic steps to follow when evaluating an EMS of an organization (Wang and Wu, 2013). Regardless of the sector that this organization belongs to. They are the basic milestones of an integrated environmental management and apply to every firm, public organization, or Department including the Defence sector as well that wishes to effectively address its environmental issues.

Considering all of the previously mentioned factors and projecting them on the Defence sector implies that the environmental footprint of military activities needs to be examined holistically providing relevant feedback. However, the usual officials' misunderstanding is that they think that the needed environmental measures are part of the management system, and not an integrated result of the implementation of it. Taking expensive but inappropriate measures, without those measures being part of the overall EMS system, is not the most effective reaction. Taking the appropriate measures in an integrative model has to be a consequence and the result of the effective implementation of an EMS. The management system usually unveils their necessity early enough, so that the particular decisions on submitting proactive effective action can be made by the defence authority itself instead of reacting to external interference at unexpected time.

Additionally, the leadership in all levels must know the results which are expected, therefore, should present commitment and offer the proper strategic planning

as well as effective control and measure mechanisms which are more than required. And this is exactly the core value and the main goal of the environmental management systems. In the UNCCHDPP final report in 2003, it is emphasised that is not so important if an EMS is there and is certified, as the targets and the results that are achieved (UNCCHDPP, 2003).

The Continuous Improvement process is also fundamental for the success of an EMS, as established in the PDCA cycle, and most of the NATO Armed Forces have considered and implemented it on their plans in order to better manage the environmental aspects of military activities. The similarities of the equipment, the facilities as well as the procedures between different nations' Armed Forces are remarkably great, so the differences in the EMS establishment and implementation processes are minor. Therefore, it is possible for every nation, to begin its own effort to incorporate the environmental awareness into military operations, or to improve the already existing one, making use of the existing experience on EMS.

CONCLUSION

The present study showed that many of the NATO and non-NATO Armed Forces have adopted an EMS framework based on a certified (ISO, EMAS or others) or not standard system. The concept of sustainable development is embedded in the military world in most of the countries examined, and in the NATO structures, even during peace or war times. Although there are some differences among the systems and policies adopted, because of the particularities of each country, the similarities are evident. It is common sense in almost every Defence Department that an EMS is an absolute necessity for the army of the future and that the environmental aspects must be considered in the operational plans and the routines of military organizations. Every member is responsible to take care of the environment and stimulate other people to do the same.

It has been demonstrated in the scientific literature that implementation of an EMS is not a guarantee towards environmental improvement and its effectiveness has often been questioned. However, it is widely accepted that successful implementation does have a positive impact on environmental performance, not only in the defence sector, but also in the general public and private sector. There are

several factors that need to be considered, in order to be able to successfully implement an EMS. These factors projected in the defence sector are:

- The actions as well the commitment of top level members have a substantial role to play
- Decision-making process of everyday operations should include integrated methods into all levels and thus, be considered as a chance to reduce costs and gain environmental benefits.
- Data and high-quality information are required to establish a sufficient international database, to improve impact assessment and communicate effectively the relevant measuring, monitoring and reporting procedures
- The process requires frequent reviews and respective updates to proactively respond to the demands. Effective interaction will be secured by regular reviews.

The incorporation of environmental aspects into all domains like the training programs, the operational planning process and execution are necessary not only due to public pressure but also to ensure the long run of military activities, to protect the well-being personnel and to minimise costs. However, the primary role of military sector is the military defence. Therefore the military organizations have to comply with regulatory boundaries in order to protect and preserve the environmental resources. The multitasking and complex characteristics of every military activity always result in having environmental impacts to the extent that each factor is enabled.

An important issue arising from the implementation of EMS on military activities is the measurement of environmental performance. This is a field, where there are huge gaps in knowledge, since there is very little literature on the link between the implementation of an EMS in the Defence sector and the performance improvement. Thus, further studies are needed in order to develop the respective indicators which have to be internationally applicable, in order to identify and evaluate the correlation between implementation and performance.

A major conclusion emerging from the above is that it is not feasible to promote a single recipe for effective implementation of an EMS. Every nation needs to adjust properly the general guidelines in order to find out the optimal framework concerning the EMS into defence activities. It can be concluded that there is no "one size fits all" design.

Finally, taking into consideration all of the aspects of EMS, it has to be mentioned that the final question is not the effectiveness of an EMS or whether a certified standard is being there and is certified, as the targets and the results that are achieved.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

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