

Global Weapons Tracking

Team Members

Emily Bubencik
Julia Ormerod
Maxwell Westreich
Evan Llewellyn

C term
March 2021

Advisors

Sarah Stanlick
Bethel Eddy

Sponsors

Oxfam
SOAS-SCRAP



Figure 1: Highlights of the final product

Abstract

Arms control, tracking, and verification is one of the most pressing and complex issues of our time. In 2018 over 77,320 people died in armed conflicts (Amnesty, 2019). One promising area of innovation in arms control is the use of technology to aid in the sharing of open-source information between organizations who work in this field and connecting a wider audience of concerned citizens. Acknowledging and addressing this opportunity, our sponsors, experts from Oxfam and SOAS University of London, invited us to work on a project to create an online platform that would help gather, connect, and present information on arms control and tracking. Our project is directly connected to the SCRAP initiative, a decades-long initiative that seeks to integrate weapons disarmament, and non-proliferation practices developed in the last decades. For our project, we created a website that acts as a data portal to various open-source arms control organizations. This project aims to address the lack of communication within the arms control community, and we believe that this is an important step towards coordinating efforts and sharing information across stakeholders. Our website should in theory allow for much easier access to the wide range of organizations within arms control, providing much-needed unity between both citizens and organizations. From discussions with our sponsors, their main goal for this project is to integrate a variety of applications into the website. Towards this end, our project serves as a springboard for future groups to have a baseline to work off.

Introduction

Abandoned munitions, and the continued movement of weapons in our modern time, pose a large threat to global security. The tracking and mapping of these weapons of war are critical to the safety of humankind and new technologies are available to aid in that process. The following will discuss the connections of weapons to social, political, and health implications, as well as the history of tracking the weapons. There are important technological opportunities for tracking and arms control that exist today. In addition to the opportunity that technology affords for tracking, there are a few areas of urgent attention. These areas include prevalence of munitions, the seeming lack of technological advancements in arms control and tracking, and the need for organizations working in this space to be better coordinated and connected.

Firstly, prior to researching this topic, we initially thought that the instances of these munitions would be relatively localized to areas in which there was active conflict, which isn't true in most cases as many previous conflicts leave behind many munitions that are still active today. Secondly, we noticed in our research that there is a seeming lack of solutions to problems in tracking weapons, human rights violations, and available tools to address these problems that have been going on for a long time, as well as the lack of reporting, which is what our sponsors at Oxfam and SOAS want to help fix with this project. Lastly, we found that there are several organizations that are working to solve these problems that showed no connection or communication between them and to help solve this problem we created a portal to connect each of them and continue the spread of information.

Basics *Societal Impact of Munitions*

Focusing on the social aspect of verifying abandoned munitions, we investigated how abandoned munitions affect people around them. Local communities have been negatively affected by the presence of this type of weaponry. There are multiple sources that have discussed tragic events involving abandoned

munitions. After almost a year of conflict in Mali as of March 2013, there were many explosives being left in communities around central and northern Mali. From April 2012 to March 2013, 53 people were injured (38 were children) and seven people (five children, two adults) were killed from abandoned munitions unexpectedly detonating. During that time, the UN Refugee Agency (UNHCR) continued to find unexploded ordnance (UXO), artillery shells, grenades and more all around the community (IRIN, 2013). Another report from a village in Russia details



Figure 2: Description and examples of what a munition is

about how 1,800 abandoned munitions were found there. A 22-year-old was killed in 2013 because of those munitions (Interfax, 2013). Regarding the physical effects, people can be killed, their limbs could be blown off, or they could lose their ability to see or walk by the abandoned munitions. This can be a very traumatic moment in someone's life, and it can also affect the victim's career, which negatively affects their financial status and that can put a strain on their family (International Mine Action Standards, 2005).

These abandoned munitions have psychological effects on the people in the communities they are left behind in. In Mali, a thirteen-year-old boy described how soldiers were shooting missiles near his school and everyone inside thought the bullets were going to hit them. Everyone in the school had to run home to make sure that they would be safe, which was the right decision as when they came back their school was damaged with big holes in the walls and munitions lying everywhere (IRIN, 2013). Children growing up in this type of society will remember these moments for the rest of their lives. Also, victims who have experienced explosions from explosive remnants of war (ERW) develop psychological effects which affect their daily lives. They experience emotional and physical pain. The IRIN source we mentioned above provides insight into the factors that can negatively affect someone's mental, physical, and emotional health due to abandoned munitions in their communities. Each of these instances in this section further prove the point that these unpredictable abandoned munitions are a danger to the local communities and the people living in them.

Political Involvement in Arms Control

Many ordnance and munitions left behind are due to conflict and war between countries. Abandoned munitions can also be traced to faulty weapons used by countries in conflict, as well as a lack of rule of law to secure weapons after conflicts have stopped. Often after past conflicts, land mines that were buried and never detonated can explode on unsuspecting citizens. Due to the Iraq War from 2003 to 2011, many bombs and other munitions were left behind in Iraqi towns. The impact these munitions have had on innocent people has led many organizations to try and find ways to protect the people. Groups like the Mines Advisory Group work in countries like Iraq where unexploded ordnance and bomblets scatter the area. Iraqi landmines along with unwatched weapons are left from past conflicts and can cause extreme harm to unsuspecting people (AP, 2003).

Militant forces have left behind munitions in



Figure 3: Explosive experts searching for leftover weapons from villages in Mali

the places where they are no longer working. In Mali, munitions are left by Tuareg rebels and Al Qaeda-linked Islamist militants who were present after the government was overthrown. The people in this community felt unsafe knowing that soldiers left behind munitions after shooting missiles throughout the community (IRIN 2013).

Up until 2006, the United Nations (UN) had not implemented guidelines and restrictions to munitions that were causing destruction in communities. One big push for many countries to advocate for regulation of some weapons was Israel's use of cluster weapons in Lebanon. These cluster weapons would leave behind hundreds of submunitions, not all of which exploded with the initial explosion. These remnants would maim and kill many civilians, most prominently children. This led to Norway pushing for a treaty to ban cluster weapons. Eventually getting support from many countries, the UN saw this and started regulating the production and use of weapons ("International: Dead munitions; Arms control", 2011).

Thus far, action has not been taken in some countries because of disagreements on treaties. Some of the countries that have taken action have differing solutions depending on specific conditions and the government that is implementing the solution. Solutions have been tailored to the number and type of munitions and explosives of concern. The solution also needs to consider the countries' specific history with munitions as that will impact what they think is the acceptable way to deal with munitions (Linkov, Trump, Ditmer, Hazle, 2014).

Environmental Impact of Munitions

Going deeper into the health aspect of abandoned munitions, there are far more risks than the obvious physical ones. These abandoned munitions

2020 ESTIMATED GLOBAL NUCLEAR WARHEAD INVENTORIES

The world's nuclear-armed states possess a combined total of nearly 13,500 nuclear warheads; more than 90% belong to Russia and the United States. Approximately 9,500 warheads are in military service, with the rest awaiting dismantlement.

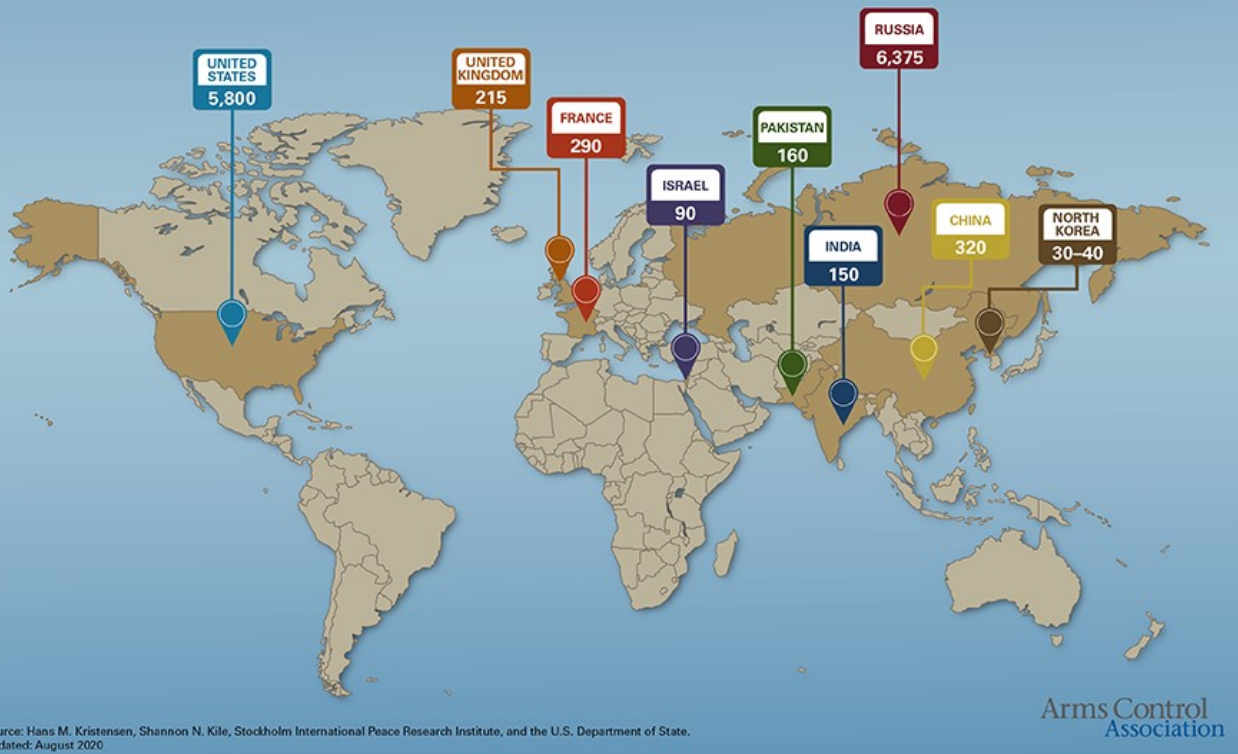


Figure 4: A map depicting the amount of nuclear warheads that each country possesses

can cause extreme damage to the soil, groundwater, animals, and humans who live around them. In fact, abandoned munitions fall into three rough categories when discussing their environmental effects.

The first of these categories is unexploded munitions. This is a broad category which is an umbrella term for all munitions which have not fired such as bombs, bullets, and mines. The main

environmental risk of these is accidental triggering, either by human intervention or otherwise. If these munitions are not triggered and they degrade they become a different form of abandoned munition, either a metal or a propellant.

In these states the munitions no longer become an immediate risk, but instead become a risk in the long term. The metals can pollute groundwater

with heavy metals and cause heavy metal poisoning of drinking water. Propellants can kill the microbes that are found in soil, leading to extensive crop death and poisoning. In both cases, the main method in which these munitions cause these issues is by leaching different chemicals, and chemical compounds into the soil and groundwater (Rectanus, Darlington, et al, 2015).

Rectanus, Darlington, et al was a good source of information on environmental impact of munitions and it allowed us to have a greater understanding of the specifics of how these abandoned munitions could cause environmental damage. Specifically, they went into the technical descriptions of how these chemicals made their way into the soil and groundwater. This source coupled with prior knowledge, allowed a clear understanding of what the main environmental risks of abandoned munitions were.

Technology's Current Use in Munitions Tracking

Currently the system for finding abandoned munitions is laypeople, usually local citizens or organizations, reporting possible sightings to officials. For instance, in the Russian village incident, a local motorcyclist was the one to report the projectiles to the municipality head (Interfax, 2013). In an account from the Interfax-Kazakhstan news company, local citizens reported finding multiple types of abandoned munitions after water had been drained from a local reservoir (Interfax, 2007). Once the munitions are verified, the proper organization will go in to safely dispose of them. For example, in Afghanistan when 80 tons of TNT and 15,000 other types of munition were found, the United Nations Development Program (UNDP) were the ones to create and execute a plan for disposing of them (M2 Communication Ltd, 2006). These sources clarified to us how abandoned munitions are handled currently.

However, there have been many technological innovations to help aid in the current effort to monitor and mitigate the risks associated with abandoned munitions. One is a standardized geo-database to keep track of potential polluters in potentially polluted marine sites (PPMS). PPMS refers to many things like a shipwreck, dumping sites, or pipelines. This database was made to help standardize the data that hydrographic agencies normally contributed to the identification of PPMS since most other databases for this lacked uniformity. Databases like this allow for the easy exchange and re-use of information. The group who made this database also deployed a Web GIS to better communicate this information to the public as well as allowing for better development and integration with other datasets (Masetti, 2014). This was a great example for us to take inspiration from as creating a geo-database of information about abandoned munitions' locations would be extremely useful for monitoring and eventually removing those munitions. Then adding on a Web GIS would help us communicate the data we collect to the public who may not understand the data or topic at all.

Another approach has been an online catalog. The catalog is comprised of up-to-date information about dumped conventional munitions on the sea floor. The information mainly includes historical information and data about all types of munitions that were dumped into the sea that could still be potentially hazardous today and how they are dangerous. This information can be used by mariners to identify any munitions they may find on the sea floor so they can determine what to do about it. They would probably contact the authorities so that a special forces team could neutralize the threat (Mietkiewicz, 2020). Although this system doesn't completely align with the end goal of our project, it does provide us with insights into how we can assist in informing the public about abandoned munitions and their dangers so if they find them, they can react accordingly.

Lastly, another approach for the problem at hand is 3D mapping. More specifically, it is underwater 3D mapping of disposed munitions in the Baltic Sea. The people behind this project managed to



Figure 5: Transuranic waste in a trench at the Hanford Reservation in the 1950s. The trenches would be covered with dirt and the soil and groundwater would be contaminated.

do it with the rapid development of underwater imaging technologies with a focus on underwater visual recorders. With other advances in technology, they created a 3D model, which was a reconstruction of the dump site of the underwater munitions. They did this to aid a visual monitoring approach (Koch et al, 2019). This approach of 3D mapping was not used in our project, but this does show how far an application can go in solving the problem of identifying and tracking abandoned munitions.

Overall, it's clear that people have been making applications to try and help find, identify, and track abandoned munitions. Although all the sources we've cited here have been for underwater munitions, their practices and methods can be easily applied to munitions found on land as well. The application designs discussed are more suited for the end vision of

the project that our sponsors gave us. Our sponsors and our group agreed that creating a foundational website for their project would be what our group would achieve in our time together and future groups would create and implement the designs with inspiration from previous applications like those mentioned above.

This information allows us to understand the importance of the solution we will be proposing for our project. We have gained a better understanding of the impact this solution will have on these communities and the environment endangered by abandoned munitions. We also looked at some past technological applications that helped us understand potential application designs and some of the challenges we needed to overcome to design an effective and impactful website. The future of this research will help to advance the technological applications needed in order to find solutions to the unknown locations of abandoned munitions.

The Importance of Open-Source Information in Arms Tracking

An important aspect of our project is that we are working with open-source information. Open-source information is anything that is available to the public or that can be available through request or transaction. It ranges from information published by the media (newspapers, television, etc.) to government reports that are open to the public (Waters, Ball & Dudgeon, 2008). Open-Source Intelligence or OSINT is taking that public information and analyzing it (Bacastow, 2020). It can be used to prevent hacking and to be able to identify possible threats. The wide array of available information provides valuable insight (The Recorded Future Team, 2019). Open-Source Verification is the monitoring of activities by use of public information. This helps the arms

tracking field because the spread of public information can be compiled and analyzed in order to keep track of certain munitions. Open-source verification helps to figure out the whereabouts of weapons (Wilson, Samuel & Plesch, 2020). In our project, we compiled open-source information in the form of different tracking organizations (human rights, weapons, tools) to provide people the information they need with ease.

We created our website as a central location for people in the arms control community to become connected with each other as well as to spread information on arms tracking. If something happens in the world, we wanted to create a spot that could connect anyone who is curious to the information they need to understand what is happening. It is important to connect these people together to make progress and facilitate new ideas in the arms control field. These communities can come up with innovative ways to work through the politics of arms tracking and verification (Wilson, Samuel & Plesch, 2020).

The Importance of Addressing the Disconnect within the Arms Control Community

Throughout the course of this project our goals have shifted greatly. While originally we were to work directly with tracking these munitions, through both our research and discussions with our sponsors, we all realized that before an application like our proposed one could be developed, there would need to be a community to support it. Towards this end, it was of utmost importance that we created a 'hub' page of sorts with the end goal of fostering better connections between the various arms control organizations around the world.

Find any reported arms transfer by clicking a country



Figure 6: A map depicting the reported arms transfers between the United States and various

Methodology

The project we undertook was focused on the challenge of arms control and scalable technology for tracking and verification. We researched the different aspects (political, social, and health) that surround the verification and tracking of weapons systems as well as arms control and open-source information. The other aspect of our project was creating a user-friendly interface that functions as a central hub for anyone to find information on what is currently happening in the arms control field and the organizations related to this field. The following research questions are what guided our study:

Research Questions

- 1) What challenges exist to modernizing arms verification and tracking through technology?
- 2) How can we create an app that helps experts and non-experts work together in order to identify abandoned munitions?
- 3) What could we do to make people more aware of the dangers and reality of abandoned munitions?

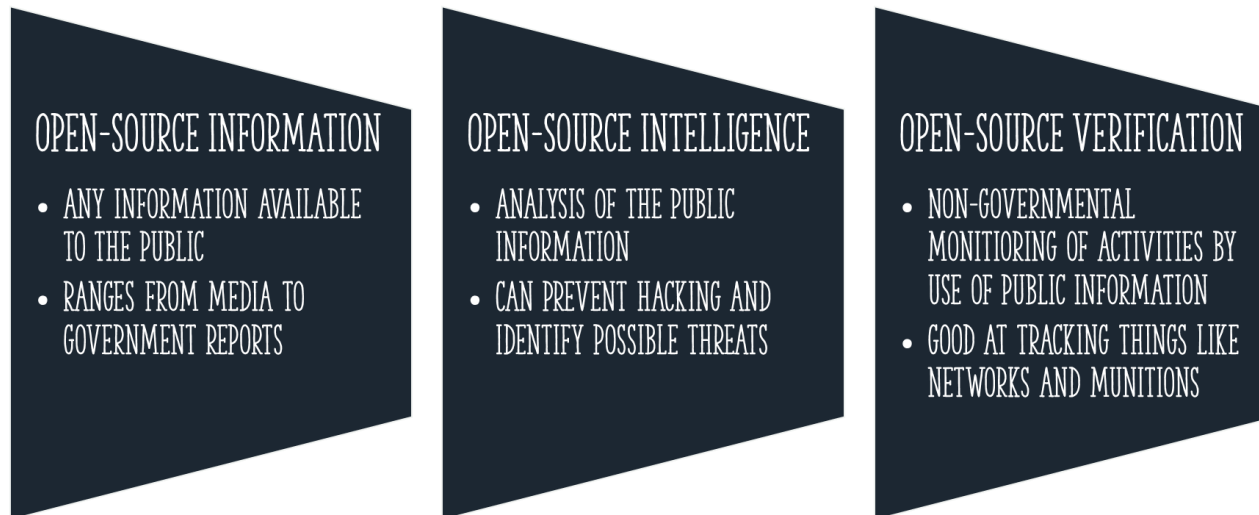


Figure 7: Description of the different types of open-source

Primary Objectives:

- 1) Discover how technology is used currently in the arms control field
- 2) Discover how different groups of people (laypeople, experts, government officials, etc.) interact with weapons systems and munitions
- 3) Identify different arms control organizations and what type of information they each specialize in
- 4) Find the best way to connect those arm control organizations with each other
- 5) Determine how the political climate plays a role in the movement of weapons and their verification

Study Design and Objectives

Our project worked to combine information on weapons and the experts in the field of munitions and bringing them together in an online platform. Because of this we used a mixed methods study. We used quantitative information from our sponsors and from surveys. We also received quantitative data from our survey in scale format, multiple choice, and yes or no questions, reflecting on our website. Our sponsors also provided us with qualitative information on different organizations in this field and the services they provide. Along with quantitative data, the surveys provided us with qualitative data from free response questions. We asked experts in the field to provide us with feedback on the things that need to be improved on our website.

Research Instruments and Methods

To fulfill our objectives, we employed a number of methods for information gathering, testing, and analysis. The methods that we used included: database research and background information gathering, subject matter interviews, and website design and content creation. In order to realize the project and the research objectives, we used a variety of methods in order to accomplish this plan. We first started by conducting the background research to increase our own knowledge about the topic. We then interviewed our sponsors to get a better understanding of the project. Branching from the sponsors, we engaged with individuals in the field through a number of events such as webinars and open virtual discussions. After we gathered the information that was needed to start our project through those interviews and events, we were able to create the website.

Database research and background information gathering.

We first found background information on weapons systems, munitions, and open-source organizations in related fields. It was also beneficial to learn more about open-source verification and arms in general. We began our online research by typing different key words including arms control, arms tracking, large and small weapons, and open-source information. We also looked into credible databases provided by our sponsors that listed organizations by the categories of tracking weapons, tracking human rights, tracking tools, and Think Tanks, Training and Services. This helped us to get a solid background in what is currently happening in the world with weapons systems and arms control.

One major political topic is arms control, which is something else we researched in order to discover how different people and groups deal with weapons systems. It was also helpful to research the websites from different arms control organizations to get a better understanding of issues surrounding weapons systems. Finally, this preliminary research also gave us contact information for all of the organizations which would be helpful later in connecting organizations through the website.

Subject matter expert interviews

Our team also conducted subject matter expert interviews and attended many events with experts in the field to learn more about the importance, challenges, and opportunities for arms control and tracking work. This work with subject matter experts started with our sponsors, who are well-established figures in the arms control field. Our research project had two sponsors with expertise in the field of arms control and conflict: Oxfam and SOAS at the University of London. Oxfam is a global organization who is working to end the injustice of poverty. They work to build better futures for people, hold the powerful accountable, and help people in disasters. SOAS at the University of London aims to teach students cross-disciplinary skills to understand key concepts on a range of topics as well as inform them about the different economic, social, and political problems of the world. The website was designed to complement the Strategic Concept for Removal of Arms and Proliferation (SCRAP) project. SCRAP designs research projects on disarmament relating to the globalization and the existing development agenda.

Our next step was to talk to people with a background in this field. We met with our sponsors and they provided us with resources like webinars to learn more about weapons systems and open-source

research. We watched the seven Verification in the Age of Google Earth Webinar Series videos on the SCRAP weapons website. Our sponsors also invited us to virtual cafes where the discussion topics included open-source verification and arms tracking. We went to one on December 9, 2020 and February 24, 2021. From talking with other people who are interested in this field, they showed us different aspects of the topic that we had not thought about before. For instance, open-source verification became a recurring topic of importance that gave us another line of inquiry for our work. We did more research on open-source verification and databases because that is a big part of the current process of verification of weapons. We also attended a talk on February 24, 2021 by Dr. Frank N. von Hippel, a physicist and co-director of the Princeton University's Program on Science and Global Security. He focused his presentation on nuclear security. We gained valuable insight on nuclear weapons throughout history, the threats they caused, and their consequences.

Website Design and Content Creation

Our goal was to take what we had learned and sources of information and make sense of it in a coherent, easy-to-use web interface. We also aimed to create a website that would be a central point for organizations in the arms control field to connect with each other and have most of the arms control data all in one place.

To accomplish this, we first took the Excel spreadsheet that one of our sponsors made with a list of all the organizations and wrote a short description for each of them. Using this information, we made a website page for each organization which consisted of their logo, a short description, and a link to their website.

Once we had this rough outline for our organization pages we went back and began brainstorming how we wanted each category page to look and function. We went through a few major iterations of this and ended up with a relatively simple page featuring a brief description of the category, followed by a list of the organizations that fell within that category. Each of these organization links was then set up to be a button which featured hover text with a short two to four word blurb describing the organization's rough purpose.

As a final step for our website, we began formulation of our home page. This page, more than any other, changed wildly. Our first draft featured a scrolling "carousel" of images with a brief description of the website found atop. At the bottom of the page was a circular menu to navigate the website. This draft was then changed to be more user friendly, the about section was placed within a drop down, the color palette was changed to match our sponsor's website, and interactable elements were made much larger and given highlights to help them pop. Our final iteration differed wildly from the previous two. In this iteration, the scrolling images were removed, the circular menu was reserved for use on the category and organization pages, and the About section was moved to be in a menu on the header of the website.

As for the platform for creating the website itself, we brainstormed a few ideas in the beginning using React and WordPress. After experimenting with these tools, we decided to just use WordPress and incorporate HTML and CSS code into it. WordPress allowed us to create 40+ pages and link them all together. Once we were able to incorporate the plugins, we added a bubble menu that made the navigation of the website easier. From any page, the user is able to get to a category page or the home page via the menu at the bottom of the page. We matched the color scheme to our sponsors' website per their request. We made sure that the text was easy to read and that all

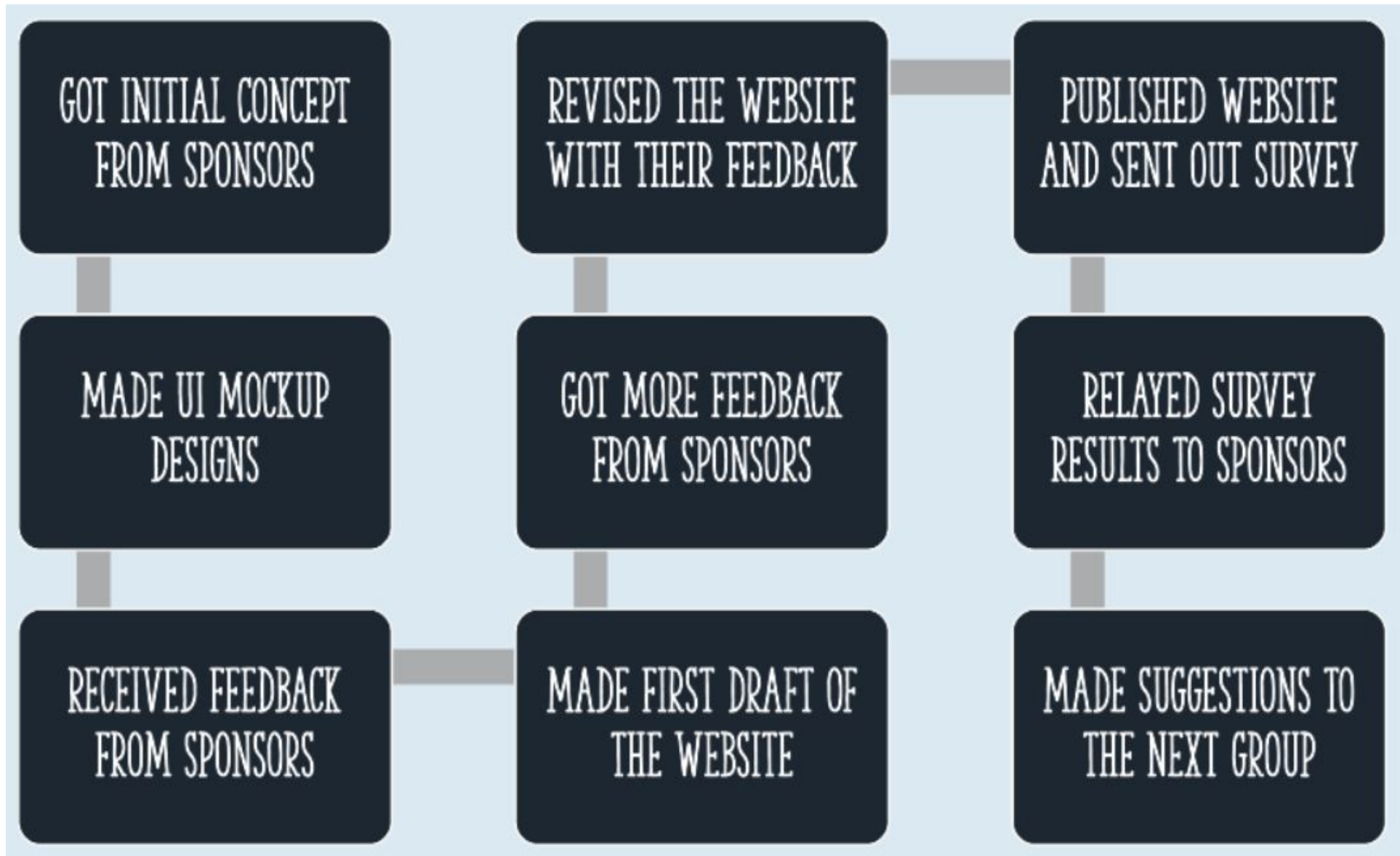


Figure 8: The overall process our of project

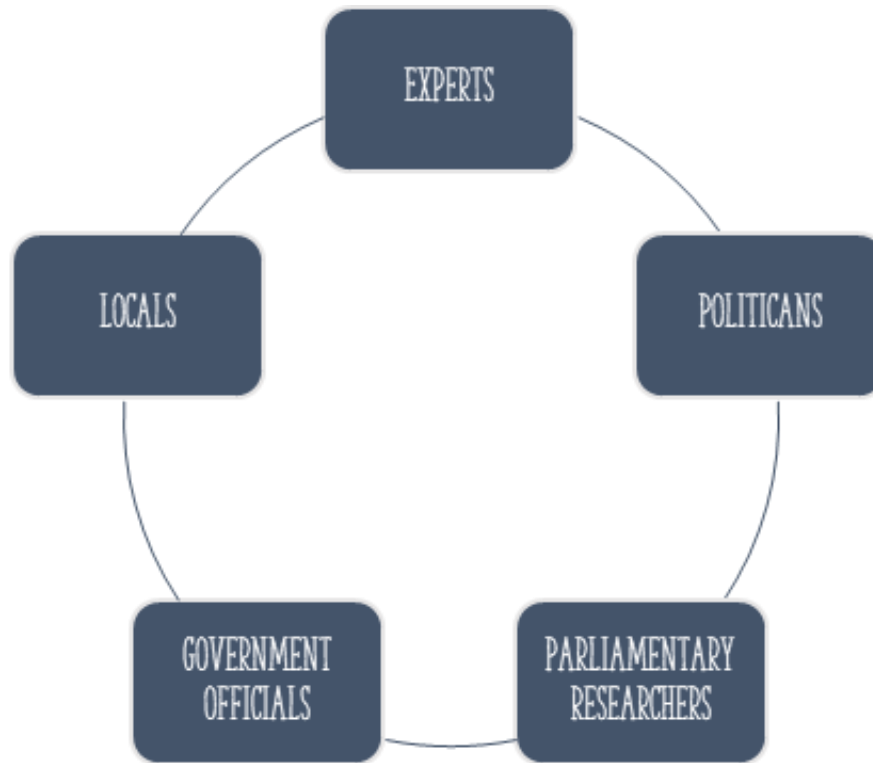


Figure 9: The different types of users for the website

features were a big enough size so that the site is accessible to a wide variety of people.

For our application to be usable by everyone we needed to make an easily accessible user-interface (UI). This is an important task because it will make it easy for users to navigate our application. However, we were guided by our sponsors on how the UI needed to look and we worked them to make the best UI for this application. On top of that, we all had to do research into UI design and programming languages so that we could find the most effective way to make a good UI that is accessible to anyone using our application.

Lastly, we created a website that compiles various open-source organizations that are related to arms control and verification. This was an important task because it will be necessary for people using the application to get accurate information about organizations or news they are interested in. To achieve this goal, our sponsors gave us the names of arms control organizations to categorize and find connections between. We then compiled the organizations and created pages for each. We needed to make sure our database is efficient, and editable so that if our dataset becomes large, we can still have good runtime in our application so that our users will

not have to wait for the results they requested. It is also important that other organizations or features can be added to the website.

One of the last tasks we completed to accomplish our objectives was conducting a survey. The survey provided us with the necessary feedback needed to make our application the most helpful it can be for the people that will benefit from it.

Challenges

We are grateful that we were able to still work on our IQP, however it did come with challenges. It was difficult to work on the project during the pandemic. Our project had to be done all virtually. We met with our teammates, advisors, and sponsors all on Zoom. We had to work around three different time zones to have meetings. At the beginning of the project, we struggled with getting clear on what the final product was expected to be. After meeting with our sponsors a few times and getting the specifics on the project we started to draw up what we thought they were looking for. We edited the sketches with our sponsors until we came up with a design that they were happy with. Sometimes what was pictured for the project looked different once it was executed, so we needed to be flexible and make changes when we were asked to. This became hard once we had a short time span to make the edits but we were able to work with it and create a finished product.

One of the many challenges in the realm of arms control is the lack of communication between experts in the field, as well as barriers to communication between community members and experts. In addition, many arms control organizations that provide open-source information are not in communication with each other, and because of this there currently are not many advances in the arms control technology or policies. Another challenge in

this field is that there are many people who are educated in arms control, but they do not know how the legal process works. They all have these visions about how to improve arms control, but they do not know what the specifics are about what can be implemented into law.

Moving on from the challenges, one of the most important things for our project was to ensure that we were on the same page with our sponsors. This was both in terms of how we went about solving the problem and the specific data sets we were going to be using. Both forms of information came directly from our sponsors to ensure that there were no discrepancies between our final product and their expectations. On the other side of things, the quantitative data we received from our sponsors was primarily in the form of data sheets containing information pertaining to arms control and other related organizations. Because both types of information came from the same source we removed potential sources of conflict and error.

Our group researched the political, social, and health aspects of arms control and the weapons field as well as open-source organizations. The purpose of this research was to establish the context and importance of tracking and provide the rationale for undertaking a project that helped to democratize the information. With the help of our sponsors, we collected the necessary information in order to know what was already happening in this field as well as what the future of open-source and arms control is. We have outlined the steps we took to acquire the information.

Results

In the following section, we will elaborate on the main findings of our research that connect to our guiding research questions.



Figure 10: The homepage of the SCRAP website

RQ1: What challenges exist to modernizing arms verification and tracking through technology?

Our first objective was to find out what challenges exist in modernizing arms verification and tracking through technology. Through our research and discussions with our subject matter experts in the field, we found that challenges included communication, information sharing, and deep knowledge about the legal and policy aspects of the field. With regards to communication, one of those challenges is the lack of communication between experts in the field, as well as barriers to communication between community members and experts. In addition, many arms control organizations that provide open-source information are not in communication with each other, and because of this there currently are not many advances in the arms control technology or policies. People in this field, both experts and non-experts who are interested, are very knowledgeable on a wide variety of topics. To be able to accomplish peace and treaties in this field there needs to be shared information as well as support. Another challenge in this field is that there are many people who are educated in arms control, but they do not know how the legal process works. They all have these visions about how to improve arms control, but they do not know what the specifics are about what can be implemented into law.

The first approach to assisting that challenge of communication and information sharing was to map the field and understand the important stakeholders. To accomplish this, our sponsors gathered links and descriptions of many different open-source organizations with over half of them doing research and work in the arms control field. They compiled them into a large spreadsheet, which we then took

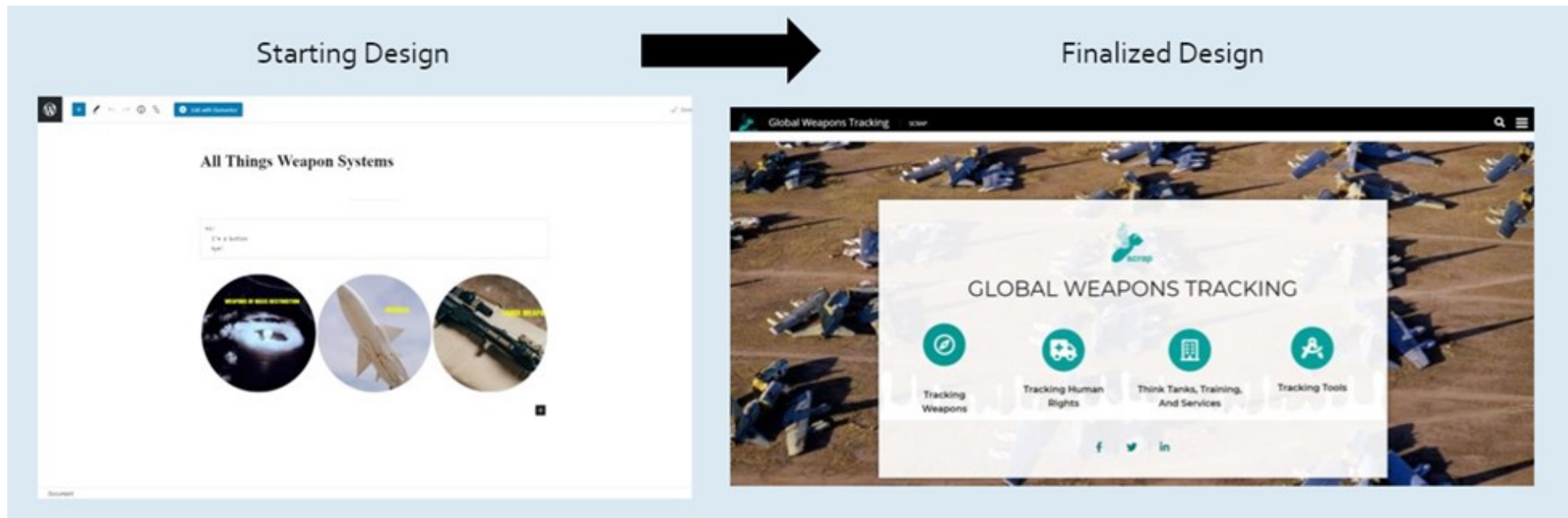


Figure 11: The first design and final design of our website's homepage

and did a systematic categorization and cleaning of that data. Upon completion and organization of the data, we then returned the database to our sponsors for a review. During that process, our sponsors helped us narrow down the many categories we had into four large umbrella topics: Tracking Weapons, Tracking Human Rights, Think Tanks Trainings and Services, and Tracking Tools. We used these four categories along with the list of the relevant organizations to guide the structure and framework of the web platform we created. On that website, we compiled all this information into one place and made it easily navigable, so that anyone could go to the website and get the information they needed. It was very important to go through several rounds of organization of these links and descriptions. Having all of these organizations' information in one detailed place allowed the process of linking the several pages of the website to be much easier.

RQ2: How can we create an electronic resource that helps experts and non-experts work together in order to identify abandoned munitions?

Our second objective was to figure out a way to create a website that helps experts and non-experts in arms control to work together in order to identify abandoned munitions. We knew going in that we would have a very wide range of users that access our website. These users include experts, government officials, politicians, parliamentary researchers, and laypersons. We recognized that because of this our website's user interface needed to be as user-friendly as possible while still using the same theme as the SCRAP website that our sponsors requested of us. In order to get a better understanding of our users and the topics they were interested in, we attended two virtual cafes hosted by SOAS and watched the whole SOAS webinar series. Both had various open-source arms

control organizations in attendance. We also watched a presentation by Frank Von Hippel about the continuing risk of nuclear war. In all these events, we got to learn more about the problems and solutions certain organizations are looking into in the arms control field, but we also got to see the kinds of people behind the organizations and others who would potentially use the website. Towards this end, we made strides to ensure that our website was highly usable for a wide range of people. Specifically, the two major changes that were made towards this goal, were first, the change of the sizing of buttons and text in general and second, ensuring that all text would be readable to a wide range of people. For this first change, we increased the size of all buttons on our website by about 50% and gave all non-obvious buttons bright backgrounds to ensure that they popped out. For this second change, we made sure that all text was of a legible font, font size, and color. Originally we had planned to have a darker background with lighter font

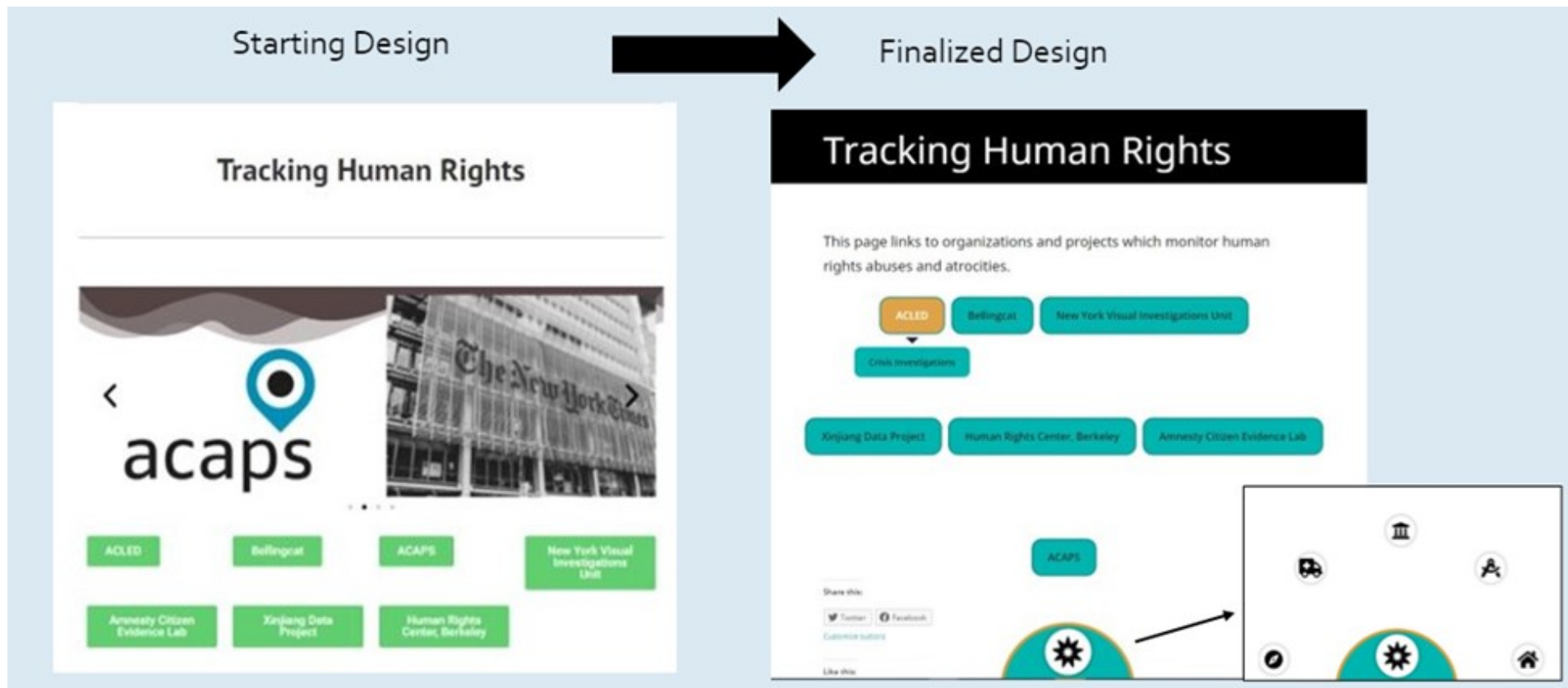


Figure 12: The first design and final design of one of our website's category pages

but reversed this once we realized that this would make it more difficult for certain people to read. Overall, over the course of this project, through both our research and our discussions with others, we made great strides in creating a workable user interface.

RQ3: What could we do to make people more aware of the dangers and reality of abandoned munitions?

Our last objective was about how can we make people more aware of the dangers and reality of abandoned munitions. Our initial concept for the project was to make an app that could track abandoned munitions as well as allow laypersons who find them to get in contact with experts to learn about the munition and what to do about it. Citizen participation is important in weapons tracking. By

having more and more people participating in this field, more information will be obtained about the whereabouts of weapons. This information can be shared so that people who are researching topics like global arms transfers can get a better understanding of what is happening around the world. We also discussed having a database of munitions that people could look through to learn more about any munition they wanted to investigate. This ended up being a bit too complicated for us to complete in the timeframe given since there was no base product to start



Figure 13: The first design and final design of one of our website's organization pages

working with. We had to talk with our sponsors to figure out something more manageable for our group to complete that still accomplished a similar goal while also providing a launch point for that concept in the future.

We ended up settling on creating a website that was a data portal to many various open-source organizations, about half of them being related to arms control. We provided categories and descriptions for each of these organizations so that someone navigating our website would still be able to find useful and informative information. The goal of the website is to be a central location for anyone interested in global weapons tracking and the arms control field. It is a place for people to get connected with organizations, learn about different topics, and share information. We specifically designed the website to reach a wide audience. We made sure it was easy to navigate by

having clearly labeled buttons and a bubble menu to go back and forth between categories and the homepage. Every page has a description so that anyone who uses the website will be able to find what they are looking for.

Information Our Sponsors Told Us

To create our website, we relied on information from our sponsors. The main data that we included on the website was the list of open-source organizations related to arms tracking. At the beginning of this process this data base was a list of a few organizations with links to their home pages. After several rounds of sending the data base back and forth we ended with four umbrella categories and short hover menu descriptions of each organization.

Our sponsors focused greatly on the importance of accessibility and future editability. In our final website design, we stuck with lighter backgrounds and darker text to make it easier to read for all people as well as big and well labeled buttons to easily navigate the website. To ease future editability we created documentation of how we created each page button and feature of the website. This resource was passed on to our sponsors and will be provided to all who will work on this website in the future.

Secondary research

Our secondary information was feedback on our website. We received feedback from our sponsors and from a survey sent out to students and faculty. All of the feedback we received in our meetings with

Examples of open source research ☆ 🗑️ ☁️
File Edit View Insert Format Data Tools Add-ons Help

100% View only

fx Organisation

	A	B	C	D	E	F
	Organisation	URL	Hover label	Categories	short categories	
1	Open Nuclear Network	https://www.oneearthfuture.org/open-nuclear-network	nuclear proliferation	Nuclear Weapons- using data and analysis to reduce the use of nuclear weapons after conflict	nuclear weapons	
2	Datayo	https://www.oneearthfuture.org/program/open-nuclear-network/datayo	crowd sourced satellite imagery	Nuclear open source data platform, identify track and understand the threats	nuclear weapons	
3	RUSI Project Sandstone	https://rusi.org/project/project-sandstone	North Korean shipping	project to analyze and expose north korean shipping- uses open source data mining	weapons flows	
4	Kings College London, Project Alpha	https://www.kcl.ac.uk/alpha	weapons exports	department at King's college London- focuses on science and security and is the department of war studies webpage.	weapons flows	
5	EU Arms Project	https://euarms.com/landing	monitoring export evasions	Tracks EU arms exports to see where they really end up via teams of journalists, investigators, and topic experts	small weapons, large weapons	
6	Forensic Architecture	https://forensic-architecture.org/	explosion investigations	Research agency that investigates human rights violations, state and corporate violence, and environmental destruction, builds models to reconstruct events	human rights, chemical weapons, political violence	
7	ConflictID	https://conflict.id/home	South Sudan Weapons	They collect, classify, and analyze images of weapons from the ongoing conflict in South Sudan, one of the least documented conflicts in the world	small weapons, large weapons	
8	Syrian Archive	https://syrianarchive.org/	Syrian conflict records	This organization deals with human rights violations and conflict in Syria	chemical weapons, human rights, political violence	
9	Bonn International Center for Conversion	https://www.bicc.de/our-work/data-and-geographic-information-systems/	weapons and wildlife in Africa	BICC is a research-based organization that mainly focuses on arms control, dynamics of violent conflict, and order and change	small arms, wildlife poaching	
10	Lighthouse Reports	https://www.lighthousereports.nl/ourprojects/2018/11/15/euarms	EU arms tracking news	Lighthouse Reports deals with arms tracking	small weapons, large weapons	
11	SIPRI	https://www.sipri.org/databases/armstransfers/sources-and-methods	documenting weapons proliferation and trade	Tracking arms trades	nuclear weapons, chemical weapons, biological weapons, small weapons, large weapons	
12	Federation of American Scientists	https://fas.org/issues/nuclear-weapons/nuclear-notebook/	tracking nuclear war gaming and stockpiles	Tracks the advancement and production of nuclear arms	nuclear weapons	
13	The Bureau of Investigative Journalism	https://www.thebureauinvestigates.com/	tracking drone use	Provides unbiased and factual news stories	drones	
14	Campaign Against the Arms Trade	https://caat.org.uk/challenges/the-arms-trade/	tracking UK arms trade	Contains arms data about multiple countries	small weapons, large weapons	
15	James Martin Center for	https://www.promerica.org/category/types/emerg	North Korean sanctions	training and research into proliferation	weapons flows	

Tracking Weapons Tracking Human Rights Think-tanks, training and services Tracking Tools Others (ignore for now)

Figure 14: The database of organizations and categories provided by our sponsors

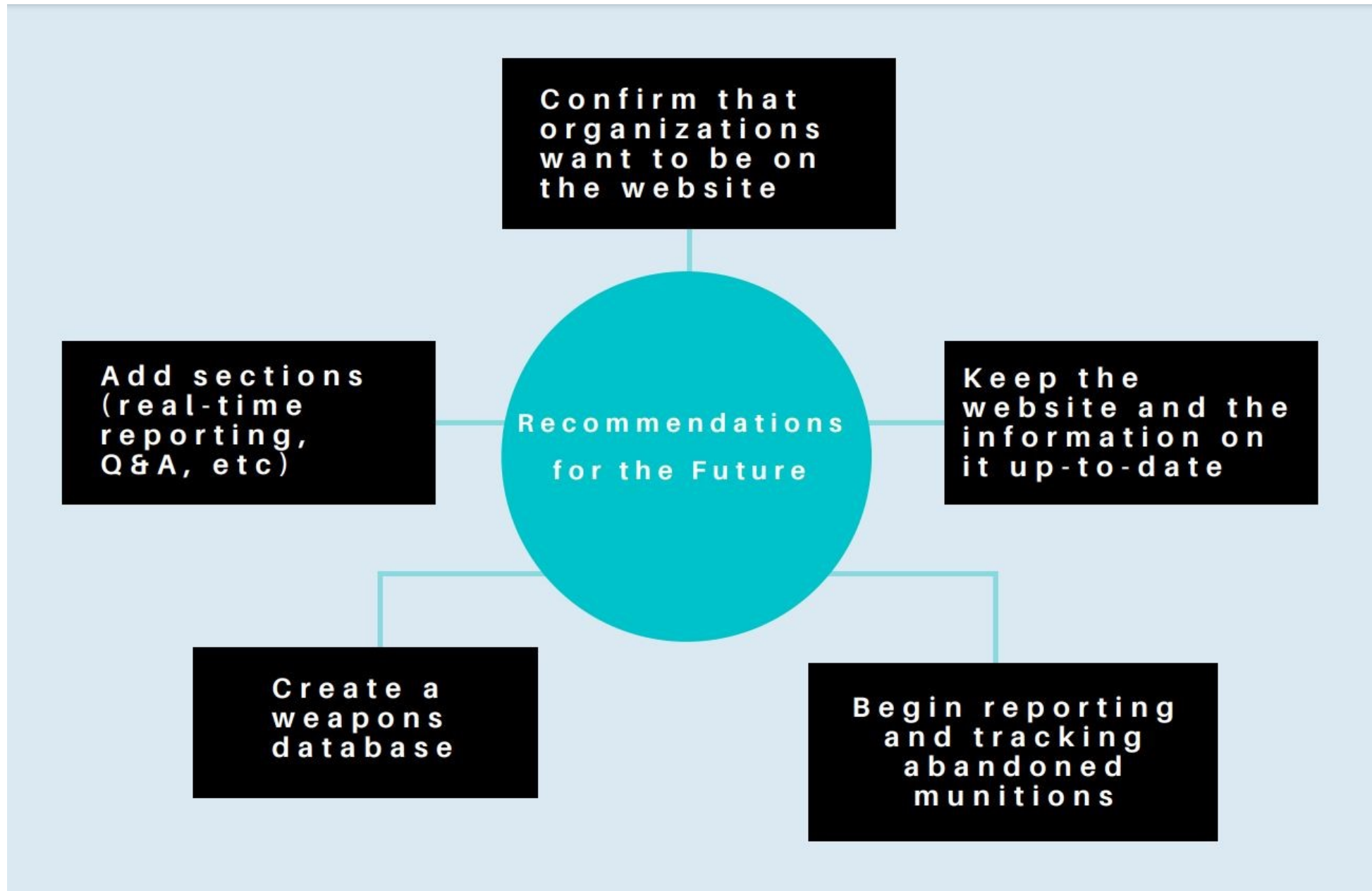


Figure 15: The recommendations we made for the future of this project

sponsors was written down to be changed. We went through these notes and changed the website several times to get pages that encompassed our sponsors' vision. After several rounds of feedback and changes we ended with a website that looks polished and, after approval from organizations, can be published. Although we did not make revisions based on the feedback from the survey, we distributed these results that formed a large portion of data we collected. We sent this survey to WPI students and faculty as well as SCRAP students and board members. Of the surveys sent out we received 20 responses.

Using the responses about past or present area of study, we know that those who took our survey have a wide variety of expertise. This was an important part of this survey as we could have people who are experts at technology, experts in arms control, or people who have no expertise related to this website. We found this important to know because it allowed us to receive usable feedback as well as feedback about accessibility. Our first two survey questions asked about the general experience with the website and the interface. There was a range of reviews, but the majority of people said their overall experience with the website and the user interface was generally good. Later on in the survey we asked about the ease of navigation for the user interface. The average response to this was between extremely easy and somewhat easy. These questions helped us gauge how users felt while interacting with the website. When looking at the qualitative data, the users identified what we could improve to make the website better.

The positive feedback about the website focused mainly on the ease of usage and features we focused on to create better accessibility. There were several areas of feedback as to what users disliked. Some of these dislikes focused on the color scheme and number of buttons on the page. One dislike that was mentioned a few times was the lack of clarity of the bubble menu. If this was clearer to users, it would also solve the problem of not being able to go back to a previous page. When asked what one thing they would change about the website, users left a variety of

responses. The most notable and consistent changes were about the drop-down description, the bubble menu, and the clarity of what SCRAP is. Users felt that the drop-down description looked like a button to then be able to click on. The bubble menu confused several users as they felt it was unclear it was a menu.

One of our last questions was "Would you use this website again?" The average response was between yes and maybe and most users said yes. This discrepancy could have been caused by the type of users we asked. As stated before, the users were a wide variety of people some of whom would have no use for this website after viewing it and taking the feedback survey.

Recommendations

In this section we will provide recommendations based on our research for the field of arms control, for our sponsor, and for future student research teams. In addition, we have a final subsection that is focused directly on the website maintenance. These recommendations are a mix of intellectual and practical that will help to guide future research while also providing some guidance on the support and maintenance of the website repository that was created for this project.

Recommendations for the field of arms control

After doing research on the field of arms control and global weapons tracking, we have recommendations how to continue improving the work being done in this field. We spent a significant amount of time looking through the database of organizations given to us by our sponsors. They each contain key information on one or more topics in the arms control field. This is why it is so important to

continue connecting organizations together and connecting people to their information. Spreading information can help to move the field forward

To continue the momentum of sharing information, we recommend that the website be used as a collaborative repository of information. Along with the organization pages, there can be sections for real-time reporting and a place for people to ask questions and discuss topics. It can be a place for a wide variety of people to connect. From parliamentary researchers and government officials to non-professional trackers and the public, anyone will be able to utilize the site. While we did not focus on the tracking and reporting from users for this project, we would encourage in the future the opportunity to engage citizens and laypeople into the practice of monitoring and reporting unusual weapons discoveries, abandoned materials, and/or human rights issues that they perceive in their home countries.

Recommendations for Oxfam/SOAS

In this subsection, we will focus on recommendations for features and content that could be added to the database and the way in which the Oxfam/SOAS professionals might consider future opportunities for the site development. At the beginning of planning for our project, one idea that was brought up was the creation of a weapons database. This would have been a database that compiles a list of all the weapons that can be tracked in the world. During the process of narrowing down our project we realized that it would take more than the allotted number of weeks to create a website as well as a database. Because of this, we decided to just focus on creating the website. We recommend that a future group lead by the Oxfam/SOAS professionals go forward with creating the weapons database because it

would provide further share of useful information to people in the arms control community, and it would be a great resource to add to the website.

We also had ideas on the content that could be added to the website. As of right now, the portal consists of a short description of different organizations and links to their websites. It might be helpful to start adding more categories directly to the website. For example, a breaking news section could be created. If something happens in the world that pertains to one of the category topics, there could be a section that talks about it and then links to the organizations' websites that are covering it. At this point, we have four umbrella category pages: Tracking Weapons, Tracking Human Rights, Tracking Tools, and Think Tanks, Training, and Services. Future groups could add new categories to the list if they find organizations that do not fit into those four topics. The goal of this website is to act as a central location for people to find information on global weapons tracking. Adding more content in a user-friendly manner is the best way to bring this project to its fullest potential. As time goes on, this field will change and evolve. The website should change and be updated alongside it.

Recommendations for future teams

Based on discussions with our sponsor, we know that there will be future WPI IQP teams who will work in partnership to expand on the work we did this year. In this section, we will include recommendations on what other teams can do to improve or add on to the project. Focusing on the groups that will work on this project in the future, we have a few suggestions on where this project could go. First, a way to expand upon the website is by introducing live tracking. Incorporating tools onto the website that are able to identify types of weapons and where they are will provide another element in arms tracking that will further the spread

of useful information on arms control. Another idea is to create a blog or live feed where people from the arms control community can share their thoughts on any of the categories. This can be done by adding a Twitter Plugin that highlights certain topics or hashtags. It would also be helpful to include more visuals to display the information. An example might be adding a map that displays locations of organizations, where different types of weapons are being held, or the location and direction of the transfer of arms.

Recommendations for Website maintenance

The organization links are the first important piece. The website is centered around the compilation of the organizations, so having up to date links is crucial to continue to connect people to the right information. It would be good to go through each organization page every few months to ensure that everything is up to date. As well as keeping up with the links, it's important to ensure that all organizations have confirmed that they want to be on the website. That goes for any organizations that are added in the future. This is something that has not happened yet, so we recommend that the next group that works on this project reach out to the organizations that are already on the website as well as anyone that they may add. Our sponsors have relationships with some of the organizations so they will be a good resource to go to when getting confirmation. We lastly wanted to ensure that the website continues to focus on the ease of accessibility. We chose specific text colors and backgrounds to make sure that it was easy to read. We made sure it is easy to navigate with the use of the bubble menu. With this menu, it doesn't matter what page you are on, you can always click back to the homepage or one of the category pages. Both changes lead to an easily accessible website. Any person is able to use it without having

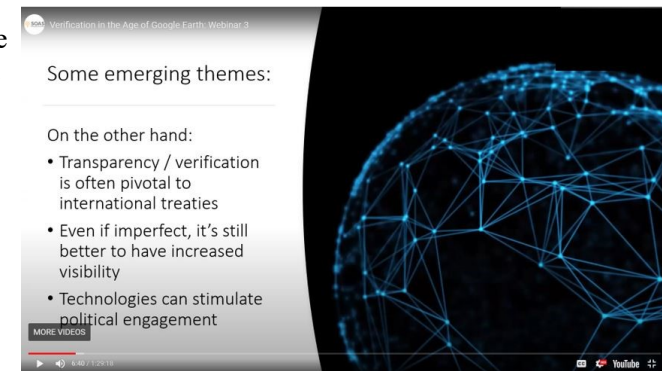


Figure 16: A screenshot from Webinar 3 of the Verification in the Age of Google Earth webinar series on the SCRAP website

to be extremely good with technology.

Along with the creation of the website, we also created documentation on how it was put together and how to maintain the site. We recommend that this piece of writing is updated whenever there are additions or changes. Our sponsors will have a copy of it to pass on to future teams to help in the transition process. Keeping detailed notes on anything new regarding the website will ensure that this project can keep being improved on and passed along to other groups with relative ease.

Conclusion

The prevalence of abandoned munitions and the continued movement of weapons today pose a significant threat to global security. Many conflicts, both past and present, leave behind munitions that pose a threat to the communities that they are in or nearby. These abandoned munitions, even if never touched again, negatively affect the environment and the people living nearby due to deterioration of heavy metals damaging the soil or poisoning drinking water. That is why this is an extremely important issue that our sponsors wanted to address

with this project. They envisioned a website that would be able to expose these threats of abandoned munitions anywhere in the world and let anyone interested in arms control learn about current events or almost anything related to munitions and arms control.

Another reason why they wanted to make this website was to kickstart the advancement of technology in arms control again. Many of the technologies in the arms control and tracking field are highly specialized for one specific purpose in one specific area as we saw in our background research. Our sponsors believe this is partly due to the lack of coordination and communication between arms control organizations, specifically open-source organizations. They wanted to make a central place where all these organizations can be easily found and navigated to, and, if achieved, the organizations would be able to discover and connect with those with similar goals and work together to make more of an impact.

While this is the overall goal of this project, our group focused on making a website as a foundation for a future group to work with in order to implement the bigger goals of this project. The goal we had for the foundation of this website was to get a list of open-source arms control organizations, categorize them, and make a website with that. Our sponsors were able to get us a list of organizations they thought should be on the website and we worked together to categorize them. Then we put them all into the website. We made sure to keep documentation of how we did everything, so that when a future team takes over this project they will know how to add onto or change the website.

We believe that our project was an overall success. We also feel that the next team to take over this project should be able start on the right foot because of the work we put into making this foundational website in conjunction with the results we got from the feedback survey. Moving forward, we hope that this project will become integrated into the arms control community and that it will be able to be a starting point for more technological innovations in the arms control field.

Acknowledgments

Our team would like to thank our sponsor organizations, Oxfam, SOAS University of London, and the team at SCRAP, for making our project possible. We would also like to thank the individuals who offered us guidance and made the completion of this project possible:

- Our Sponsors: Henrietta Wilson, Olamide Samuel, and Dan Plesch
- Our Advisors: Professor Sarah Stanlick and Professor Bethel Eddy

References

- Amnesty. (2019). *Killer Facts 2019: The Scale of the Global Arms Trade*. www.amnesty.org/en/latest/news/2019/08/killer-facts-2019-the-scale-of-the-global-arms-trade/.
- AP. (2003). *International: The lethal detritus of war; Cluster bombs and Iraq*. *The Economist*, 367(8328), 52-39. <http://ezproxy.wpi.edu/login?url=https://www-proquest-com.ezpxy-web-p-u01.wpi.edu/docview/224043849?accountid=29120>
- Bacastow, T. (2020). *Open Source Information*. PennState: College of earth and mineral sciences. <https://www.education.psu.edu/geog594/osint/overview>
- Interfax. (2007). *Munitions cache found in central Kazakh town*. BBC Monitoring Central Asia. <https://www-proquest-com.ezpxy-web-p-u01.wpi.edu/docview/450416695?accountid=29120>
- Interfax. (2013). *Army; Villager finds almost 2,000 abandoned munitions in Astrakhan region*. Interfax: Russia & CIS Military Information Weekly. <https://www-proquest-com.ezpxy-web-p-u01.wpi.edu/docview/1347831381?accountid=29120>
- International: Dead munitions; Arms control*. (2011, Dec 03). *The Economist*, 401, 74. <http://ezproxy.wpi.edu/login?url=https://www-proquest-com.ezpxy-web-p-u01.wpi.edu/docview/908037151?accountid=29120>
- International Mine Action Standards. (2005). *How to conduct sustainable MRE for children*. IMAS mine risk education best practice guidebook 5: Education and training (pp. 23-41)
- IRIN. (2013). *Abandoned munitions endanger lives in Mali*. <https://www.thenewhumanitarian.org/news/2013/03/19/abandoned-munitions-endanger-lives-mali>
- Koch, R., Köser, K., Kwasnitschka, T., and Song, Y. (2019). *Iterative refinement for underwater 3D reconstruction: Application to disposed underwater munitions in the Baltic Sea*. *International Society of the Photogrammetry and Remote Sensing* 181-187. <https://doi.org/10.5194/isprs-archives-XLII-2-W10-181-2019>
- Linkov, I., Trump, B. D., Dittmer, R., & Hazle, M. (2014). *Munitions and explosives of concern: International governance and applications for the United States*. *Environmental Sciences Europe*, 26(1). <https://doi.org/10.1186/s12302-014-0030-5>
- Masetti, G., Calder, B. (2014). *Design of a standardized geo-database for risk monitoring of potentially polluting marine sites*. *Springer* 34, 138–149. <https://doi.org/10.1007/s10669-013-9486-x>
- Mietkiewicz, R. (2020). *Dumped conventional warfare (munition) catalog of the Baltic Sea*. *Marine Environmental Research* 161. <https://doi.org/10.1016/j.marenvres.2020.105057>
- M2 Communication Ltd. (2006). *US DEPT OF STATE: Bouquet of flowers leads to largest cache of abandoned munitions in Afghanistan*. Normans Media Ltd. <https://2001-2009.state.gov/r/pa/prs/ps/2006/63441.htm>
- Rectanus, H., Darlington, R., Kucharzyk, K., & Moore, S. (2015). *Attenuation pathways for munitions constituents in soils and groundwater*. NAVFAC.
- The Recorded Future Team. (2019). *What is open source intelligence and how is it used?* Recorded Future. <https://www.recordedfuture.com/open-source-intelligence-definition/>
- Waters, G., Ball, D., & Dudgeon, I. (2008). *Information warfare: Attack and defense. Australia and Cyber-warfare*. (pp. 33-58). ANU Press. <http://www.jstor.org/stable/j.ctt24h2tt>
- Wilson, H., Samuel, O., & Plesch, D. (2020). *Arms control 2.0? With open source tools, desktop sleuths can go where governments won't*. *Bulletin of the Atomic Scientists*. <https://thebulletin.org/2020/07/arms-control-2-0-with-open-source-tools-desktop-sleuths-can-go-where-governments-wont/>