

Modeling Explosive Ordnance Victim Assistance Activity Using Multi Criteria Decision Making Techniques to Support Sustainable Development

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Abstract: The Explosive Ordnance (EO) is one of the most serious problems experienced by countries that have emerged from war and conflicts, as they represent an invisible killer that poses a real threat to civilians' lives, especially innocent children, who are probably the biggest victims. It also constitutes an obstacle to achieving sustainable development goals. Mine action activities, including Victim Assistance (VA) activity and its relationship to Sustainable Development (SD), are the significant key to making a real difference in the reintegration of people with disabilities into the communities in which they live.

Most of the literature review did not use operational research methods (such as mathematical modelling or a Multi-Criteria Decision Making (MCDM) approach) to solve the problems of (VA) activity, especially in the presence of multiple heterogeneous criteria for this activity, to decision makers participating in Mine Action Activities (MAA) programs, specifically in (VA) activity to prioritize victims who need help most.

The researchers suggested using a Fuzzy Dynamic Model in a decision matrix, which helps in analysing and prioritizing victims, especially in large-scale data, to be applied in countries affected by conflicts and wars.

Key Word: Explosive Ordnance, Multi-Criteria Decision Making, Sustainable Development, Victim Assistance.

1. Introduction

Victim Assistance (VA) is considered one of the most important activities in mine action. In mine action, it includes EO (Mines, Cluster Munitions, Unexploded Ordnance, Abandoned Ordnance, Booby traps, other devices (as defined by CCW APII), Improvised Explosive Devices) (IMAS 13.10, 2020). Victim is defined as individuals or groups who have suffered physical, emotional or psychological injury, economic loss or significant deprivation of their basic rights through actions or omissions related to the use of mines or the presence of explosive remnants of war.

For victims, their families, and communities affected by landmines and explosive remnants of war, VA refers to all aid, relief, comfort, and support provided to victims (including survivors) for the purpose of mitigating the immediate and long-term medical and psychological effects of trauma (IMAS 04.10, 2019). The objectives of VA in the field of mine action include reducing the suffering of victims, and reducing the social and economic impact of EO by assisting victims to reintegrate them into normal economic life and helping them overcome long-term loss of income (due to the death of a family breadwinner, for example) (NATO, 2020).

Victim assistance is the responsibility of the affected state regardless of the general responsibility of the government to provide assistance to victims, and victim assistance is carried out in accordance with basic humanitarian principles, including neutrality, impartiality, independence, and victim assistance activities must be guided by principles, including (Non-Discrimination, Participation and Inclusion, Accessibility, Gender and Diversity Consideration, Rights-Based Approach, Coherence with International Humanitarian and Human Rights Law). VA depends on national policies, plans, and legal frameworks related to (health, human rights, education, disability, employment, poverty reduction, and social protection), and its various components can only be implemented in this way through a multi-pronged approach. VA components include Data collection i.e., understanding the challenges being faced, emergency and continuing medical care, rehabilitation, psychosocial support, and social and economic integration. This also includes education, skills development, social inclusion, employment, social protection, enactment of laws, and policies (IMAS 13.10, 2020).

In Disability International's view, victim assistance includes the following components: pre-hospital care, in-hospital care, rehabilitation, social and economic reintegration, enactment of laws and policies, and finally, oversight of health and social assistance departments and research (Handicap International, 2002). For its part, the International Committee of the Red Cross (ICRC) stressed that landmine survivors have both special medical needs and rehabilitation requirements and that the main factors influencing the provision of assistance include a careful assessment of the level of that need and the survivors' access to the services provided (Coupland, 1997; GICHD, 2007).

It may be difficult to know the number of survivors of EO in the world with great accuracy, but it is necessary to carefully know the need for providing assistance to landmine victims. As for the physical needs, injuries to landmines or explosive remnants of war can cause many different injuries. Including the loss of a limb, stomach or chest injury, spinal injuries, blindness or deafness, or psychological trauma that is less visible than other injuries (Landmine Monitor, 2002). Victims of mine often suffer from a lifelong disability, and the physical disability can be alleviated with appropriate treatment (Coupland, 1997).

In order for the activity of VA to be modelled using the MCDM, it must go through several stages, which are, amongst others, the Formulation of the decision-making problem, defining a set of criteria, constructing a decision metric, Calculation of criteria weight, and finally Ranking of alternatives (Hasan et al., 2022; Kashid et al., 2019).

MCDM is a foundation of decision theory and an important field of operations research. MCDM techniques are the right approach to prioritize assistance to victims of EO, meeting their needs in terms of medical care, rehabilitation, as well as providing psychological and social support. Therefore, the focus of this research is to discuss the criteria and alternatives available for victims of EO, to present the MCDM techniques that are used to determine the weight of criteria, evaluate alternatives, and identify their effective role in supporting the sustainable development of countries that have faced conflict.

Some of the drawbacks of the previous research done are that it has not followed the appropriate mathematical modelling approach, nor the MCDM approach, in determining the priorities to help victims of EO, based on different quantitative and qualitative criteria. This is in addition to the fact that most of the literature reviews did not address the use of modelling (operational research methods) in solving problems of activity (VA), especially in the presence of conflicting (heterogeneous) and multiple criteria in this activity. Fig. (1) illustrates the research problem for the Mine Victims Assistance Activity.

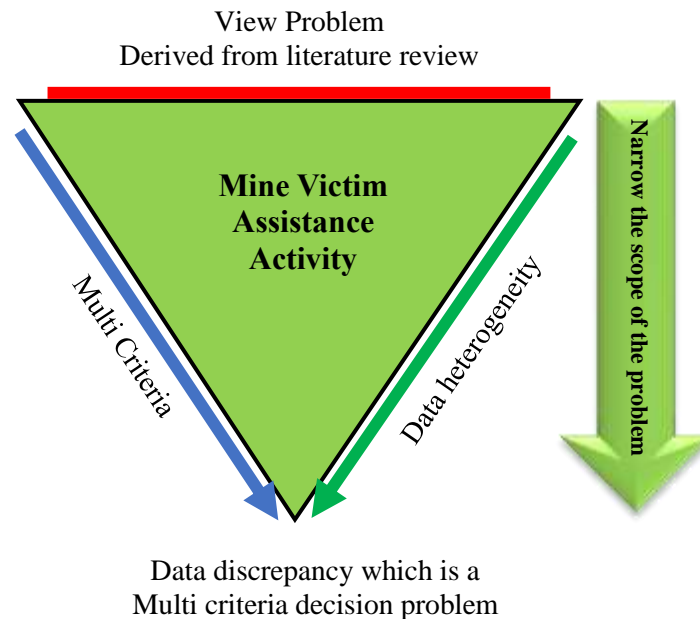


Fig. 1: Research problem for VA activity model

2. Literature Review

The studies below dealt with most of the criteria that are relied upon in VA activity, which are (gender, age, marital status, number of children, educational, occupation before accident, occupation after accident, year of the accident, injured or killed, general functional evaluation of the victim, amount receive salary and disability percentage).

Ruan (2001) presented the work programs of the Organization of American States and its efforts in helping victims by offering a special program for victim assistance. The most important of these programs is to connect the victims with appropriate medical resources that help in their rehabilitation and reintegration into society, and by continuing the program of this organization and the exercise of its efforts in Central American countries, the future will become Brighter communities in the region.

Fiederlein showed the relationship between victim assistance activity and mine action, in a study prepared by Geneva International Centre for Humanitarian Demining (GICHD), through a case study of four countries, collection of detailed data on the activity in each of them, using a questionnaire to collect information on, for example, medical care for the victim and economic reintegration, how to collect and exchange the required data on victims, how to obtain adequate attention from donors, how to coordinate victim assistance activities more effectively. The countries, however, should provide information about their needs, and capabilities to assist victims, as this paves the way to focus on victims' activity, especially after it lags behind the rest of the MAA in finance, international attention, and hence, this activity will take the initiative to shape its future and address the ongoing challenges (Fiederlein, 2002).

Bailey presented a study on the framework for the final report of the first conference of the Mine Ban Convention in Cambodia by analysing information on the presence, locations of mine survivors, people with disabilities together with the stating the main problems they face after injury, relevant legislation, and current programs that meet their needs. Besides, conducting an interview with aid worker's victims, field visits to the families of the dead and injured, and what health services are provided to the victim. These have been carried out for the purpose of informing the competent authorities of the situation of mine survivors, the families of the dead and injured, and the others with disabilities in the affected communities. In addition, identifying the strengths and weaknesses of the current policies and programs in place, to improve the lives of those affected and integrate them into their communities. Notwithstanding, Sustainable Development (SD) is the real solution to help reintegrate people with disabilities into the communities in which they live (Bailey, 2005).

Young (2008) show cased the Prosthetics Project founded by (Linda Smythe) in Iraq / Basra, with the purpose of enabling the Iraqi Ministry of Health to make a greater impact on amputation victims, by providing training for doctors and prosthetists who work at the Prosthetics Center in Basra, thus providing better treatment and assistance more effectively for landmine/ERW

survivors. The project provides the materials and technologies needed to assist factories specialized in the manufacture of artificial limbs, and this project creates an opportunity for landmine survivors in Iraq to regain their lives again by providing this much-needed assistance, and with increased funding, the project can now expand to provide assistance to a larger group of survivors.

United Nations International Children's Emergency Fund (UNICEF) presented a study showing its support for survivors of landmines and explosive remnants of war, as part of its comprehensive support for children affected by armed conflict, children with disabilities, and calls for the implementation of all Mine Action (MA) agreements, to support all efforts seeking to assist victims, restore their social and economic reintegration which aimed at strengthening victims at the gender and age level, through the development, dissemination, analysis of a child-focused victim assistance questionnaire and comprehensive mapping of the victim assistance program, in order to improve the well-being of children directly or indirectly affected by landmines and explosive remnants of war, as well as children suffering from physical and psychological disabilities (UNICEF, 2014).

Mohammed & Sachit presented a study on the assessment of Post-Traumatic Stress Disorder (PTSD) among mine victims in Maysan /Iraq, through a descriptive correlative study of (assessing the level of tension among landmine victims in Maysan, the relationship between the victim's age and socioeconomic status, identifying potential differences in the level of PTSD in terms of age groups, gender, marital status, and injury to the upper and lower extremities). The research sample was included (100) adult victims, and it was found that PTSD affects all participants in the study regardless of their age, and that injuries above the elbow level contribute in higher levels of PTSD, injuries to the metatarsals and ankles contribute to the highest levels of PTSD. Thus, the use of prosthetics as a walking aid causes the highest levels of PTSD (Mohammed & Sachit, 2018).

The United States Agency for International Development (USAID) did a case study illustrating the challenges faced by people living in an EO-contaminated area, through interviews with several mine survivors, due to a lack of data on the quantitative impact (whether victims access to services and aid), and qualitative impact (whether meeting victims' needs improves their lives). Through the activity of USAID represented in providing a demonstration model for Community-Based Inclusive Development (CBID) to improve and sustain the independent living and functional capacity of persons with disabilities regardless of age, gender, the inclusion of persons with disabilities within communities, providing psychosocial support, and medical rehabilitation of the victim, and thus the CBID model leads to the development of inclusive and equitable societies to help mine survivors and people with disabilities. Such a model can be applied at the community level, if the government and communities are effectively involved (Franck et al., 2020).

Mashchenko et al. (2020) assessed victim assistance capacities in Ukraine, using a two-stage assessment as a mixed research approach, including secondary data analyses as well as qualitative and quantitative research tools. In the first stage, a questionnaire was used, although it was difficult to locate EO victims due to the lack of a database recording victims, snowball samples were used. While the second phase focused on assessing the educational capabilities of children, as the assessment took into account (gaps in the legal environment, data collection, emergency and continuous medical care, rehabilitation, psychological and social support, and socio-economic inclusion). The researchers, however, recommended further assessment of victim assistance, such as assessment of the socio-economic impact of accidents on children and other future assessments.

Heshmati & Khayyat presented an analysis of the data of victims of EO in the Kurdistan region of Iraq during the period from 1960 to 2005, in addition to descriptive data analysis and regression analysis to indicate the determinants of the probability of being killed by a mine or unexploded ordnance, and to estimate the specific effects using a set of social and economic variables for the purpose of benefiting for planning, monitoring and allocating the necessary resources for mine action, labor market programs and rehabilitation activities. The study showed that males are more vulnerable than females to mine accidents due to the nature and activity of their work, and that there is a negative impact of age, as young people are less exposed to the danger of mines. The study also confirmed the importance of medical care for mine victims (Heshmati & Khayyat, 2021).

The International Campaign to Ban Landmines and Cluster Munition Coalition (ICBL-CMC) has presented guiding principles including (a human rights perspective, political participation and inclusion, non-discrimination in terms of gender, race, color, social status, gender and diversity, full social and economic inclusion, victim capacity building and sustainability, victim assistance financing, and other principles). Hence, provide a framework for all relevant actors to plan, implement, monitor, and evaluate victim assistance. It was based on (the Mine Ban Treaty, the Convention on Cluster Munitions, the Oslo Action Plan, the Lausanne Action Plan, the International Mine Action Standards, etc.), and was guided by the 2030 agenda for Sustainable Development and the Sustainable Development Goals (SDGs) and resulted in a commitment by donors to assist victims and integrate persons with disabilities into humanitarian work (Coalition, 2021).

Table (1) shows a summary of the literature review of the VA activity.

Table1

Summary of the VA literature review

Criteria Researcher Name, Year	Gender	Age	Marital Status	Number of Children	Educational	Occupation Before Accident	Occupation After Accident	Year of Accident	Injured or Killed	General Functional Evaluation of the Victim	Amount of Receive Salary	Disability Percentage
(Ruan, 2001)		✓								✓		✓
(Fiederlein, 2002)				✓					✓			✓
(Bailey, 2005)									✓	✓		✓
(Young, 2008)									✓			✓
(UNICEF, 2014)	✓	✓										
(Mohammed & Sachit, 2018)	✓	✓	✓					✓		✓		
(Franck et al., 2020)	✓	✓				✓	✓			✓		✓
(Mashchenko et al., 2020)			✓	✓						✓		✓
(Heshmati & Khayyat, 2021)	✓	✓						✓	✓			✓
(Coalition, 2021)			✓		✓	✓			✓			✓
Proposed Model	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Over the years several algorithms have been developed that have greatly contributed to the evolution of MCDM. These methods differ in terms of their computational logic and assumptions, applicability, complexities of computation, and ability to tolerate variations in given circumstances (Pramanik et al., 2021). Among these algorithms or techniques that are used to determine the weight of criteria and evaluate alternatives based on the decision-matrix are (The technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), Kriterijumska Optimizacija Kompromisno Resenje (VIKOR), Multi-Objective Optimization by Ratio Analysis Method (MOORA), Gray Relational Analysis Technique for Order of Preference by Similarity to Ideal Solution (GREY TOPSIS), Best-Worst Method (BWM), Simple Additive Weighting (SAW), ... among others).

3. Contribution (VA) Activity to (SD)

Development is defined as “an attempt to increase the well-being of people in poverty in some way in the things that sustain life and make it worth living” (Maslen & Lloyd, 2004). As for sustainable development, it is defined as development "that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Imperatives, 1987). For development to be sustainable, it is argued that the three dimensions - economic development, social justice and environmental protection - need to be balanced and addressed in unison (Murphy & Drexhage, 2010).

In order to achieve sustainable development, it is necessary to work towards a world free of EO to ensure that the needs of the affected population are met through mine action and development programmes (UN, 2009). In this regard, mine action stakeholders can draw on decades of experience and achievements from around the world which include (a comprehensive understanding of how mine action contributes to improving lives and livelihoods as part of peacebuilding, early recovery and long-term development, the increasing use of data for data-based planning evidence and reporting establishment of information management systems targeting activities for the most marginalized groups in society, supporting national ownership and capacity development to operate in a range of operational settings from humanitarian emergencies to long-term development) (Harpviken et al., 2004; GICHD, 2009).

Victim assistance targets both survivors and indirect victims (e.g. families of injured and dead people, as well as people living in affected areas) of explosive ordnance and is provided based on the human rights principle of non-discrimination. As such, it must be approached from the standpoint of disability and vulnerability. Socioeconomically, survivors and indirect victims tend to be marginalized and discriminated against, as they are often seen as not fully contributing members of the family or community, but rather as a burden (Bailey, 2005).

The global SDGs targets clearly refer to persons with disabilities and at risk. As current practice shows, victim support enhances or has the potential to promote equitable and disability-sensitive access to survivors, and sustainable development can assist in this regard, including by identifying survivors and victims’ indirect people are among the most vulnerable in society, linking victim assistance with the broader dimensions of disability, vulnerability and social protection (as well as human rights and development), and finally collect disaggregated data, measure progress and ensure accountability at the national level about whether victims benefited from a country’s sustainable development efforts, are effectively accessed (e.g. access to services, increased participation) and included as full and productive members of society among broader groups of beneficiaries (GICHD

& UNDP, 2017). Fig. (2) shows sustainable development according to its three dimensions related to the criteria for victim assistance activity.

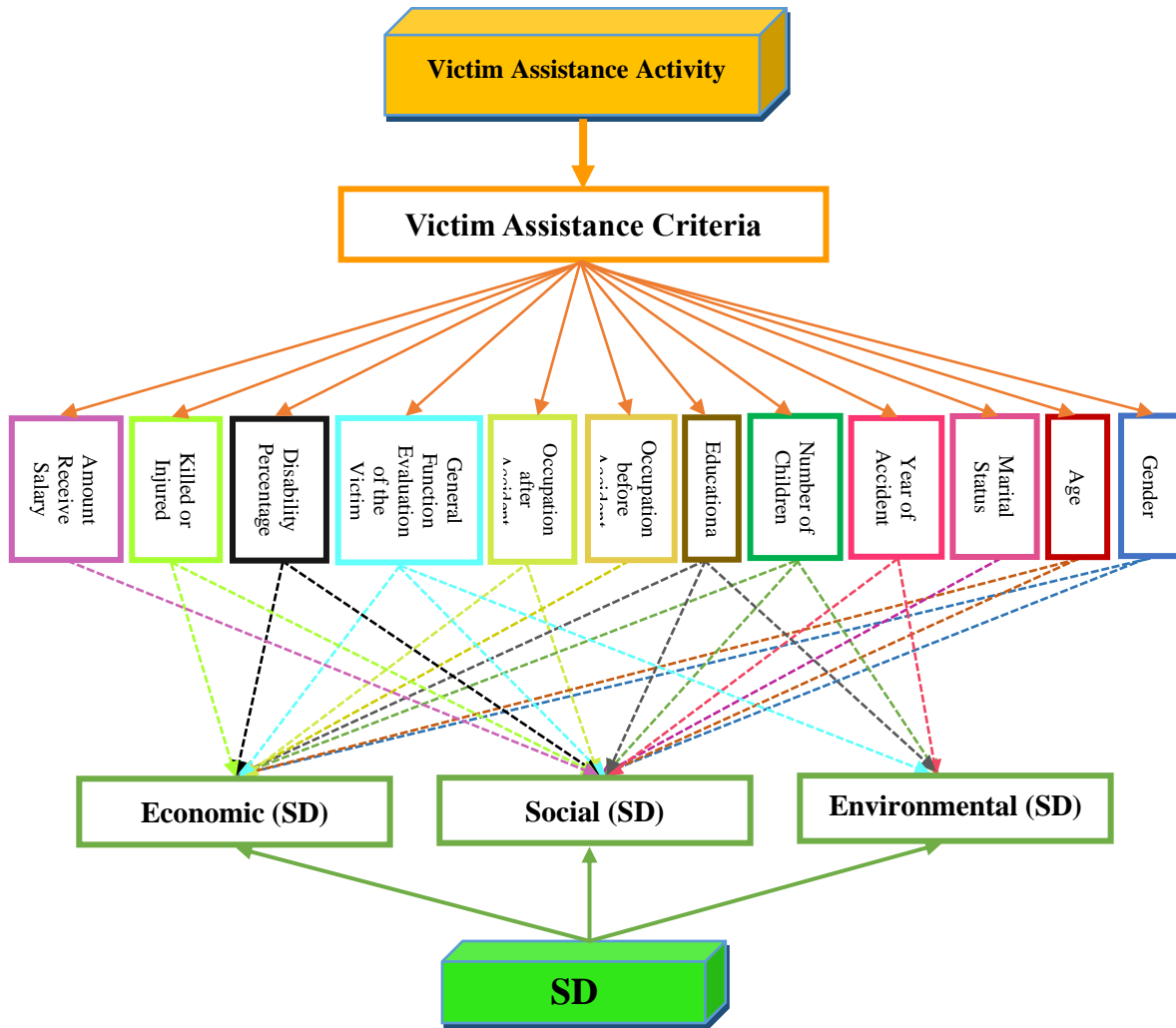


Fig. 2: Dimensions of SD and VA Activity Criteria
Source: Created by researchers

4. Methodology

Using the modelling methods represented by the MCDM method to determine the priorities of assistance to victims of EO, and based on the table (1) above, the researchers, after referring to experts in the field of this activity, chose (12) criteria from the criteria established in the Information Management System for Mine Action (IMSMA) for the assistance of mine victims, and these criteria are:

1. Gender
2. Age
3. Killed or Injured
4. Occupation after Accident
5. Occupation before Accident
6. General Function Evaluation of the Victim
7. Educational
8. Marital Status
9. Amount of Receive Salary
10. Number of Children
11. Year of Accident
12. Disability Percentage

Where a dynamic method for alternatives (number of victims) will be proposed in a Decision Matrix (DM) based on spherical fuzzy groups and compared with four classical methods: (TOPSIS) method, (VIKOR) method, (MOORA) method, and (TOPSIS Gray) method. Fig. (3) illustrates the proposed methodology for prioritizing the activity of victims of EO, which takes place in three phases:

First Stage: building a decision matrix resulting from the intersection of alternatives (the number of victims to be chosen) and the (12) criteria.

Second Stage: Determine the weights for the criteria used in the matrix, where the Best-Worst Method (BWM) will be used in calculating the weights for each criterion.

Third Stage: Using five methods to find priorities for each victim based on weights calculated, using the Best Worst Method (BWM) in the second stage.

5. Discussion

Some solutions can be recommended to improve the work of VA activity and help decision makers take the optimal decision to solve many of the problems they are facing, in order to support sustainable development. Operations research, MCDM are techniques that allow decision-makers to make the best decision in the event that there are multiple criteria, that may be incompatible.

MCDM methods attracted great interest from decision-makers, academics and researchers. It was used in various fields (science, engineering, technology, economics, military strategies, business, supplier selection, ... and others). The MCDM is a method for assessing conflict situations in the real world based on different quantitative and qualitative criteria under risky and uncertain environments, so that decision-making becomes an essential part of the procedures' problem solving, a structured approach such as mathematical modelling or MCDM approach is necessary.

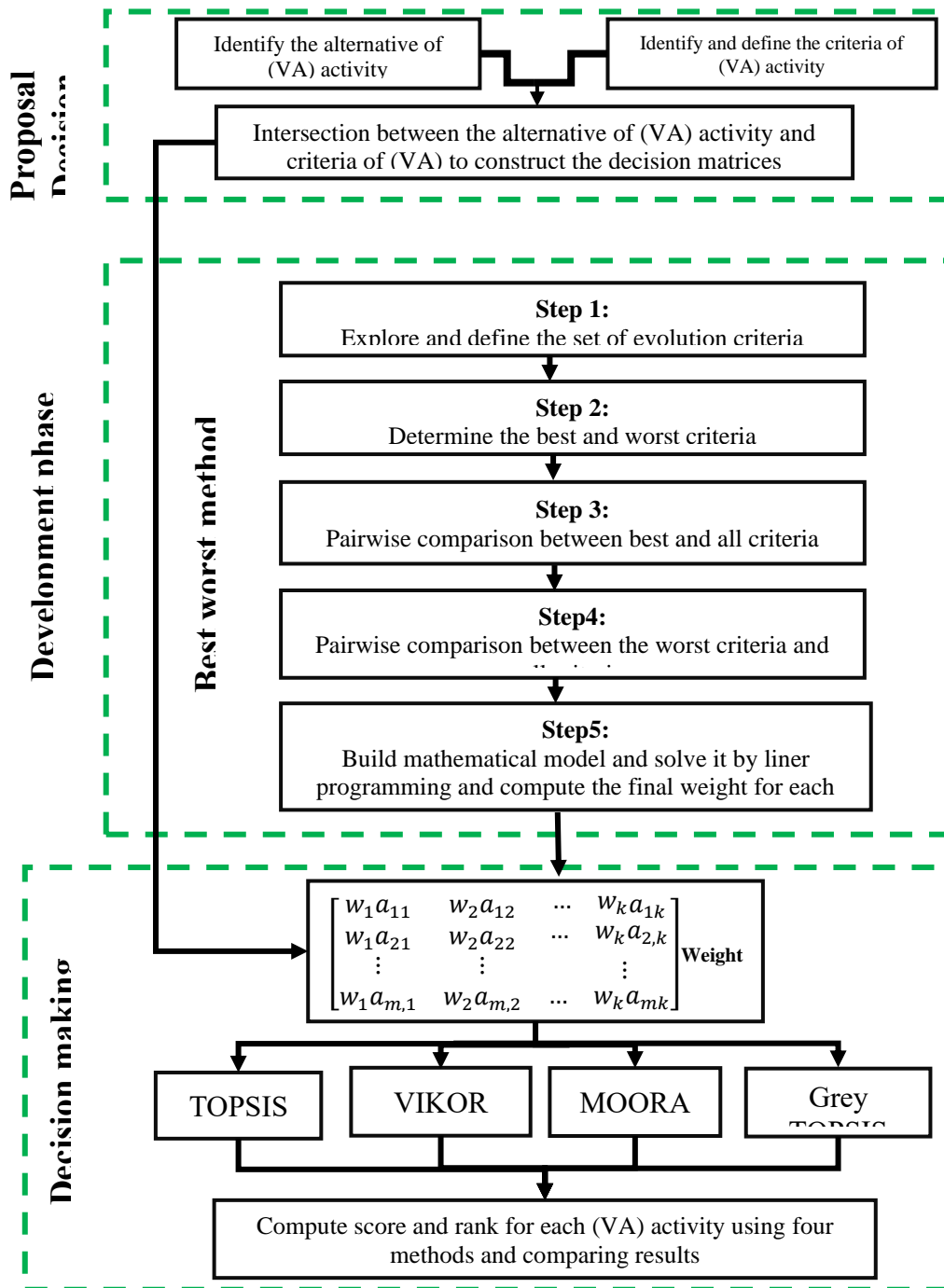


Fig. 3:

Suggested methodology stages for prioritizing explosive ordnance victim assistance (VA) activity

Source: Created by researchers

6. Conclusion

Finally, after conducting this paper, the following can be stated, as the main concluding remarks:

1. The study shows that previous research works on the subject matter failure to use the criteria established in the (IMSMA), for VA activity including register victims of explosive ordnance, as criteria for decision making to prioritize victims for purpose of helping them, alleviate their, and integrate them into society.
2. The use of MCDM techniques will help decision makers involved in Mine Action Programs (MAP) and specifically VA programs to prioritize victims who need assistance most.
3. Proposing a fuzzy dynamic model in a decision matrix, which helps in analysing and prioritizing victims, especially in large-scale casualty data, can be applied in countries affected by conflict and in which the number of war victims and the victims of the remnants of explosive ordnance has increased.

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