

Journal of Conventional Weapons Destruction

Volume 19
Issue 3 *The Journal of ERW and Mine Action*

Article 13

December 2015

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Recommended Citation

Heymans, Hansie and Claassens, Arie (2015) "Effectiveness of GIS in Mine Action," *The Journal of ERW and Mine Action* : Vol. 19 : Iss. 3 , Article 13.

Available at: <https://commons.lib.jmu.edu/cisr-journal/vol19/iss3/13>

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Effectiveness of GIS in Mine Action

According to a survey conducted by Geometric Solutions, Ltd., the usage of a geographic information system (GIS) stands to benefit the mine action community within the context of strategic planning and operational decision-making. Furthermore, web-based GIS can provide mobile spatial data for operations and lead to an overall improvement of mine action operations.

by Hansie Heymans [Geometric Solutions, Ltd.] and Arie Claassens [Esri]

In order to assess the diverse opinions of the mine action community, Geometric Solutions, Ltd. conducted a survey from October to December 2014. Various mine action stakeholders were invited to take the 23-question survey, covering different demographics, geographic locations and organizational themes. The survey's main goal was to gauge whether the mine action community would value the benefits that a geographic information system (GIS) could offer as a Spatial Decision Support System (SDSS) and to what degree GIS solutions are already in use within the mine action field.

Mine Action Community Survey Analysis

In total, Geometric Solutions, Ltd. received 101 responses; however, only 71 respondents completed all 23 questions. As a result, the findings presented here only cover the fully completed questionnaires. A summary of the respondents show that 93 percent are male and 60 percent are between the ages of 20 and 40 years old. In terms of sectoral representation, 46 percent work for the U.N. and 25 percent for commercial companies, with the remainder working in nonprofits, non-governmental organizations or consulting environments. Of the 71 respondents, 48 percent work in top- or middle-management positions and indicated that they currently or have previously used GIS when making decisions.

Of the respondents, 34 percent directly work or participate in mine-clearance operations, while 28 percent work in the program-management field. Only 15 percent of the respondents work in GIS sections, which is in accordance with the majority of respondents falling in top- or middle-management positions. Of the respondents, 42 percent work in country programs, while 20 percent work in the headquarter offices of their respective organizations. The majority of the respondents work in Africa, Asia and the Middle East, with some respondents working in multiple regions.

Results indicate 85 percent of respondents are familiar with GIS and use GIS on a regular basis. In addition, 83 percent of respondents noted that most of the time GIS is used to produce mapping products and provide a better spatial understanding of the mine action problem. Depending on the nature of the mine action problem, 40 percent said they use GIS for spatial analysis, while 35 percent use GIS to assist with data cleanup activities.¹

Of the respondents, 55 percent have direct access to GIS, while 33 percent do not. The majority reported that their organizations have sufficient GIS staff, while 24 percent reported insufficient GIS staffing. Given that 45 percent of respondents think their organizations will invest in GIS and a further 31 percent believe their organizations might invest in GIS, this suggests that the mine action community understands the potential value of GIS to assist in intelligence and decision-making processes.

Understanding the Operational Value of GIS

GIS can be used for different types of analysis that assist decision-makers at an operational level, which means that organizations will be able to make better decisions on the probability of finding mines or making use of the appropriate resources for the clearance task at hand. Results indicate that 69 percent of respondents use GIS as a decision-support system for strategic planning, operational decision-making and prioritizing. In addition, 69 percent of the respondents also reported that they understand the associated risk of using GIS to make better decisions on the probability of finding mines or assigning appropriate resources during clearance operations. From the literature review, GIS was used to classify either the area or the hazard itself, but limited research has illustrated the prediction of finding mines during clearance operations.^{2,3,4,5} On the other hand, available evidence

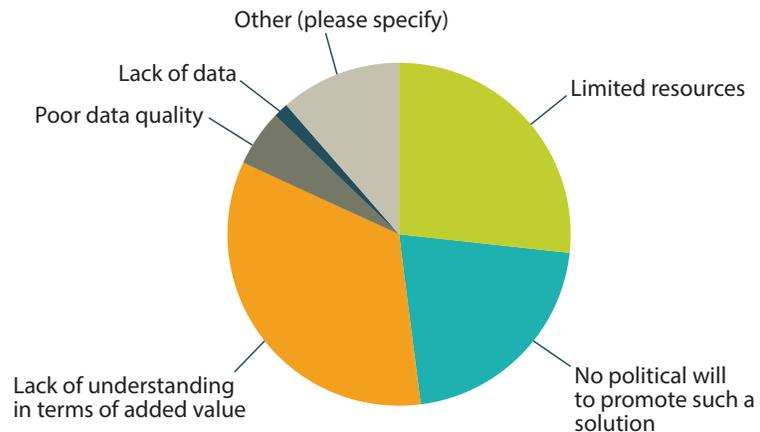
suggests that GIS is used to assist with assignment of appropriate resources for clearance operations.

Mobile GIS solutions can be used to capture spatial data directly into databases, which can improve data quality and make data immediately available to stakeholders and decision-makers. Seventy-nine percent of the respondents indicated that such mobile GIS solutions would be useful.

In contrast to the earlier finding where 69 percent reported that they have used GIS as a decision-support system for strategic planning, operational decision-making and prioritizing, 45 percent of the respondents indicated that insufficient organizational awareness on the value of GIS made obtaining GIS solutions difficult. A further 27 percent indicated that limited resources and skills were the biggest challenges for organizations to obtain access to GIS solutions and products. Moreover, organizations seem reluctant to develop existing GIS capabilities on account of not understanding the potential worth of GIS.

Providing direct access to national mine action databases, or a summary thereof, is one way of promoting transparency to all mine action stakeholders, which can be achieved by using modern web-based technology solutions. An ArcGIS online solution, used to assess the effectiveness of GIS as a decision-support system for mine action on a global level, was made available to respondents for evaluation. Of the respondents, 61 percent indicated that a web-based GIS would be useful to their organization, while 21 percent suggested that a non web-based GIS would be more useful.

In regards to why respondents think that global web-based GIS tools do not exist for mine action, 27 percent suggested limited resources, and 34 percent pointed to insufficient understanding of the value GIS adds to decision-making processes. Indeed, 21 percent indicated a lack of political motivation to promote and establish such a solution. Of the respondents, 80 percent believe the ArcGIS online solutions can be used as a decision-support system at a global level to make policy decisions such as the allocation of funding.



Answer Choices	Responses	
Limited resources	26.76%	19
No political will to promote such a solution	21.13%	15
Lack of understanding in terms of added value	33.80%	24
Poor data quality	5.63%	4
Lack of data	1.41%	1
Other (please specify)	11.27%	8
Total		71

Figure 1. Results for the question related to global web-based GIS for mine action. Figure courtesy of Hansie Heymans.

Participants made the following comments at the end of the survey:

- “It is important to define a minimum set of indicators.”
- “GIS analysis generates facts, while political considerations can ‘ignore’ facts; mine action should continue to base planning on facts, not political considerations.”
- “Policy decisions such as the allocation of funding of mine action depend on a wide range of non-spatial as well as spatial factors. Potentially there is value in providing such global level information spatially, yet this should be considered only as one source (of many) types of information, which could be used to assist with decision-making.”
- “Global comparisons of data might reduce national governments from sharing such data (or even making it available at any level to the international community).”
- “Simplified GIS systems can be used by an ‘ordinary’ person—the web viewer is a great example of this.”
- “The GIS is a powerful tool, but poor data quality is the main obstacle.”
- “Potential for GIS use on the country/region level for planning and prioritization.”

Recommendations

In general, the results from the survey confirm that the mine action community understands the advantage of GIS within the context of strategic planning, operational decision-making and prioritizing. However, operations in the field of mine action hesitate to invest in existing GIS capabilities because the potential return on investment is not clear. As a means of assisting decision-makers, global spatial solutions are generally well accepted, but concerns such as data quality and insufficient political support from national authorities are likely to prevent these global systems from further development.

The complexity of current GIS solutions and the familiarity respondents demonstrate with GIS need consideration when evaluating these responses. Traditionally, significant intellectual investment is necessary for an individual to become *au fait* with the steps required to produce usable GIS outputs. If this restriction can be reduced by the implementation of automated or geo-computational processes, such as fuzzy logic in the interpretation of incident reports by using the respondents' input, the quality of the GIS input and output will markedly improve the utilization benefits of GIS as an SDSS.

In essence, by simplifying the processes required to produce spatially oriented outputs and delivering this information via easily accessible platforms, decision-makers have the opportunity to interact with and examine the spatial and non-spatial data impacting mine action planning activities.

The value of web-based GIS is becoming increasingly obvious, as evidenced by the growing adoption of web technologies by traditional GIS companies and

the surge in online mapping applications. Respondents' answers to questions suggest an understanding of the opportunity for GIS to provide practical utility within mine action programs. However, respondents seem tempered by the impact of politics and political processes. Responses also indicate that the values gained through the development of GIS capabilities via tangible projections and training would be required to convince decision-makers with little to no practical GIS experience.

Web-based GIS delivers an accessible, analytical reporting platform. Furthermore, online GIS tools can provide the functionality required by data capturers, GIS operators, compliance officers, directors, planning officers, etc. Accessible via mobile devices ranging from smart phones to laptops, these tools operate just as well on static desktop systems. The primary consideration for the deployment of web-based GIS no longer rests with the computing power of end-user devices; it is determined by the quality of the data connection between the web GIS and end-user device.

By leveraging the power of web-based GIS, mine action practitioners can increase the quality and depth of spatial data operations, leading to an improvement in the quality of mine action operations. ©

See endnotes page 67



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