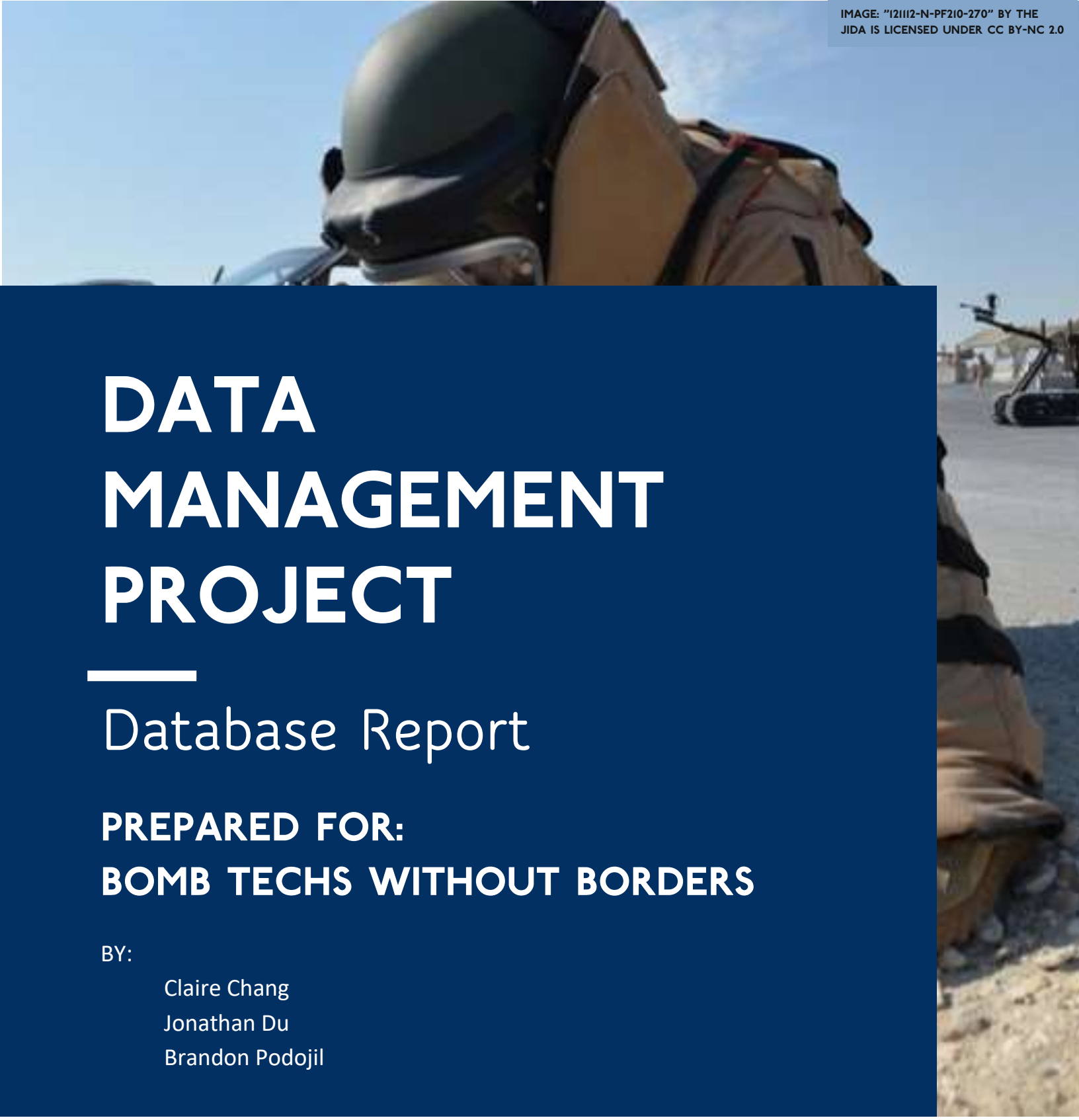

DATA MANAGEMENT PROJECT

Database Report

PREPARED FOR:
BOMB TECHS WITHOUT BORDERS

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BOMB TECHS WITHOUT BORDERS
DÉMINEURS SANS FRONTIÈRES

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INTRODUCTION & EXECUTIVE SUMMARY

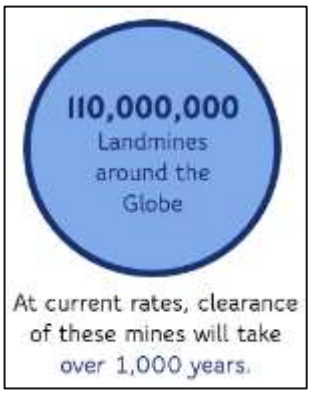
This report seeks to represent in the written word, the work that was conducted for Bomb Techs Without Borders (BTWOB) through the first-half of 2020 by the authors listed above. Through the report, we will:

- Describe the client and identify their data management requirements.
- Identify and define a solution -- a normalized, tidy database.
- Detail our solution process, including how we conducted the needs assessment, which ultimately drove the architecture for a normalized database.
- Define BTWOB's processes in terms of three lines of efforts which became the landscape for which we constructed our data.
- Outline software considerations that were communicated to BTWOB, and why we ultimately chose Airtable as the database platform.
- Identify which best practices of data management are observed within Airtable, and which practices are not observed, either because Airtable does not provide the functionality or the client specifically requested a certain design choice.
- Identify conditions which signify opportunity for BTWOB to expand and grow the database.
- Discuss how this database can be leveraged to support research, including the identification of potential questions and methods.

At end state, this process resulted in the delivery of a normalized, tidy database to the client which supported their primary three lines of effort, financial management, mission management, and impact assessment. The database includes 24 separate tables and 432 unique fields.

BTWOB OVERVIEW

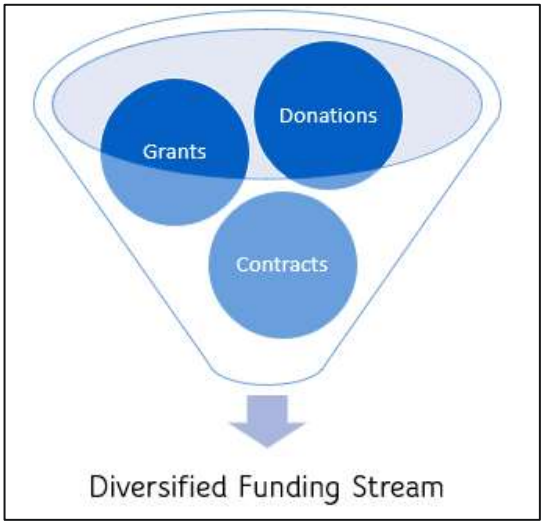
Bomb Tech's Without Borders (BTWOB) was founded by Matthew Howard and Kevin Moultrie in 2019 and was recently approved as a 501(c)3 nonprofit organization. The organization's mission is to help "rid the world of landmines and the casualties caused by them" (Howard and Moultre 2019). There are over 110,000,000 landmines spread across the world, and at the current rate of clearance, it would take over 1,000 years to dispose of them (Howard and Moultre 2019). BTWOB's mission is undoubtedly noble, but even well intended organizations must employ effective and efficient strategies to succeed. To this end, Matt, Kevin, and the rest of their team have gone to great lengths to understand both the realities of the de-mining space as well as the relative advantages they bring to bear.



BTWOB is a volunteer organization with a five-year strategy to expand its capabilities. Initially, it will focus on training bomb disposal techs around the world to promote greater country self-reliance. Next, it plans to begin landmine disposal consulting by 2023. In this capacity, BTWOB would visit on-going disposal missions and provide feedback, guidance, and support to the personnel conducting disposals. Finally, by 2025 BTWOB hopes to have the equipment and authorization required to begin conducting munition disposal themselves. Throughout this process, BTWOB aims to promote strategic communication and raise awareness regarding the problem of abandoned explosive munitions. BTWOB has found initial success and momentum, recently receiving an invitation to attend a UN de-mining conference in Geneva, Switzerland.

BTWOB representation at the 23rd International Meeting of Mine Action National Directors and United Nations Advisers in Geneva, Switzerland

While many countries and international organizations already work to address this challenge, Matt and Kevin identified two key challenges facing others in this space, stable financing and the cost of skilled professionals. Often the majority of funds for de-mining efforts come from governments. Unfortunately, this funding faces fluctuations with political and market cycles creating a highly volatile, unpredictable financial environment in which these organizations are operating. This lack of consistency made it difficult for organizations to both build capacity and weather weak financial times, impacting their ability to operate.



BTWOB has a strategy to mitigate this risk by diversifying its funding stream. In addition to accepting typical government grants (which often come from larger international institutions such as the UN), BTWOB will seek to accept contracts from individual governments and organizations to directly support on-going de-mining efforts. On top of this, BTWOB also has begun a robust philanthropic fundraising campaign. In our discussions, Matt relayed that very few large philanthropic organizations are currently in the de-mining space relative to other international development and aid efforts. Furthermore, BTWOB is headquartered in Silicon Valley, where Matt has observed that many tech organizations are interested in expanding their philanthropic efforts. BTWOB hopes to leverage its

location, network, and expertise to create a stable fundraising base from which it can hedge against public spending fluctuations.

BTWOB also has an approach they plan to use to address the challenge of bringing skilled and talented professionals to bear. The landmine challenge disproportionately impacts the developing world, where few individuals are appropriately trained and equipped for de-mining efforts. Two trends further exacerbate this issue for these countries. First, few of them can afford to hire a professional for-profit de-mining organization. Second, any investment these countries make to develop their own talent often flees as those trained individuals seek better paying opportunities elsewhere. BTWOB will leverage its status as a non-profit and volunteer organization to reduce the cost per trainee or per mine cleared for their clients, allowing de-mining fund dollars to stretch further than with other organizations. This addresses the financial challenges by directly reducing the cost of service requisition as well as the cost of training competent and capable individuals to promote a country's sustainability and self-reliance.

Our group discovered BTWOB during a survey of potential clients and felt inspired by its important mission. Motivated to see if we could help this new organization establish its data management practices, we contacted BTWOB earlier this year with the proposal that our team could help them think about their current and future data needs. Ultimately, we decided upon building BTWOB a normalized database. We came into the project with the idea that we would support their ongoing data needs, but found that they have not yet built up significant data repositories. Instead we determined the best assistance we could provide was to help establish the foundation of future data needs by giving them the tools to expand upon their database once our team concluded the project.

DATA MANAGEMENT REQUIREMENTS

Initial discussion with BTWOB sought to better understand the organization and their data management requirements. These requirements informed the decision to eventually build a normalized, tidy database for them as well as the approach taken to create a customized solution that best suited their needs, capabilities, and future plans. The requirements that BTWOB needed their data management solution to fulfill included:

- Establishing data management best practices up from the start. This would enable BTWOB to avoid the need to constantly revisit, update, and correct their data management practices as new challenges or issues arose.
- Facilitating global fundraising and mission efforts. BTWOB is inherently an organization that will operate around the globe. Given this, its data management solution must also be accessible by its members whenever and wherever required.
- Enabling impact assessment and "seeing themselves." A key component to BTWOB's strategy is performance assessment, which drives both their internal processes to reduce costs and maximize efficiency as well as their strategic communications with financiers.
- Minimizing the need for technical background or training. BTWOB does not currently have a full time technical or information officer, nor does it maintain individuals who are trained in coding and managing highly technical databases. Therefore, any solution should be graphically oriented, easy to use, and require little to know technical expertise.
- The ability to scale with the organization as it expands and grows in capability. BTWOB is just starting its journey. While the product eventually built is comprehensive based on their current understanding and capabilities, they will inevitably identify new data requirements. Their data management solution must include the ability to easily grow and scale in conjunction with the growth of the organization.

DATA MANAGEMENT SOLUTION

After reviewing BTWOB's data management needs, the group determined the best solution consisted of a normalized, tidy database. The following section defines what makes a database normal and tidy. It then outlines the collaboration plan and requirements identification strategy employed to tailor the product to the client's needs.

Normalization

Normalization is a series of conventions used to organize the tables, rows, and columns of a database. We employ the normal form paradigm established by E.F. Codd as described by William Kent (Kent 1983). The BTWOB database generally adheres to the conventions outlined for the first and second normal forms (1NF and 2NF, respectively). 1NF requires that tables in a database contain the same number of fields for each observation - or row and that each cell of a table represents a singular value (Kent 1983, 120). 2NF requires compliance with 1NF and that a singular primary key represents each observation and that a table's fields describe only the observation and the observation in its entirety (Kent 1983, 121). Despite the majority of the database complying with 2NF, some violations exist throughout. These arise either due to the functionality of Airtable, or the preferences of the client. For example, several of the many to one relationships are represented by multiple entries in a single cell. Though this violates 2NF, this is both the preference of the client and the default way that Airtable represents these relationships. Furthermore, the database does not emphasize adherence to the normal forms beyond the second to improve ease of use for the client given their current level of technical database management experience.

Tidy Data

The database also adheres to the conventions of tidy data as described by Hadley Wickham (Wickham 2009). This requires that tables represent observational units, columns are exclusively variables (or fields), and rows are observations (Wickham 2009, 4).

Client Collaboration

Collaboration with BTWOB proved pivotal to our ability to create a customized data management product for their use. Given the geographic distance, work with the client resided exclusively online from the very beginning of the project. In this sense, the disruption caused by the response to COVID-19 was minimal.

The primary collaboration method between BTWOB and the group consisted of video conferencing, first via Facebook, and then Zoom. The migration to Zoom was primarily driven by the ability to share screens with the client to simplify conversations about the products. Additionally, relevant stakeholders from BTWOB were granted access to the group Google Drive and Airtable pages in order to allow the client to directly interface with and assess the products at their convenience.

Data Requirements Identification Strategy

The collaboration process was organized based on three processes identified in discussion with the client: financial management, mission management, and impact assessment. For each process, our group met with BTWOB's subject matter experts in four distinct phases.

The first phase focused on understanding the process and in particular the inputs and outputs for each step. This step was essential for ensuring that the database eventually included all the necessary functionality to support each process.

Following this, the BTWOB representatives identified the various fields and specific data requirements that would need inclusion in the database, which the data management team then converted into normalized, tidy data tables with an appropriate naming convention, data type, and organization. To facilitate ease of collaboration, these products were built into spreadsheets.

With this step complete, the data manager next incorporated the spreadsheet tables into corresponding entries in the Airtable. This phase included the establishment of appropriate primary keys for each table and linking tables with foreign keys as appropriate to establish relationships.

The final phase of this process consisted of sitting with the client to examine the tables, reviewing fields, data types, and inter-table connections. This step also included demonstrating various features of Airtable and conducting limited simulations of the database to ensure that it met BTWOB's intent. All feedback from the client was then incorporated into the database prior to a final review and handover of the product.

One critical distinction about this database is its intended purpose, which is primarily to serve as a decision-making, planning, and assessment tool to aid BTWOB's leaders. While the database could have included additional tables and features to automate various financial and administrative functions, our primary focus for this database was to ensure that the BTWOB board could easily track, visualize, and understand the various aspects of the organization in order to make the best decisions possible. Importantly, incorporating more functions into the database would consume a significant portion of the storage space allocated in the database - particularly if they select the free version for future use. Instead, BTWOB's other automation functions, such as relationship management and accounting are served by other software. Future refinement of the database could include an emphasis on consolidating some of these functions should it become necessary or advantageous to do so.

BTWOB PROCESS OVERVIEW

Our assessment began with a meeting of the leadership of BTWOB, along with members of our team to determine what approach we would take when building a normalized database. We decided on three distinct lines of effort that would guide our approach and the architecture of a normalized database. Figure 1 in the appendix provides a process diagram that outlines the lines of effort and a generic workflow for BTWOB.

- Line of Effort One- Financial Management: BTWOB identified the problem that many mine clearance organizations are often reliant on inconsistent government grants and contracts. In order for BTWOB to survive for the long-haul, BTWOB would need to locate and utilize other revenue sources including consulting contracts and philanthropic support. A normalized database could help BTWOB streamline their operations, data collection, and better manage mission initiatives. Through discussions with BTWOB's financial director, we determined that the majority of his responsibilities fell into one of five process steps, outlined below.
    - Step One: Compliance
        - Ensuring BTWOB complies with all local, state, federal, and foreign government obligations and regulations. This includes adhering to BTWOB's nonprofit status.
    - Step Two: Fundraising
        - In order to help BTWOB continue to function as an organization and at full capacity, fundraising cannot be an overlooked function. We wanted to help BTWOB create a unique, streamlined, and easy way to track all revenue-raising efforts including during events.
    - Step Three: Revenue Management
        - Smart financial decisions will need to drive BTWOB's efforts, especially early on. Using our database, we wanted to ensure that BTWOB was well aware of their fundraising, as well as what contracts and bids are in the pipeline.

- Step Four: Partner Relations
  - BTWOB sees itself as a partner with many organizations. Our database will help them track and maintain relationships with various parties including government officials, donors, personnel, and contractors.

- Step Five: Fund Allocation
  - As BTWOB obtains funds needed to conduct operations like training sessions or disposal missions, funds will need to be allocated. Our database will help them track where their funds are going. We will also help present tools to better visualize data.

- Line of Effort Two- Mission Management: Managing global operations poses a significant logistic and coordination challenge, even for the most robust organizations. Working with BTWOB, we identified the requirement that each mission undertaken by BTWOB must receive individual planning attention as well as resource deconfliction. Each one will require different expertise, different equipment, different amounts of expenditure, and keeping that information streamlined could become an issue. We felt that a normalized database could help them streamline their data collection in these efforts and help them visualize their data in different ways to understand themselves and effectively allocate their talent, equipment, and resources.
  - Step One: Personnel and Equipment Readiness
    - Our database could help BTWOB assess personnel and equipment so that they are ready to deploy when the time comes. We wanted to track organization personnel and equipment available for use.

  - Step Two: Site Assessment
    - Often, BTWOB will carry out missions that will be away from the United States, making the tracking of needs, issues, and resources incredibly important for mission success. Our database can help them keep track of these reports and re-use them for future use.

  - Step Three: Mission Planning
    - A normalized database can help BTWOB decide which missions should be prioritized and keep an accurate count of available resources so that they can be allocated effectively.

- Step Four: Tactical Planning
  - BTWOB will need to decide on specific job responsibilities and specific resource allocation. Our normalized database can help them track this kind of information.

- Step Five: Quality Evaluation
  - BTWOB will need to apply observations and measure effectiveness post-mission in order to decide on next-steps which can include re-training, redeployment, or completion of the mission.

- Line of Effort Three- Impact Assessment: One of the most important aspects of BTWOB will be its impact assessment, detailing the results of their efforts. This is crucial for answering three general questions: What was the effect of the mission? How can we continue to improve our processes? How can we continue operations? This latter question is especially important for communicating with donors, supporters, governments, and organizations. Collecting these data can present numerous challenges, our normalized database sought to streamline data collection, provide simple tools to evaluate data, and provide a way to present data.
  - This line of effort is unique in that it will draw upon our other LOE's in order to produce reports to distribute. We will help provide the tools and platform to manipulate and present data in the program. We made sure that all data inserted into the database could be manipulated and presented, rather than having only specific sets that could be used.

SOFTWARE CONSIDERATIONS

During our conversations with BTWOB, we realized the need for a program that would allow the organization to scale up as they grow. We also needed a platform that would invite collaboration and allow other members of the team to add to the database without requiring an extensive amount of technical knowledge. We also wanted to ensure that the software used would be accessible as a free platform, although we explored paid options as well, should the team choose to utilize them once our team was done with the project. The final software selection decision was determined by the BTWOB leadership team.

Option 1: Airtable (Chosen Software)

- Pro:
    - Airtable combines the robustness and validation tools of a database with a spreadsheet's ease of use.
    - This software is incredibly accessible for members of the organization who may not have the technical know-how on how to organize and edit a database. This was the primary factor in our considerations
    - Live support team. As we hand the project off to the team, we understand that we may not always be around to answer their questions. Because Airtable is a company that is supported through subscriptions, there remains a team to help answer BTWOB's questions should they arise.
    - Linked databases. One of the biggest reasons we ended up choosing Airtable was the simple link feature. Instead of making a record multiple times, once a linked database was created, we could update it once and it would be updated elsewhere.
    - Unique database features. Airtable is innovative in the way that it presents unique tools for its users. Although this is a paid feature, we foresaw many

features that would be helpful for BTWOB. This includes adding real-life map locations into the spreadsheet, integrating pivot tables, easy-to-use graph creators, Google Hangout integrations, report creators, and a whole range of other unique features.

- One of the requests that BTWOB made of us was that our software would integrate with Hubspot. Airtable allows integrations with multiple different programs, including Hubspot.

- Community Supported. Airtable has millions of users and its users are able to share templates across the platform. If BTWOB needs to find a unique way to set up a new database in the future, there will likely be another organization that has created and shared their setup.

- Con:
  - Many of the unique features of Airtable are locked behind a subscription model. Although we created a free database and a "pro" database, we wanted to make sure that BTWOB knew of the paid features. Airtable offers a non-profit subscription fee which makes it much more accessible.

  - Some technical capabilities of a dedicated database software program are left out of Airtable.

  - Some of the observations will inevitably get messy because of the nature of databases.

Option 2: MySQL

- Pro:
  - One of the world's most used database management tools. It's managed by Oracle and is continually updated. The community also helps support its users.

  - It can also integrate with various other programs like Hubspot.

- MySQL is a true database management software tool, it can conduct many sophisticated database functions, so of which may not be applicable to BTWOB.

- Con:
  - The free software is limited compared to its commercial form.

  - This software would require an extensive amount of database management expertise, which would not allow the average database user to access the software.

CRITERIA	AIRTABLE ✓	MYSQL
Establish Best Practices	✓	✓
Global Access and Support	✓	✓
Data Visualization	✓	✓
Ease of Use	✓	✗
Scalability	✓	✓
Value	✓	✓

This figure shows how we graded the two software options against the data management needs identified in the data management requirements section. A blue checkmark indicates that the software established a baseline level of competency in the criteria under consideration. A gold checkmark indicates that the software performed the best among the two options in terms of meeting and exceeding our expectations regarding the criteria in question. In the table, a red 'x' indicates that the software did not meet expectations.

DATA MANAGEMENT BEST PRACTICES

Following the selection of software upon which we would build BTWOB's database, we set about ensuring that the product we constructed followed data management best practices. This section addresses some of the measures we took to address some of these principles of effective data management including storage, collaboration, organization, version control, and data integrity.

Storage

As a database management tool, Airtable provides a purpose-built way for BTWOB to store data. In Airtable, we created an integrated database that included the necessary tables to support BTWOB's three lines of effort. Every user can create unlimited numbers of tables and bases, which are the collections of related tables. Additionally, Airtable provides flexible options for the storage space. For a free base, users can store up to 1,200 records and 2GB attachment space; for a "pro" base, users can store up to 50,000 records and 20GB attachment space.

Collaboration

The variety of options to collaborate in Airtable suit the needs of BTWOB. For example, staff in different departments have access to different tables; appropriate permission levels can be assigned so that key stakeholders, such as clients and volunteers can view necessary information but are not able to edit the database. According to these needs, Airtable has the options to share the whole workspace which includes all the bases, or just one specific base within the workspace. Also, when inviting someone to collaborate in the workspace or base, different permission levels can be assigned and can be changed later. These permission levels include read-only, commenter, editor, creator, and owner.

In addition, we helped BTWOB create forms to gather information and automatically send the information gathered to Airtable across different tables at once. Airtable has the function to create forms but the form is limited to be generated within one table.

Hence, we choose the tool called JotForm to collect and fill in the data across tables and bases. We integrated JotForm with the Airtable API key and customized the forms for BTWOB to send out to potential donors and volunteers in the near future.

Finally, we demonstrated the Page Designer report feature of Airtable. This feature allows users to directly pull information from the database into a report that is printable and distributable. Additionally, these reports are customizable, allowing users to create professional looking reports in the platform, removing the need for an external software. Each record can have its own unique report, and can be updated over time. Additionally, the report feature allows direct editing access to specific observations should the need arise.

Organization

Developing a tidy dataset makes future analysis and research become more effective, because it reduces the time and efforts spent on cleaning the data (Wickham 2009, 1). Hence, we ensured the database adhered to both the principles of normalization and tidiness while building it in Airtable.

In addition, we designed a database schema to visualize the relationships between each table for BTWOB. We aimed to minimize the data redundancy and dependency of data, and prevent data anomalies from database modifications such as updates, insertions, and deletions. The data structure of Airtable helps us achieve the goal of database normalization up to the second normal form.

The hierarchy of data is spontaneously built within Airtable. Data is commonly organized into fields, records, files, and databases, and this data structure corresponds to columns, rows, tables, and bases in Airtable.

First, when creating the field (column) In Airtable, there are different field types provided, such as text, date, number and checkbox. Second, since Airtable works like the databases, the idea of having the primary key is addressed. The first column in every table (file) is the primary field and cannot be hidden or moved. Every record (row) in the table can have unique IDs automatically generated because the primary field can be configured as a formula in Airtable. Last, Airtable can work as a relational database

because the tables can be connected using linked records. Also, we built the schema for BTWOB in Airtable to represent the relationships among all the data elements.

Finally, Airtable offers intuitive ways to manipulate and represent the data. Features such as to hide, search, and group fields work similar to simple relational query language. Also, not only looking at the data in a spreadsheet-like grid, we created different "views" for BTWOB to check the data in unique ways. For example, we use the gallery view to show the branding image in a larger card to help them manage their brand.

Version Control

Airtable helps to control the version in three ways. The first one is to back up the base, the second is to restore data from the trash, and the last one is to track changes in record level.

First, the base can be manually backed up and restored to an earlier version. Airtable uses the idea of taking snapshots of bases as data backup. The system automatically takes snapshots periodically, and users can take the snapshots manually as well. When restoring the base from the snapshot, a new base will be created without impacting the existing base.

Second, every deleted data element from fields, tables, bases to workspace is temporarily available for seven days. The workspace owners have the access to check the detailed information of the deleted element and have the control to restore it within seven days. This time frame is extended in the pro version to six months.

Last, users can check the changes made for every single record. The revision history includes who made the changes, when and what changed.

Data Integrity

In terms of data integrity, we applied strict data typing to enforce logical integrity, data validity, and the system of Airtable helps to protect physical integrity.

In order to minimize the chance for invalid entries in the database, we put several constraints in the database. For instance, we used the pothole style as BTWOB's naming

convention, and strictly defined the data types for every column to ensure domain integrity. If the entry does not fit to the predefined constraints, the system would not accept it.

Airtable makes the commitments to maintain the security and privacy of customers' data. The data is protected using 256-bit SSL/TLS encryption during the transmission between users' servers and Airtable's servers. At rest, Airtable encrypts data using AES-256. The backups are encrypted and stored in a separated and isolated location. Users can manually back up the data by exporting CSV files or retrieving via Airtable's API.

FINAL PRODUCT

As discussed previously, a normalized database represented the culmination of this data management project. At end state, the constructed database addressed the various data requirements discovered during the assessment of the three lines of effort, financial management, mission management, and impact assessment. It consisted of 24 separate tables and 432 unique fields. A schema for the final database created for BTWOB can be seen in figure 2 of the appendix.

In addition to the handover of the final database, we identified several features that enhanced the potential for BTWOB's data management practices. These included the integration of forms for data input through an integration called Jotform. Additionally, we explored built-in features for creating self-generating reports for data output, namely Airtable's Page Builder and Pivot Table blocks.

FUTURE REFINEMENT OPPORTUNITIES

During the collaboration and final handover with BTWOB, the data management team provided several examples of how to update and refine the database in the future. Undoubtedly, the organization will identify additional information requirements, update their processes, or integrate new functions into their organizations. Airtable provides a simple means to ensure database flexibility without requiring significant knowledge about database design or programming. This ease is particularly important for BTWOB as they do not have an identified chief technology or information officer.

One area that BTWOB has already identified the need for future expansion comes from its mission management section. Currently, the database is built to handle missions focused on training bomb disposal technicians. In the future, the organization intends to expand its mission set to include consulting for and conducting actual munition disposal. These missions were not included in the current database because BTWOB still does not know enough about how it will conduct these missions to identify the information requirements associated with them. That said, the data infrastructure is set for this future refinement and the data management team has provided sufficient instruction and coaching to the BTWOB personnel to prepare them to incorporate this functionality at the appropriate time in the future.

Finally, throughout the project, both the data managers and the client identified some limitations with Airtable. On the whole, the benefits of using Airtable, in particular its ease of use, outweigh the weaknesses for BTWOB at this time. In the future though, should BTWOB gain access to a full-time data manager, it may make sense to migrate the database to a more comprehensive software. With the appropriate talent on the team, a more robust software set may provide more nuance, functionality, and customization for BTWOB to overcome some of the current limitations of Airtable.

FUTURE RESEARCH OPPORTUNITIES

While the BTWOB database primarily serves as a knowledge management function for the organization, there also exists the significant potential to use data gathered from the database for research purposes. The research potential includes what this report refers to as micro and macro effect assessment. The two types of research, as well as methods to consider for conducting the research, are detailed further in this section.

For this report, micro research refers to efforts to evaluate the effectiveness of the services provided to clients on their direct ability to address their bomb disposal challenges. Are trainees more effective following this training? Does a decrease in metrics such as accidental deaths follow after missions are conducted? Researchers can often answer these questions by simple observation of the data, though more rigorous studies offer more robust and reliable insights. Furthermore, these questions are directly related to how BTWOB conducts its operations.

Macro research, on the other hand, considers some of the larger questions about the efficacy of bomb disposal efforts. Besides the direct improvement in safety for client villages, do missions conducted by BTWOB result in other improved outcomes, such as economic growth or improved access to various public services such as healthcare and education? The theoretical connection between a safer environment and improved societal outcomes seems logical- improved safety could correspond with increased willingness to start a business or increased travel between the village in question and larger commercial or governmental centers. This dataset has the future potential to empirically assess these theories.

Several methodologies lend themselves to assessing both the micro and macro trends of interest. Relatively simple designs such as regression discontinuities or difference-in-difference designs would allow for some assessment. Arguably, the greatest opportunity comes from randomized controlled trials, similar to the work by Nobel laureates Abhijit Banerjee and Esther Duflo (Banerjee and Duflo 2009). Though this design potentially requires greater planning and coordination, it is often considered

among the most effective methods for empirical studies in the development community. To be sure, BTWOB's primary objective should be to deliver quality training and service. In the future though, BTWOB could seek partners who wish to establish the controls, procedures, and infrastructure necessary to conduct these controlled trials and address these important questions.

CONCLUSION

Bomb Techs Without Borders fulfills a noble calling in helping to rid the world of the pain, suffering, and hardship inflicted by abandoned and unexploded munitions. It seeks to do so by leveraging unique financing, training, and volunteer organization strategies. Its members and leaders have thoroughly considered its operations, processes, and plans to achieve its objectives. In doing so, they have already begun to generate significant interest, excitement, and momentum for their work.

The objective of this project was to empower BTWOB's leaders to make the greatest possible impact. To achieve this, we first identified and understood BTWOB's processes, organizing them by financing, operations, and impact assessment areas of responsibility. With this paradigm in mind, we built and refined a normalized, tidy database in the Airtable software that has been tested, vetted, and approved for immediate use by our client. Given BTWOB's nascency, two key features that we considered in building the data management product were ease of immediate use and the ability to expand the database to meet new requirements for the client as they grow their mission set. The members of the student team have been inspired by the work, motivation, and character of the BTWOB team and we are proud of the product we have built for them.

Now, frankly, the easy work is complete. BTWOB has the data infrastructure to begin their journey. This journey is filled with uncertainty and risk as the team endeavors to solve challenges that other organizations have attempted and failed to resolve. Our hope, however, is that BTWOB finds themselves armed with the information they need to successfully manage their operations, refine their processes, and understand the scope of the problem they are facing and their own effectiveness. There are lives counting on it.

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APPENDIX

Figure 1: Process Diagram for BTWOB

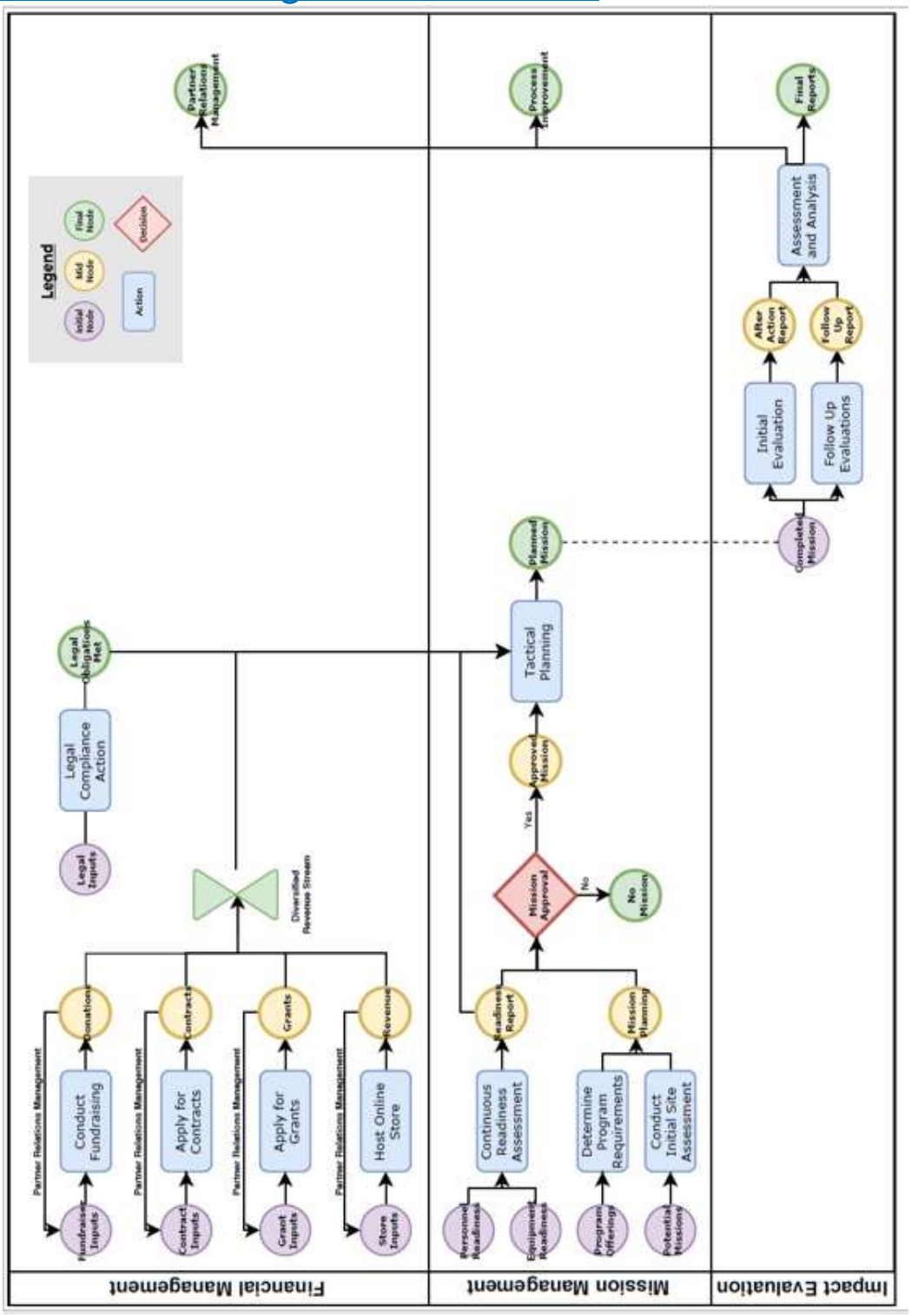


Figure 2: BTWOB Database Schema

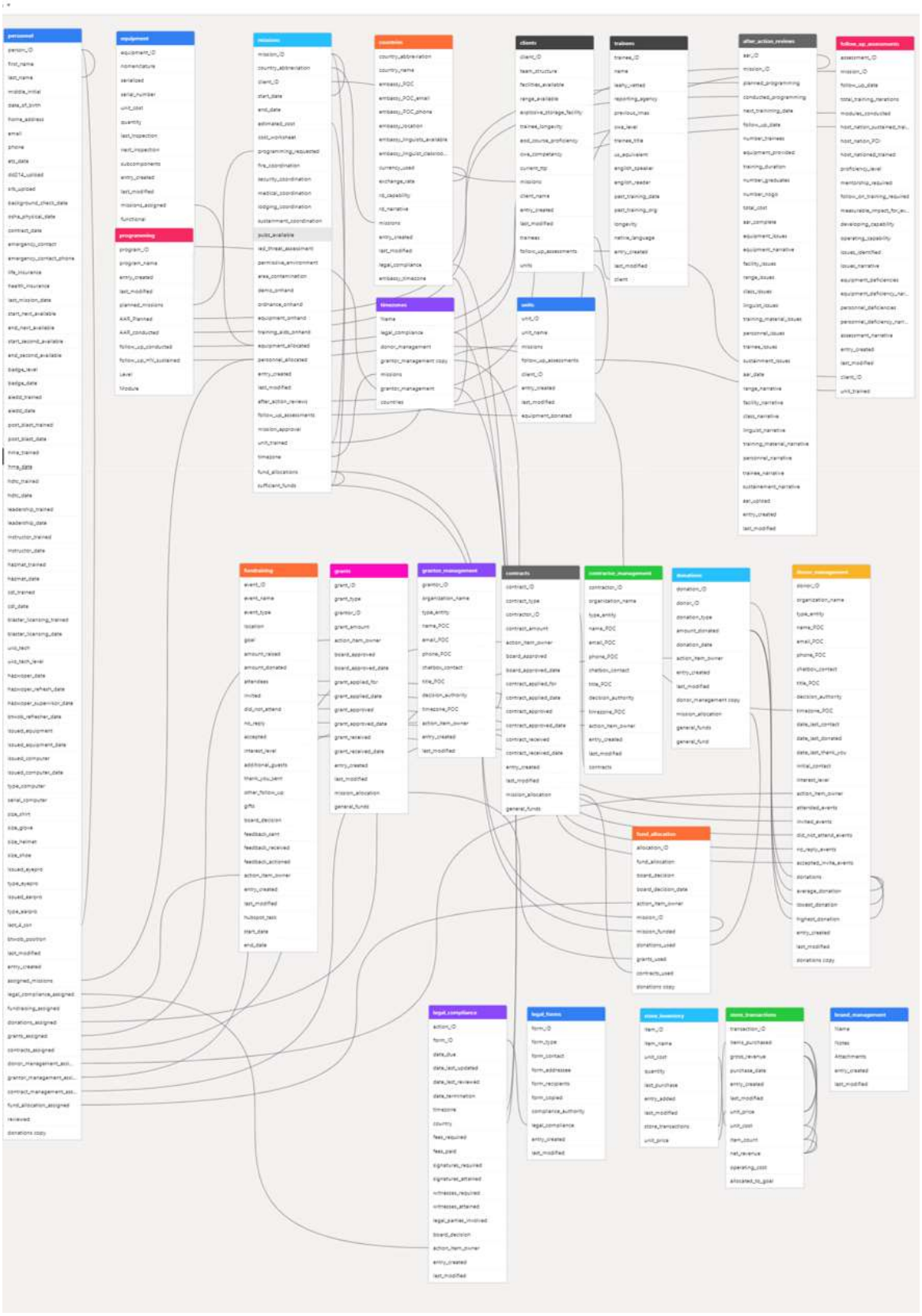
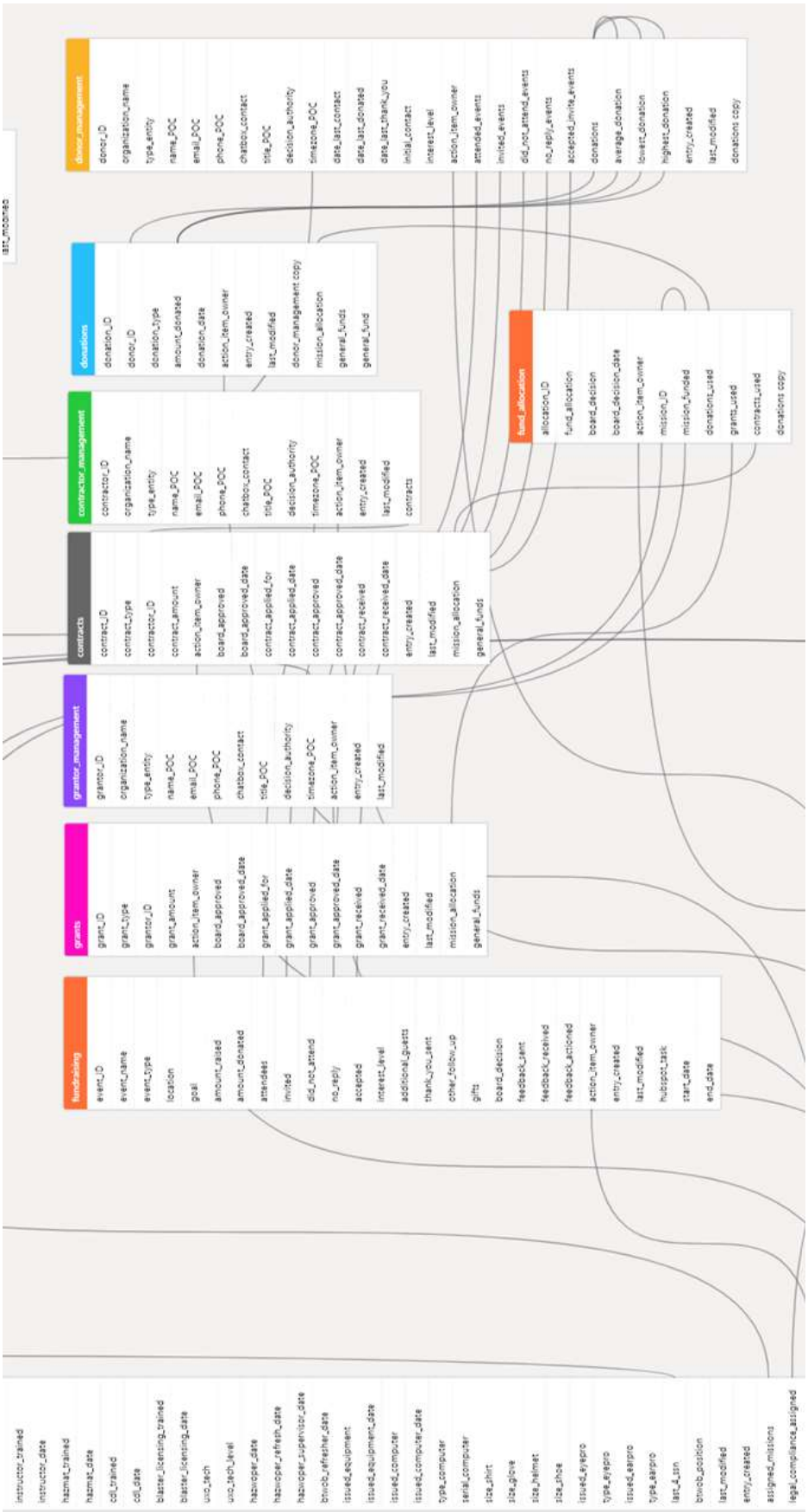


Figure 2 (Continued): Schema Close Ups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donor_ID
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type_entity
name_POC
email_POC
phone_POC
chatbot_contact
title_POC
decision_authority
timezone_POC
date_last_contact
date_last_donated
date_last_thank_you
initial_contact
interest_level
action_item_owner
attended_events
invited_events
did_not_attend_events
no_reply_events
accepted_invite_events
donations
average_donation
lowest_donation
highest_donation
entry_created
last_modified
donations copy
donations
donation_ID
donor_ID
donation_type
amount_donated
donation_date
action_item_owner
entry_created
last_modified
donor_management copy
mission_allocation
general_funds
general_fund
contractor_management
contractor_ID
organization_name
type_entity
name_POC
email_POC
phone_POC
chatbot_contact
title_POC
decision_authority
timezone_POC
action_item_owner
entry_created
last_modified
contracts
contracts
contract_ID
contract_type
contractor_ID
contract_amount
action_item_owner
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board_approved_date
chatbot_contact
contract_applied_for
contract_applied_date
contract_approved
contract_approved_date
contract_received
contract_received_date
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general_funds
grantor_management
grantor_ID
organization_name
type_entity
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email_POC
phone_POC
chatbot_contact
title_POC
decision_authority
timezone_POC
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last_modified
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grantor_ID
grant_amount
action_item_owner
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board_approved_date
grant_applied_for
grant_applied_date
grant_approved
grant_approved_date
grant_received
grant_received_date
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event_type
location
goal
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amount_donated
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did_not_attend
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accepted
interest_level
additional_guests
thank_you_sent
other_follow_up
gifts
board_decision
feedback_sent
feedback_received
feedback_actioned
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end_date
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fund_allocation
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board_decision_date
action_item_owner
mission_ID
mission_funded
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grants_used
contracts_used
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instructor_date
hazmat_trained
hazmat_date
cdl_trained
cdl_date
blaster_licensing_trained
blaster_licensing_date
uxo_tech
uxo_tech_level
hazwopper_date
hazwopper_refresh_date
hazwopper_supervisor_date
bmob_refresher_date
issued_equipment
issued_equipment_date
issued_computer
issued_computer_date
type_computer
serial_computer
size_shirt
size_glove
size_helmet
size_shoe
issued_eyepro
type_eyepro
issued_earpro
type_earpro
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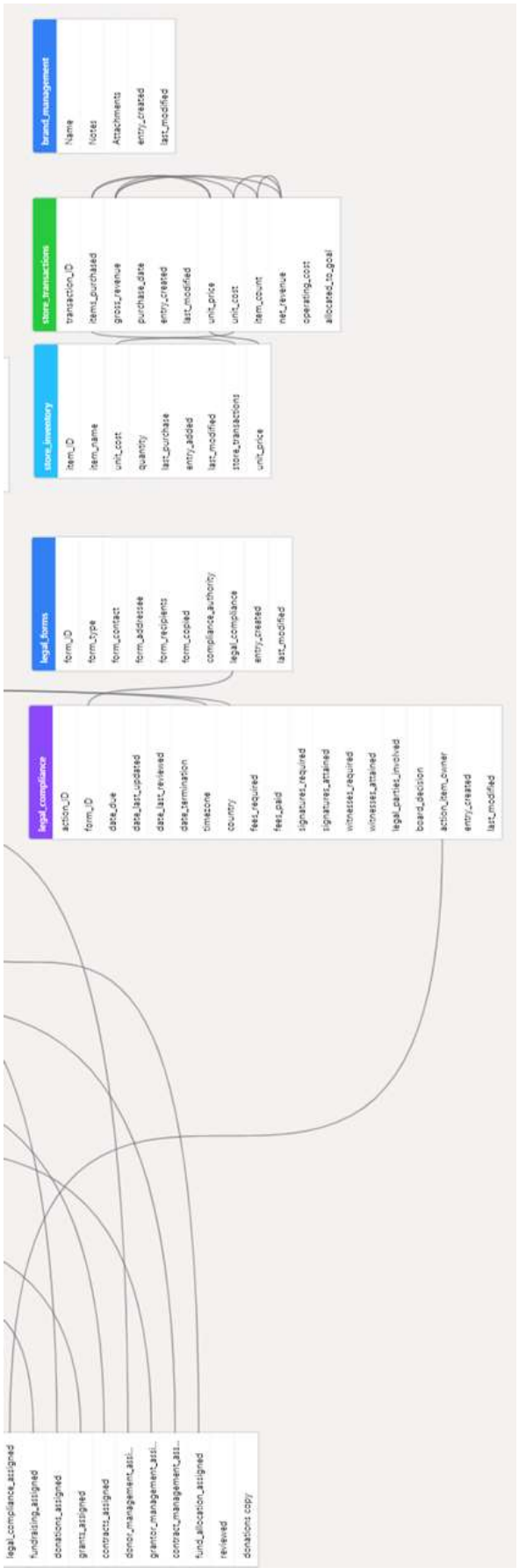
bmob_position
last_modified
entry_created
assigned_missions
legal_compliance_assigned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Attachments
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purchase_date
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unit_cost
item_count
net_revenue
operating_cost
allocated_to_goal
store_inventory
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item_name
unit_cost
quantity
last_purchase
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unit_price
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form_recipients
form_copied
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last_modified
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form_ID
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date_last_updated
date_last_reviewed
date_termination
timezone
country
fees_required
fees_paid
signatures_required
signatures_attained
witnesses_required
witnesses_attained
legal_parties_involved
board_decision
action_item_owner
entry_created
last_modified
legal_compliance_assigned
fundraising_assigned
donations_assigned
grants_assigned
contracts_assigned
donor_management_ass...
grantor_management_ass...
contract_management_ass...
fund_allocation_assigned
reviewed
donations copy