Database Development and Management for Men on the Side of the Road Interactive Qualifying Project

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Men on the Side of the Road
Interactive Qualifying Project**

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Sponsoring Agency: Men on the Side of the Road

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Abstract

Our goal was to collaborate with Men on the Side of the Road (MSR) to improve their data management system for member information. After consulting stakeholders using interviews and surveys, we designed and implemented a system that met MSR's needs, trained employees on system use, and established a maintenance plan consisting of a user manual and an IT support network. Emphasizing sustainability was key to ensuring our project supports MSR as it continues its mission of reducing unemployment in Namibia.

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Executive Summary

Since gaining independence from South Africa in 1991, Namibia has had political stability and consistent economic growth; however, the unemployment rate in Namibia has remained quite high, particularly over the past few years. Motivated by the lack of stable employment opportunities available in rural areas, much of Namibia's unemployed and underemployed population has migrated to the nation's cities in search of jobs.

Windhoek, the nation's capital, is no exception to this urbanization and economic disconnect; in the past two decades, the city has witnessed an increase in population, and there has been little change in the unemployment and underemployment rates as people struggle to find stable jobs suited to their skill sets. The Namibian government has recently enacted several programs to create an economic environment more conducive to entrepreneurship, thereby aiming to reduce unemployment nationwide. In accordance with this initiative, Men on the Side of the Road (MSR) was founded in 2007 with a mission of empowering unemployed and underemployed individuals through training and job opportunities, assisting them on their paths to employment. Unfortunately, without a well-organized data management system that reflects the organization's needs, employees of MSR are concerned that they may not be able to efficiently access member information, and subsequently may not be able represent their members effectively to potential employers, nor their organization to potential supporters.

Seeking to maximize their impact on the unemployed and underemployed, MSR employees were looking to adopt more advanced technology for better data organization and management. Prior to our arrival in Windhoek, employees of MSR communicated their concerns that the organization's data management difficulties stemmed from an inefficiently structured system, particularly because their member information was stored inconsistently across Excel spreadsheets and paper files. Their hope was that a single, comprehensive data management system with improved querying features would make member information more accessible to the MSR staff. In turn, the employees would be able to connect members with job opportunities more quickly, better market the organization to potential employers in order to broaden its partnerships, and increase donor funding.

In working with MSR, our goal was to develop an intuitive data management system that was well organized, widely accessible, and easily maintainable by the employees of MSR. To realize this

goal, we first used interviews and surveys to establish an understanding of not only the database content and functional requirements, but also viable data management solutions given locally available technology. We then identified which of the data management solutions that we considered would be most appropriate for MSR's needs, and determined how to make the system accessible to those using it (mainly MSR employees). Finally, we developed instructional materials for the system's operation and a network of local resources that will be beneficial to MSR in sustaining the system.

The interviews we conducted with stakeholders provided us with a more comprehensive understanding of the nature of the data managed by MSR. In particular, the feedback we received from MSR's employees allowed us to begin to establish the criteria that were most important to the development of the data management system, such as cost effectiveness and internet accessibility. The employees also provided us with a general outline of the information they store for each member, as well as recommendations for the data's organization within the new system. As the employees were hopeful that an improved data management system would allow them to more effectively market MSR members, we also surveyed several members to determine if there was any additional information, beyond that included in their membership application, which they wished to be included in the database. The members frequently mentioned the importance of employers knowing about a member's language skills, training received, and work experiences, indicating that the database needed to be queryable so this information could be easily found.

We also interviewed several frequent employers of MSR members to learn more about what companies look for when hiring a member and about any improvements that could be made to the hiring process. The employers generally placed emphasis on knowing a member's education level, language skills, and work experience. Some common suggestions included listing what training a member had, as well as performing background checks so that employers did not have to do this themselves. They were excited about the idea of an internet accessible system, as it would shorten the hiring process.

The interviews we conducted with local employment agencies helped us to learn about their experiences in managing similar member data. Overall, we found that many companies were having the same struggles as MSR. Some of the companies stressed the importance of well-developed training and maintenance plans, as they had tried many different data management solutions but had not found one that worked due to user difficulties or product failure. Others

expressed their concerns with using computerized systems over paper files, because reliance on electronic data storage alone makes it easier for information to be lost due to technical issues.

These interviews and surveys allowed us to generate a comprehensive list of key criteria for the new data management system, which the MSR employees then prioritized as follows: cost effectiveness, ability to be queried, internet accessibility, necessary storage capacity, maintainability, and intuitiveness/ease of use. Using these ranked criteria as a metric, we compared MSR's current data management system to three possible solutions and determined which of the solutions would be the most appropriate data management option for the organization. After evaluating the possibility of implementing pre-existing systems, a modified version of MSR's previous data solution, or a newly designed system, we determined that the best option was to create our own data management system.

Once we made this decision, we familiarized ourselves with the technologies necessary for the system's development. We chose a combination of web development tools that would enable us to have maximum control over the system, ensuring usability and performance. We designed the back-end server using Node.js and Express because of their easy integration with the JavaScript programming language. For the database architecture, we used Microsoft SQL (MSSQL) because of its free testing environment on GearHost. We designed our front-end application using the React framework, which allows developers to integrate JavaScript programming with the HyperText Markup Language (HTML) that web browsers know how to render, allowing us to efficiently create the user interface of the client-side application. Using these tools, we were able to design a server-side application to retrieve information from our database and host it for secure access by the client-side application. We then worked to ensure system usability by interviewing MSR employees to assess the system's intuitiveness. We used the feedback from these interviews to gauge how to further tailor the system to MSR's needs, which in turn informed our process of refining the system design and implementing the finalized product.

Finally, in the interest of sustainability, we recommended strategies to ensure the system is easily maintained by MSR employees for years to come. We created a user manual detailing the operation and maintenance of the system, focusing on tasks that will be frequently performed by the employees of MSR. Additionally, we interviewed members of Bank Windhoek's IT team to determine a maintenance plan for the hardware required to host our system. We also worked with faculty at the Namibia University of Science and Technology (NUST) to identify a contact within

the Computer Science Department who will partner with MSR as a resource for software maintenance.

With an established IT support network and supplemental reference material, the employees of MSR have the resources to continue to use the data management system and to adapt it to accommodate the evolution of the stored member information. In collaborating with the employees of MSR to enhance the organization's data management system, we have provided MSR with the means to serve more people in its mission of reducing unemployment in Namibia.

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2.2 Effectively Implementing and Adapting to New Technologies (Matt McDonald, Deanna Poirier, Ryan Wittenberg)

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1. Introduction

Despite Namibia's political stability and consistent economic growth, the unemployment rate remains quite high, reaching 34% in 2016 (Reuters, 2017). Motivated by the lack of stable employment opportunities available in rural areas, much of Namibia's unemployed and underemployed population has migrated to the nation's cities. Namibia's capital, Windhoek, is no exception to the pattern of urbanization and economic disconnect.

The Namibian government has recently enacted several programs to create an economic environment more conducive to entrepreneurship, thereby helping to reduce unemployment nationwide. In accordance with this initiative, Men on the Side of the Road (MSR, 2014 f), was founded in Katutura to empower unemployed men and women with the skills and mindsets needed to better market themselves to employers or to start their own businesses. Hoping to increase their impact on the community, MSR employees are looking to adopt a more advanced data management system that will allow them to better market their members to potential employers and their organization to potential donors.

Unfortunately, MSR's current data management system is inefficiently structured and therefore largely ineffective. Because many member files are disorganized, MSR employees feel they are unable to fulfill their mission to the best of their abilities (C. Beukes, personal communication, 31 Jan., 2018). Improved access to member information would enable the organization to connect members with job opportunities more quickly, increase its number of partnerships, and more easily gather statistics for funding proposals.

The implementation of more advanced information technologies, especially data management systems, has been beneficial to small companies operating around the intake, storage, and analysis of data (iDataLabs, 2017). Beyond providing a means of organization, electronically-based data management systems like databases allow companies to conditionally query mass quantities of information rather than synthesizing the data manually. This capacity of data management systems enables small companies to operate efficiently and make substantial progress even with very few employees (as in the case of MSR).

In working with MSR, our team's goal was to identify and develop an intuitive data management system that is well organized, widely accessible, and easily maintainable by the employees of

MSR. To realize this goal, we first used interviews and surveys to establish an understanding of not only the database content and functional requirements, but also viable data management solutions given locally available technology. We then identified which of the data management solutions that we considered would be most appropriate for MSR's needs and determined how to make the system as accessible as possible to those using it (mainly MSR employees). Lastly, we developed instructional materials for the system's operation and a network of local resources that will be beneficial to MSR in sustaining the implemented system. Our final recommendations to MSR included a long-term maintenance plan for the system, as well as suggestions for improving their data collection. In collaborating with MSR, our team helped to provide the organization with the means to involve more people in its mission of reducing unemployment in Namibia.

2. Background

Information technology can be crucial to the progress and growth of companies and organizations, and as it becomes more widely used, it is important that people have the tools they need to successfully implement the technology (Fulk, 1990; Love, Irani, & Edwards, 2004; Venkatesh, 2000). Ottenvanger, van den Akker, and de Feiter (2007) add that a wide variety of improvements can come from using advanced information technology, especially in small organizations where each employee needs to be as efficient as possible to complete all of their work. In this chapter, we explain in more detail the benefits of incorporating information technologies into an organization's daily operation, and how MSR may use such technologies to address their data management needs.

2.1 Need for Advancement of Information Technology

Technological advancement of computers has led to many improvements, from simplifying activities in daily life to helping large companies better achieve their goals (Fulk, 1990; Love *et al.*, 2004; Venkatesh, 2000). Technology has come to be a solution to humanity's need for improvement, and computers are commonly adopted in order to keep up with the more demanding and complex challenges that arise. For example, sequencing the human genome was an ambitious task, and without computers it would most likely have been impossible to complete; at the very least, it would have been much more time consuming, and more likely to have been done incorrectly.

Although computers have been used to complete large tasks, Fulk (1990) explains they also have many features that play a role in increasing the efficiency of small companies and organizations. As industries grew, information technology became more prevalent, and staying up-to-date on the latest technology became essential to continued success, especially in data management. For example, iDataLabs (2017) has found multiple companies such as the National Older Worker Career Center and UnitedHealth Group that use Microsoft Access as their data management system and recommends Microsoft Access as an ideal product for small companies of 1 to 200 people. The use of a data management system allows these companies to stay organized while making progress with only a few employees (as in the case of MSR).

2.1.1 Improvements from New Technology

Venkatesh (2000) and Fulk (1990) explain that there are countless improvements that can come from introducing new technology, such as increased collaboration and communication among contributors. Improvements in communication are especially beneficial, as slow communication often causes group efforts to take longer than necessary. Fulk (1990) adds that regularity in data collection is also a benefit of adopting new technology, as it can help companies and organizations perform their work more smoothly. When collecting data on paper, it can be hard to find original records, and keeping an organized system of paper documents is often a challenge. Using some form of technology allows for more streamlined organization and management of information, which can be especially beneficial when companies need to look back over a long period of time to generate statistics, such as when MSR produces quarterly reports detailing member trainings and placement rates.

Love *et al.* (2004) suggest additional benefits, including improved customer relations and satisfaction. Positive public perception is especially important to small companies and non-profit organizations, which may depend largely on the generosity of donors to fund their work. For example, the Community Foundation for Greater Buffalo relies heavily on donations but struggles to find the time and money to keep its website current and have a maintainable form of communication with donors (Mission: Ignite, 2018). The organization has expressed that adding a section on their website for online contributions is one of its main priorities, recognizing that making donating a simple process might lead to a higher donation rate. MSR works to keep its website up to date, as companies can use it to learn about MSR when deciding if they want to sponsor the organization.

Another possible benefit that Love *et al*. (2004) suggest comes from adopting more advanced information technology is reduced marketing costs. Companies and organizations can save time and money by making information accessible online, and subsequently allocating less time and fewer resources to promoting their company using other media. In the context of the Community Foundation for Greater Buffalo, setting up an online donation system could lead to an increase in funds received. If people can simply go to a website, learn about an organization, and donate directly, the organization will save time compared to those which directly market themselves to individual people or companies. In the case of MSR, having a database that employers can access to find information about members will save MSR time when trying to match members to employers, giving the employees more time to do other tasks.

For most companies and organizations, the benefits of adopting more advanced technology largely outweigh the costs. Although taking time to learn a new technology decreases productivity initially, Venkatesh (2000) stresses that the payoff can be immense once the new technology has been fully adopted. Additionally, Love *et al.* (2004) explains how it is important for companies to invest money in staying current with information technology. While the cost of implementing new technology is frequently a deterrent, the possibility of advanced productivity can motivate people to invest the money and integrate the new technology into their normal routines. Unfortunately, smaller companies and non-profit organizations often devote the bulk of their money to the service they are providing and must rely on grants or used equipment. As a result, they may not have the funds necessary to stay up to date with current technology, and therefore find it difficult to keep up with increasing demand and competition. For example, at the Muscular Dystrophy Association, only the necessary staff have computers, such as secretaries (Mission: Ignite 2018). Furthermore, the office does not have access to the internet. On the other hand, organizations such as the YWCA (Young Women's Christian Association) take every opportunity to use more advanced technology, as it recognizes the benefits that can come from investing money into staying up to date with technology.

2.2 Effectively Implementing and Adapting to New Technologies

In order to begin using a new technology, Venkatesh (2000) states that it is essential for people to receive basic instruction on its use, and to then continue the learning process on their own. It is also important to make sure the technology fits the specific needs of the users. If users feel that the technology is intuitive and useful, they are more likely to continue using it, which will allow them to expand their understanding.

2.2.1 Ensuring Continued Use of New Technologies

Venkatesh (2000) believes that before trying to teach someone about a new technology, it is important to take time to learn about the user's previous technological knowledge, motivation for learning, and willingness to adopt a new technology. Paying attention to these factors can help ensure that the new technology is presented in a way that seems appealing and feasible to a new user. Additionally, the development of training programs to educate the potential users on the functionality of new technology can greatly increase its adoption rate and the future ease of use (Venkatesh 2000). Lindsey Van Gieson (personal communication, Feb, 9, 2018), an Instructional

Tech System Specialist at WPI, suggests providing users with various ways to learn about the new technology, such as user manuals, short video tutorials, and group training sessions. Because there are different learning styles (*e.g.* visual, auditory, kinesthetic), it is important to provide users with many options for learning so that everyone feels like they have a chance to become comfortable with the new technology.

On the other hand, users who do not find the technology easy to use are less inclined to spend time learning how to use it. Even though using an advanced technology can lead to tasks being completed faster, these users may believe that it is more efficient to continue doing a task the way that it has been done in the past. Additionally, Van Gieson (personal communication, Feb, 9, 2018) explains that often times people struggle to adopt a new technology because they did not want to make a change but were forced to learn a new way to do their job.

Consequently, there is a variety of issues that can arise when transitioning an organization to using more advanced technology. As described by Bartel and Lichtenberg (1987), there is a large discrepancy in the speed of adoption among users depending on their education, experiences, and exposure to technology. Lack of education about and familiarity with technology often causes problems in trying to educate people from diverse backgrounds on the use of a technological system. In recent years, the Namibian school system has been expanding the Information Communication and Technology (ICT) program, which is part of the public-school curriculum (Namibia Ministry of Education, 2009). The courses cover fundamental skills such as navigating a computer, word processing, and basic email or internet functionality. While these programs are certainly beneficial, the material they teach will not provide someone with sufficient knowledge to comfortably navigate, operate, and maintain a complex data management system. As a result, ease of use is important in designing a system to be used by MSR, and additional, more specialized training will likely be required for those in charge of its operation.

2.2.2 Case Study: African Community Education Incorporated (ACE)

To understand the process of picking a data management system for a small company, we examined another Interactive Qualifying Project (IQP). This project focused on the implementation of a new data management system for the non-profit organization African Community Education Inc., or ACE (Berthelette, Garcia, Pacifico, & Vaughan, 2014). This IQP team primarily focused on researching different database structures in order to implement a system and train those working for ACE. The ACE data management project first compared and contrasted the

differences between relational databases and object-oriented databases. The main difference, as stated by the authors, is that object-oriented systems allow the storage of different data types like files and images. The object-oriented approach focuses on clustering data into objects before putting them into relational tables programmatically. After completing background research on databases and implementation strategies, the team conducted interviews with the ACE members in charge of managing the organization's data. These interviews focused on the database system's ease of use and its ability to meet the organization's needs. After conducting their research, the team recommended a pre-existing data management tool called Salesforce to ACE.

This case study is relevant to our project because of the similarity in project objectives, particularly the emphasis on understanding sponsor needs to make the implementation of the technology more successful. However, it differs in terms of the resources available to the sponsoring organizations. Because every organization has different needs for data management, the recommendations from the ACE project are not necessarily applicable to MSR, yet the process of evaluating the data management needs will be similar. It is clear from the ACE project that conducting research directly with potential users of the data management system allowed the students to better understand the system needs, and to make a meaningful recommendation to the sponsoring organization.

2.3 Maintainability and Sustainability of New Technology

When an advanced technological system is being developed for a group of users with little understanding of its inner workings, the sustainability and lifespan of the system can be limited (Piattini, Calero, & Genero, 2002). Because the users often do not have the technical knowledge to repair the system, other measures must be taken to ensure that the system remains functional and usable without the direct assistance of the creator. Therefore, the maintainability of software is important when selecting or designing a system.

The main goals of software maintenance are to fix problems, to enable functionality with new systems, and to make necessary improvements or upgrades to prevent any problems from occurring (Piattini *et al.*, 2002). In the case of a data management solution for MSR, fixing issues that arise will be crucial, as much of the organization's operations will depend on this system. Transitions to new systems as well as upgrades and new features are equally important, as MSR's resources and needs will certainly change over time, and it must be possible to maintain access

to their information. A variety of methods can be used to achieve software maintenance, and the ones that we suggest MSR use as they adopt a new technology are described in the following sections.

2.3.1 User Manuals

When configuring a system to be used by people other than the developer, it is important not only to ensure that the users have a strong understanding of the system, but also that they have the resources to further their knowledge and recover from errors (Wright, 1983). User manuals optimally provide information to readers in a rich, user-friendly format in order to enhance their experience with the product (Kovačević, Brozović, & Možina, 2016). A good user manual should enable new users to educate themselves and allow experienced users to learn new techniques, which can increase the usefulness and lifespan of a product.

Wright (1983) suggests that when a user interacts with a user manual or similar document, there are three main actions they undertake: searching, understanding, and applying. A user will generally first use the manual to locate the information that they require most, then read through the information to gain an understanding, and finally apply the procedure laid out in the document in order to achieve their goal. Therefore, when designing a user manual, it is beneficial to focus on these three actions. A document designed with searching, understanding, and applying in mind will be most effective for users, enabling them to quickly and easily find the information they desire. In addition to greatly helping with the initial transition to a new system, this will enable the product to continue to be used once introduced.

2.3.2 Product Maintenance and Software Updates

With most modern technologies, regular software updates including new features and "bug" fixes are very important (Piattini *et al.*, 2002). However, in the case of a system commissioned for a smaller organization or group, it is less common for regular software updates to occur, which may cause problems with the lifespan of the technology. As a result, when limited technological knowledge and a need for a long lifespan are driving forces in the design of a system, it is typically more effective to use a larger service managed by an external source. The use of such a system opens up the possibility for the external company to assist the smaller organization long after the initial configuration, both by offering assistance with issues and by regularly updating their software.

According to Pigoski (1997), no matter how well the system is designed, users will always find things wrong with the system or new features they would like to have added. The maintenance phase is almost always the longest part of the life cycle of a piece of software, often lasting three to five times longer than the time spent actually developing the system. As a result, when selecting a software solution, it is important to ensure that the company or organization providing the solution has a good system in place to support the software. Pigoski explains that most commercially produced applications have a well-designed maintenance plan in place already. Typically, this consists of an internet-enabled "update manager" that is built into the system, allowing it to regularly communicate with the servers hosted by the organization publishing the software. For example, Microsoft Office suite has the ability to include minor updates and patches as required, while also releasing large overhauls including new features every few years. This capability enables Microsoft to ensure its product is useful to users long after its initial purchase and configuration, while also allowing the company to add new features so that the product remains competitive with other, similar software on the market.

In the case of MSR, a data management system with a strong maintenance system such as that described above will be most beneficial. This would allow the system to stay up to date as technology and security continues to develop around the world, with little to no effort or knowledge required of the MSR employees after its initial setup.

2.4 Data Management Systems and Database Structures

Picking the correct data management system contributes to an organization's success because of the system's ability to improve efficiency and accuracy in the workplace (Özsu & Valduriez, 2011). In this section, we evaluate different database structures, as well as their positive and negative characteristics. We also explain the purpose of a database (the component of the data management system in which information is stored), and how someone would use one to store and access data.

2.4.1 Analysis of Different Database Structures

Because data management systems differ in their structure and design, some methods are more suitable in different situations than others (Özsu & Valduriez, 2011). There is often a tradeoff between structural complexity and convenience that must be considered when evaluating the usefulness of a data management system, specifically in terms of the system's database

component. The most commonly used database is the relational database, in which data are entered in the form of tables and are then connected to other tables using a key parameter. The key parameter is one category within a table that is guaranteed by design to be unique, like a social security number or patient ID number. This key can then be cross-referenced in conjunction with other tables to relate more information across the database. These inter-table relationships allow the designer of the database to continuously add to the database and query information on a large scale. The complexity of the relational database is ultimately determined by the number of different tables and relationships.

Although relational databases serve as the foundation for most database structures, there are additional components of the design that affect a database's complexity and convenience (Özsu and Valduriez, 2011). Some databases are limited due to the number of people trying to access or change the database at the same time. According to Özsu and Valduriez, parallel database systems attempt to solve this problem by storing data on computers with many processors designed to run at the same time. These types of data structures are imperative for databases that need to be accessed by a very large number of people, but are far too expensive and unnecessarily complicated for small-scale needs, like those of MSR.

The location of the database server largely influences the accessibility of the database. Online database servers offer a wider reach to the number of potential users of the database, and seamless transportability (Coronel and Morris, 2016). The primary downside with a database connected to the network is that concurrent modification would be more likely to occur due to the increased number of connections. Concurrent modification results when more than one person tries to access or change the same information at the same time, and is frequently an issue for large companies in which many people are using the database. However, because MSR only has three employees, it is unlikely that this problem would occur. Additionally, given the system's ability to manage requests from a client-side application, the pros of an online database server outweigh the cons in the context of MSR's needs.

2.4.2 Accessibility of Data

Despite the diversity of database structures, all data management systems need to be easily accessed by the user in order to effectively pass on data to be interpreted (Özsu & Valduriez, 2011). A lack of data accessibility can be detrimental to an organization as it works to efficiently

realize its goals, inhibiting the transportability and shareability of information between individuals or groups.

Most databases are searchable using Structured Query Language (SQL, pronounced "sequel"), which enables a user to quickly access all data in the database that match or contain a certain phrase (Lynch, 1990). Understanding how databases are queried and accessed is necessary for our project because of its impact on the structure of the data management system, as well as its impact on ease of use and maintenance. Querying for data using SQL is done by "selecting" a table and comparing a query string to a specified parameter. According to Lynch, the format of a basic SQL search query is:

> SELECT [parameter]
> FROM [table name]
> WHERE [parameter = some condition]
> ORDER BY [parameter value] (p.49).

Despite being an effective way to query relational databases, a SQL-focused database may be difficult for new users to access because of its dependency on the user knowing the SQL syntax (Lynch, 1990). Many commercially available data management systems have included the SQL-based queries in a user interface that does not require the user to understand the inner workings of SQL. This interface allows a data management system to be successful, as the users are able to confidently and quickly extract data.

Although ease of retrieval is a large component of database accessibility, it is not the only one (Lynch, 1990). Easily accessible data also allows a user to transport data to others quickly. For organizations like MSR with multiple locations, it is important to have a method by which to compare data. On a local SQL-based database, a user would be able to quickly retrieve data and send it to another location, but this is not the most efficient way. With an online-hosted database, multiple locations could have access to the same server, allowing both locations to store and retrieve data from the database. Databases are frequently stored on servers that can be accessed over an online network, and although this method may make it easier to share data across locations, it also makes the structure of the database more difficult to design and maintain. Additionally, online databases are more at risk for security issues because of their connection to more potential threats over the network. The security problems of online servers can be combated

by more sophisticated technology, which is more difficult to design, implement, and use. We kept this in mind when suggesting a data management system for MSR.

2.5 Men on the Side of the Road (MSR)

In accordance with its mission to empower unemployed individuals in Namibia as they seek work, Men on the Side of the Road (2014 f) offers its members training in workplace soft skills, resources to supplement their job search, and opportunities to apply for temporary employment. Given Namibia's high unemployment rate, MSR's commitment to its mission is critical to reducing unemployment and underemployment in Windhoek, and throughout Namibia. In this section, we give context to MSR and the organization's mission, describe the structure of the organization, and explain its current challenges with data management.

2.5.1 Unemployment in Namibia

Between 2008 and 2014, Namibia's unemployment rate decreased from an all-time high of 37.6% to 28.1% (Namibia Unemployment Rate, 2018). However, since 2014, Namibia's unemployment rate has increased to 34%, and it is now ranked among the highest of all countries. Additionally, the inequality of wealth in Namibia has remained high since independence from South Africa in 1990, in part due to residual social patterns related to colonial and apartheid attitudes that are particularly evident within informal settlements (Ganamotse, Samuelsson, Abankwah, Anthony, & Mphela, 2017). In combination with the already high unemployment rates, the poverty seen in informal settlements and many rural areas has caused much of Namibia's unemployed and underemployed population to seek work in the nation's cities and towns.

Given that this migration contributes to urban population increase, Namibia's cities are not without a willing labor force (Winschiers-Theophilus, Cabrero, Chivuno-Kuria, Mendonca, & Onword, 2017). However, while urban populations continue to grow, the cities' infrastructures are evolving at a slower rate, limiting available employment opportunities. Additionally, the skill sets of the people coming from informal settlements and rural communities may not match those required to fulfill available positions in cities. As a result, stable employment opportunities for these individuals remain scarce (Ganamotse *et al.*, 2017).

Seeking to reduce the national unemployment rate, the Namibian government has put several economic programs in place. For instance, the National Planning Commission was enacted in

2008 with the intention of "[increasing] the competence of the Namibian workforce (knowledge, skills and attitude)" and "[increasing] the productivity of agricultural and non-agricultural enterprises in rural areas" (TIPEEG, 2018, p. 5). In supporting such initiatives, the government seeks to "nurture domestic entrepreneurship, foster innovation and produce economic growth through new markets, new products and new services" (Ganamotse *et al.*, 2017, p. 28). These initiatives emphasize the cultivation of an environment conducive to entrepreneurship: they empower a self-motivated labor force with the resources necessary to realize ideas for business development and self-employment, working to bridge the gap between the unsustainable day labor market and the established business community.

In Windhoek, these initiatives and sentiments are reflected in the work of organizations like Men on the Side of the Road (MSR). As the nation's capital, Windhoek is no exception to this pattern of urbanization and economic disconnect. Between 1995 and 2015, the population of the city grew from approximately 185,000 to approximately 322,500, with many of these individuals living in the Windhoek township of Katutura, which is surrounded by some of Namibia's largest informal settlements (World Atlas, 2015). MSR (2014 b; 2014 e) was thus founded in Katutura in 2007 to provide unemployed and underemployed individuals with the training and mindset needed to succeed in the workplace, helping to combat the urbanization-induced rise in unemployment rates.

2.5.2 MSR Organization and Mission Statement

Men on the Side of the Road (MSR, 2014 c; 2014 f) is a non-profit, non-government organization that strives to give men and women the training and confidence they need to be competitive when applying for jobs. Although originally located in Katutura, MSR has since moved to Khomasdal, Windhoek, with a second office recently established in Swakopmund (C. Beukes, personal communication, March 15, 2018). Membership in the organization requires, at minimum, attendance at MSR's working world soft skills course, which highlights interpersonal communications, interview skills, and CV writing, as well as completion of the Ministry of Finance's "Budget wise, Save wise, Spend wise" training program, which emphasizes the development of good financial management habits. Members are allowed two years to complete the two required training courses and find employment; however, if either has not been accomplished by the end of the allotted time period, these individuals are allowed to renew their membership with MSR (H. Kambanda, personal communication, March 14, 2017). Beyond these requirements, MSR (2014 d) offers courses in spoken English to reduce potential language barriers that may limit members'

employment opportunities. Additionally, the organization's IT Drop-In and Job Center serves as a resource for communication materials (photocopying services, phone, fax and email accessibility) as well as computer access for employment research, CV typing, and basic computer skills development. MSR has taken initiative in creating jobs, as well, particularly through the development of programs like The Paper Block Project, which focuses on the creation and sale of a sustainable firewood alternative.

There are other organizations in Windhoek that help with unemployment in the region, but they fill slightly different niches. For instance, while NamSkill Namibia Consultancy (NNC, 2013) works to provide entrepreneurial skills workshops for the unemployed, it differs from MSR in that it places a stronger focus on providing support networks for those struggling to find stable employment. Another organization, Jobs Unlimited (2018), also offers skills workshops, but differs from MSR because of its focus on marketing workers that already have basic employment skills to new employers. MSR fits in between these two organizations by training those with little to no skills, and marketing them to businesses in the area. Despite being different, these three organizations all combat unemployment in Windhoek together by offering a support network to those in need. Due to the common mission of these organization, they do not compete with each other, but rather work with the community, for the community.

The people who are involved with MSR (2014 e) are passionate about helping to decrease unemployment in Namibia. The organization is managed by three individuals: its CEO Crystal Beukes, the MSR Trainer/SSDF (Social Security Development Fund) Project Coordinator Hilya Kambanda, and Fieldworker Tomas Shilongo. Within the last few weeks of our project, MSR also hired an intern, Marisa Lemos. Collectively, the staff markets MSR to unemployed individuals throughout the Windhoek area, coordinates potential employment opportunities with businesses and the local government, and develops relationships with domestic and international funders.

2.5.3 MSR Members

In registering for membership with MSR, all applicants are required to complete a form documenting basic demographic information, relevant education, and past work experience (C. Beukes, personal communication, Jan. 31, 2018). Additionally, MSR maintains a record of each member's completion of the organization's required training courses, as well as their job placements during membership.

As of 2018, MSR has over 1,300 members, and the organization is continuing to expand its membership (H. Kambanda, personal communication, March 14, 2018). Many members have achieved success in self-employment, applying entrepreneurial skills acquired and refined through MSR's training programs (The Southern Times, 2016). For instance, Erastus Nujoma, 33, highlights the educational and occupational opportunities with which MSR has provided him in his membership: "…through MSR I was exposed to many opportunities, which I might not have had if I did not join them. I'm thankful to MSR and I'm encouraging other unemployed people to join...," (p. 1).

Unfortunately, there is still some disconnect between member and employee understanding of MSR's mission, with some members expressing that they feel they are not being marketed to potential employers as effectively as promised. As Ms. Kambanda emphasizes, MSR was not founded solely upon the mission of offering employment to its members, but more on empowering it members with the skills and mindset necessary to capitalize on their own employment opportunities: "…we are not a job provider, but our objectives… [are to] formalise this group of people by providing them with life skills and finance management skills, so that when they get into the market they know how to manage their finances…." (Nashuuta, 2017, p. 15). However, the employees of MSR are actively working to address this disconnect, hoping to more effectively market the members to potential employers by exploring better data organization and management techniques (C. Beukes, personal communication, Jan. 11, 2018).

2.5.4 MSR's Partners and Employers

MSR has an official partnership with Bank Windhoek, which sponsors MSR and other non-profit organizations in the area (H. Kambanda, personal communication, March 16, 2018). Additionally, MSR has an associated Board of Directors to facilitate communication and maintain relationships with the organization's donors. This board includes representatives from Bank Windhoek, PriceWaterhouseCoopers, Eden Imports and Exports CC, Schoemans Office Systems, and Walvis Bay Corridor Group, as well as self-marketed social entrepreneurs.

Although the organization's focus is on providing members with the skills and mindset necessary to market themselves to employers, MSR also offers its members actual employment opportunities by collaborating with businesses seeking temporary or long-term hires (C. Beukes, personal communication, Feb. 20, 2018). Bokomo Foods (a food manufacturer and distributor),

CYMOT (an outdoor sports store), Polyoak Packaging (a packaging supply store), and Bank Windhoek are the primary companies that hire MSR members in the Windhoek area.

2.5.5 MSR's Current Data Management Structure

As an organization that strives to provide members with not only training opportunities but also a path to employment opportunities, MSR (2014 e) has accumulated a substantial amount of information on its members regarding their skill sets, experience, and achievements (C. Beukes, personal communication, Jan. 31, 2018). Several years ago, in an effort to make member information more easily accessible, MSR reached out to a doctoral student from a South African university to develop an online database to store and query member files (H. Kambanda, personal communication, March 13, 2018). While the data management system worked well for the organization, the student who developed the system left to work in Kenya once the system was up and running. Consequently, when the service hosting the database stopped doing so in 2015, MSR did not have the necessary maintenance information to resolve this problem. As a result, the database could no longer be accessed, and Ms. Kambanda and Mr. Shilongo (who complete most of the administrative work) began using a combination of Excel and paper files.

Currently, all member information is stored in an Excel spreadsheet, and the information is primarily accessed when it is requested by a potential employer. Given that the Excel spreadsheet does not have any advanced querying features, retrieval of member information is a fairly tedious process that requires sifting through the mass accumulation of data to collect the information relevant to the member of interest. This information is combined into a report for requesting employers, with the entire process lasting about a half hour (T. Shilongo, personal communication, March 19, 2018). Ms. Beukes also needs to access the data when writing quarterly reports, in which she includes statistics about number of members, number of placements compared to the national statistic, etc. (C. Beukes, personal communication, March 15, 2018). Again, a lack of advanced search features makes this process difficult.

In the absence of an efficient data management structure, MSR's growing volume of member information is making it increasingly difficult for the organization to effectively market its members to potential employers (C. Beukes, personal communication, Jan. 31, 2018). The MSR employees have consequently decided to adopt an electronic data management system to more effectively organize this information. Because MSR's past attempt to establish such a system was unsuccessful due to a lack of usability and maintainability, these criteria were important to keep

in mind when choosing the best data management system (H. Kambanda, personal communication, March 14, 2018).

2.6 Summary

MSR is a clear example of how adopting new information technology could lead to improved efficiency in an organization. Venkatesh (2000) writes that two of the main factors in making sure an organization continues to use a technology after it is first presented are understanding the users' motivation for learning and considering their willingness to make a change. Ms. Beukes has made it clear that MSR has a strong need for the use of a more advanced data management system, as it will assist the organization in being a more useful resource to its members, as well as help the staff for marketing purposes. This strong motivation will encourage the staff to put in the necessary effort to learn how to use a new system. Additionally, because MSR came up with the idea for the new system, it is evident that they are ready and willing to make a change to the way that they have been organizing and accessing their data. Despite their motivation and willingness, MSR was not sure what data management system would best suit their needs, or what the most effective ways are to make sure the staff is able to adapt to and use the system efficiently. In the next chapter, we explain how we worked with MSR to achieve its goal of adopting a new data management system.

3. Methodology

Our goal was to develop a data management system that was well organized, widely accessible, and easily maintainable by the employees of MSR, providing MSR with a tool to better market its members and itself to potential employers and supporters. To ensure that our project coincided with MSR's mission and long-term operational needs, we had the following objectives:

- Objective 1: Identify the best data management system.
- Objective 2: Identify ways to make data accessible.
- Objective 3: Identify ways to educate MSR employees on system use and maintenance.

In this chapter we explain the methods we used to achieve these objectives, and thereby our project goal.

3.1 Objective 1: Identify the Best Data Management System

To develop a data management system that meets MSR's needs, we first needed to understand MSR's current and past data management systems, why these systems were suboptimal, and how similar organizations manage their data. After conducting interviews and surveys, we synthesized the feedback to identify and prioritize the features to be included in MSR's new data management system. By evaluating our possible solutions against this prioritized list of needs, we were able to determine which data management system would be most appropriate.

3.1.1 Interviews and Surveys

When interviewing and surveying stakeholders, we made an effort to consider the perspective of not just the primary users of the data management system (MSR employees), but also those whose information is represented within the system (MSR members), others who may request information from the system (employers of MSR members), as well as users of and experts on similar systems (local employment agencies and IT specialists). To begin, we interviewed MSR's three employees. Rather than just following a generalized protocol, we conducted the interviews individually and included an additional set of questions tailored to each of the interviewees (Appendix A). In doing so, we were able to learn about their roles at MSR, any differences in their understanding of the past and current data management systems, and how they use the system in marketing MSR members and the organization to potential employers. We conducted these interviews in a semi-structured format using open-ended questions to ensure feedback addressed

major project concerns without stifling additional commentary unanticipated by the scope of the questions.

Interviewing the employees helped us better understand the data to be managed. To determine appropriate system capacity and accessibility features, we gathered basic information regarding what information was being stored, as well as additional functions they hoped the new data management system would have. Furthermore, we asked the employees questions about MSR's past data management system to gauge which features they found beneficial and which elements they found to be ineffective. We also discussed the possibility of making some of the information accessible to employers and asked for feedback regarding what they felt the employers should be able to see. This allowed us to gain a more complete understanding of operational requirements for the new data management system.

Following our interviews with MSR's employees, we surveyed the members of MSR (Appendix B). We used open-ended questions to determine if there was any information MSR members felt should be included in the data management system to make them more marketable to potential employers beyond the basic information requested during the member registration process. In terms of content, we requested information such as how long each participant had been a member of the organization, and how accurately they felt their skills and experiences were reflected in the application paperwork. The survey also contained questions about the level of commitment that they perceive MSR devotes to advocating for their employment. Finally, we asked what the participants thought MSR could do better when placing them for jobs, if anything. At the end of our survey, we included a question which requested any additional information participants felt compelled to share, thereby ensuring the feedback included all concerns or suggestions from the members.

To distribute the survey, we attended an MSR Community Meeting, where members were told about upcoming opportunities and encouraged to share their opinions on various topics. We explained our project to the 33 members who attended, and then distributed the survey to 15 voluntary participants, all at various stages of their membership. This allowed us to collect information that was representative of many of MSR's members' skill sets and experiences.

Given the interest that MSR expressed in using the data management system to better market the organization to potential employers, we also conducted interviews to learn more about the

experience that employers have had with MSR (Appendix C). Ms. Kambanda provided us with a list of five main employers who continually hire MSR members, and we emailed them to schedule a 10 to 15-minute interview, either over the phone or in person. If we did not receive a response within two days, we called the company to schedule the interview. These brief semi-structured interviews contained open-ended questions which focused on how the partnership developed, what information the employer currently receives regarding the MSR members that they hire, and what additional information the employer would like to be provided before employing a member. During the interview, we also explained our hope to make some member information available online to employers, and included a set of follow-up questions to determine what employers would like to have accessible to them in this format. However, given MSR employees' concerns about protecting member privacy, we emphasized that any information that employers would be able to access online would be fairly limited, and that the employer would still have to contact MSR to officially hire any members.

We then conducted interviews with representatives of organizations that manage information similar to MSR's member information (Appendix D). Ms. Kambanda suggested that we speak to employment agencies in the area and provided us with a list of five such companies. To schedule a brief interview, either over the phone or in person, we contacted each company first by email, and then by phone if they had not responded within two days. If the company was unfamiliar with MSR, we briefly explained the organization, its mission, and its current struggle with managing member information, then discussed how we would be working with MSR to implement a more effective data management system. The open-ended questions we asked during our interviews allowed us to learn about each company's methods for organizing and querying data, as well as any other systems they had tried in the past.

3.1.2 Analyze Responses and Identify/Prioritize Data System Requirements

Once we had gathered responses from stakeholder interviews and surveys, we reviewed the information and categorized the feedback into a set of required characteristics for the new data management system. We first made a list from each interview or survey of the information that the participant wanted in the data management system, then determined a few criteria which represented all of the needs expressed by the stakeholders (*e.g.* cost effectiveness and ease of use). We next distributed this simplified list of system requirements to the employees of MSR and requested that they give each criterion a unique priority rating, 1 (least important) to N (most important, with N being the number of criteria). Rather than distributing this list to all the

stakeholders that we interviewed, we decided to ask only MSR employees to prioritize the needs as they will be interacting with the system far more than any of the other stakeholders, meaning it is most important that the selected data management system reflects the needs as they see fit. After averaging the priority rating given to each of the criteria by each MSR employee, we created one aggregate list of system requirements. This prioritization was necessary for conducting the Pugh Analysis explained below.

The final step in analyzing the data was to create a list of potential data management solutions based on interviews with MSR employees, MSR employers, employment agencies, and Bank Windhoek, as well as our own research. By performing a Pugh analysis, we identified which of the solutions would best fit MSR's needs.

3.1.3 Select a Solution to Best Suit MSR's Needs

To determine the best solution, we used a Pugh matrix, which is a weighted pros and cons list. The matrix quantifies how well an existing solution and each potential solution addresses an identified set of criteria. In our case, the existing solution was the Excel spreadsheet and the potential solutions was modifying a pre-existing data management system, using MSR's old data management system, or creating a new data management system. The criteria against which we evaluated these solutions were the data management requirements that were ranked as explained above. As in most Pugh analyses, these rankings were subjective because we determined the final prioritization after synthesizing the individual employee's responses.

We gave each potential solution an effectiveness ranking of -1, 0, or 1 for each criterion based on how well the solution addressed that criterion compared to the existing solution: a ranking of -1 indicates the solution does not address the criterion as well as the existing solution, a ranking of 0 indicates that the solution addresses the criterion just as well as the existing solution, and a ranking of 1 indicates that the solution addresses the criterion better than the existing solution. For each solution, we multiplied each effectiveness ranking by the priority ranking for that criterion, thereby "weighting" the effectiveness. We then calculated the sum of the products for the positives, negatives, and neutrals for each solution separately in three rows at the bottom of the table. The purpose of these positive, negative, and neutral scores was to allow us to see how the pros and cons impact the solution's overall score (sum of these three products, last row of the table), which shows how well this potential solution addresses all of the criteria compared to the

existing solution. Therefore, by using the Pugh matrix, we were able to identify and recommend the best data management system based on the employees' needs.

3.2 Objective 2: Identify Ways to Make Data Accessible

Once we identified the best solution, the next step was to begin designing a system that maximized the accessibility of its contents. To do this, we needed to become familiar with the technologies to create the system before beginning the implementation process. We then used interviews to gauge user satisfaction and made any necessary changes.

3.2.1 System Development

To properly configure the system, we first needed to acquire a basic understanding of the technology that we would use to develop the system. We researched, consulted tutorials, and experimented with the data management and software development tools, which allowed us to more thoroughly understand how the system functions both on the back end and the front end. Some of the initial configuration that we performed was not necessary for the MSR employees to learn, as it was a one-time setup. However, it was important that we were familiar enough with the system to confidently explain it to MSR.

After familiarizing ourselves with the system technologies, we began implementing the system, which involved some system installation and configuration. To organize the information that we were going to include in the database, we made an Entity-Relationship Diagram, or ERD (Özsu & Valduriez, 2011). An ERD shows the relationship between objects, and the properties that each object has. In this case, the "objects" being modeled were the members of MSR's network. The properties of each of these objects include basic information such as name, residence, age, and past work experience.

The next task was to fill the database with MSR's information. To do this, we had to import the data that MSR previously stored in Excel into the database using a computer script, which transcribed the data from its current state to the required format. It was first necessary to go through the Excel sheet to make sure all of the data were inputted uniformly so the script was able to handle it. Once the member information was imported, we confirmed the functionality of the system by running example queries similar to those MSR would perform, such as searching

for a specific member or skill. At this point, users of the system were able to perform a query using processes described in Section 2.4.2.

3.2.2 Focus Group with MSR Employees on Effectiveness of System

Once we implemented our data management system and the public portion of the information was available online (as desired by MSR), the next step was to talk with MSR employees about how well it fit their needs (Appendix E). At this point in the project, we did not need to fully educate the employers on the use of the system; rather, we deemed it more beneficial to perform a demonstration for them, showing how it would hypothetically be used. By performing this demonstration, we were able to show the ideal operation of the system, representing how it will work once the stakeholders have all learned to use the system. Questions discussed during the focus group included:

- Does the system seem to accomplish all of the tasks requested?
- Can they realistically see themselves using this system?
- Are there any changes or improvements they wish to be made?

We then used the feedback from the MSR employees to reconfigure the system to better align with their needs.

3.3 Objective 3: Identify Ways to Educate MSR Employees on System Use and Maintenance

In the last phase of our project, we taught the employees of MSR how to operate and maintain their new data management system. This education process was an important step because the system needed to be well-understood for it to be beneficial. Additionally, the employees needed to have the resources to teach new users how to operate the system. To achieve this objective, we created a user manual, held training sessions, and determined ways the MSR employees could maintain the system after we left.

Creating a user manual for the data management system allowed us to provide detailed instructions for all tasks and potential maintenance requirements, helping users to learn how they can interact with and repair the system. To do this, we looked back on our previous interviews with the employees of MSR and with employment agencies to identify problems that they have

had in the past, which allowed us to more comprehensively prepare for the future questions of the MSR employees. We aimed to provide information in a way that anyone with a basic technological understanding could understand. We also needed to be as thorough as possible, because in order for the instructional material to be beneficial, it must be able to satisfy all questions a user may have. Once the user manual was completed, we included the instructions for basic tasks in a *Help* window on the user interface of the web application, and created a separate, abbreviated version of the user manual for employers that only provided instructions relevant to their user privileges.

Following the development of the user manual, we began training the users on how to search for information within the database. We held a training session with all of MSR's employees, during which we demonstrated the data management system and its main functionality. Throughout the session, we asked the users to attempt tasks they wished to accomplish and observed whether they could perform them easily. After the training session, we helped the users solve more difficult problems and answered additional questions.

To prepare MSR employees for the transition to the new data management system, we first proposed a timeline for transition to give users time to slowly get used to the new system before completely turning away from the old system. During this time, we helped reinforce the training that the system users had already gone through and were available for support. By the end of the transition, the MSR users were more comfortable with the new system, and no longer needed to rely on us for support. They were then able to teach new users how to operate the system.

Finally, we found local sources to help with MSR's system maintenance following the conclusion of our project. This step was important to help achieve a successful long-term data management solution because MSR might encounter problems with their system as technology changes and advances. We interviewed Bank Windhoek's IT Team, which is currently responsible for the operation and maintenance of MSR's website. We asked open-ended questions to gain a better understanding of how MSR's website is being hosted. From this, we were able to better understand MSR's current technological capacity to serve its own system, and gauge whether we needed to look into third party hosting services to put the system online.

We also interviewed computer science faculty at NUST in regards to their willingness to serve as a software maintenance resource for MSR. These interviews were used to establish a faculty

contact within the NUST computer science department who would be willing to perform minor debugging should the new system require it. As our system may need more involved software development as MSR's data management needs evolve, we also used this interview to determine whether students at NUST have the availability and technical abilities to undertake such major development project, and to help identify a process to find students able and willing to help MSR. To conclude, we asked the interviewee whether they had any recommendations as to any third-party hosting services we should consider (beyond those we had already explored), and more generally any suggestions as to how to we could make our system more sustainable. We conducted the interview in a semi-structured format to ensure we obtained all pertinent information without inhibiting unanticipated conversation.

3.4 Summary

After evaluating the organization's needs using interviews and surveys, we were able to determine which of our identified data management solutions would be the best for MSR. Implementation of the system required us to continually modify its design as we received more feedback from our sponsor. Finally, training the MSR employees on the system allowed us to provide them with the tools to continue to store and access their data in a more efficient and secure manner.

4. Results

The results of our interviews and surveys informed our selection of the best data management system, our implementation of the system, and our plan for its sustainability. In this chapter, we discuss the feedback that we received from stakeholder interviews and surveys, as well as how we used this feedback to identify the best data management solution, design and develop MSR's new system, and educate stakeholders on its use and maintenance.

4.1 Determination of Best Data Management System

By analyzing the results of our stakeholder interviews and surveys, we identified a data management system that best fit all of MSR's needs. This section summarizes the results of our interviews with MSR's three employees, our survey of a representative sample of MSR's members, our interviews with frequent employers of MSR members, and our interviews with local employment agencies. Additionally, we discuss the results of the Pugh analysis that we performed to determine which potential solution would be best suited for MSR's needs.

4.1.1 MSR Employee Interview and Member Survey Findings

The interviews we conducted with Ms. Beukes, Ms. Kambanda, and Mr. Shilongo provided insight into why MSR stopped using their previous data management system, why the current data management system (Excel) was not working, and what features and functions a new data management system would need to have to be a sustainable solution.

In terms of the previous data management system, Ms. Kambanda and Mr. Shilongo stated that it was intuitive and easy to use, and that they hoped that the new system would contain all of the same information and be designed similarly. In fact, Mr. Shilongo explained that he only stopped using the old system because he could no longer get it to load. Ms. Kambanda appreciated the query functions and liked when there was a search box that included a drop-down menu that allowed the user to type in or select the information they needed. However, there were a few features that were inconvenient. For instance, when searching for members by skills, the skill set desired had to be selected from a non-editable drop-down menu rather than typed into a search box. Therefore, when querying the database, if a particular skill set had not been included in the original drop-down menu, one would have to manually search through each member's file to put together a set of qualified members for the requesting employer. Additionally, Ms. Kambanda noted that it was difficult to search for specific members if she was unsure of how to spell the

members' names. Though she recognized that this may be user error and therefore difficult for us to correct, she said that she would appreciate any effort to make the querying process more forgiving of user error.

With regards to MSR's current data management system, all of MSR's employees emphasized that data inaccessibility/inconsistency, especially due to a lack of search features, was the primary reason that the Excel sheet of member information was no longer a viable data management solution. In particular, Ms. Beukes expressed that searching for specific information in the Excel sheet was an unnecessarily difficult task, as Excel is not queryable. Mr. Shilongo informed us that when using the Excel system to enter or update member files, it would take about 30 minutes to search through the database to find a member and make the changes required. Furthermore, given that Ms. Beukes now works from a second office in Swakopmund, it became increasingly difficult to keep up to date when using a locally hosted system like Excel. The employees of MSR were all referencing different versions of the file on their personal computers, leading to discrepancies in information. Additionally, if a laptop were to break or be stolen, the file would be lost with no back up.

Ms. Kambanda provided a list of the information she felt was necessary to include in the new data management system, particularly focusing on the content the database would need to be able to store:

- Member's first and last names
- Member's MSR membership ID number
- Member's skills
- Member's previous work experience
- Member's qualifications (*e.g.* certificates, diplomas)
    - Specific types of vocational training
    - Education level
- Area from which the member was recruited (*i.e.* one of the 4 job sites or an office referral)
- Member's national ID number
- Member's current status (working, unemployed, inactive)
- Placements of member that were completed through MSR (separate from past work experience)

- Training the member has completed through MSR
- Training and placements in which the member is interested

Ms. Beukes added details to the "Placements" and "Trainings" sections. In terms of placements, she explained that it would be helpful to have subsections for who the employer was, the start and end dates of employment, and if there were any issues. For training, it would be useful to have information on the field in which the training was done, the date it was taken, and whether or not the member passed. She also explained that a member's ID number was made up of the site they were recruited from, the date of their recruitment, and a number assigned uniquely to that member. Having a function that allows the members to be sorted by each of these sections would make searching more efficient.

When we asked whether they had considered archiving old member files, Ms. Kambanda and Mr. Shilongo noted that it would be helpful to store all member files past and present in the database so long as there was a mechanism for easily filtering active members from inactive members. Ms. Beukes added that updating this would be difficult because MSR may not be aware when a member is no longer employed, and recommended we keep this in mind when designing the new system.

All three MSR employees agreed that the data management system should be hosted online, especially given that such a system would allow all of them to access the same, up-to-date information. However, both Ms. Beukes and Ms. Kambanda noted that an online system would raise potential security risks and could jeopardize the privacy of the members. They explained that if employers wanted to search through the database on their own to find a member, they should not have permission to see the complete member profile that MSR employees can access, but only the member's' name and skills. Once they identified potential hires, interested employers would have to contact MSR in order to hire the member so that MSR can maintain records on member placements and pay rates.

Lastly, when discussing the organization's financial constraints with Ms. Beukes, long-term maintenance costs were the main area of concern. She informed us that they had been paying to host the domain for the previous data management system, and would be able to pay to host a new one so long as it was reasonably inexpensive. She explained that much of MSR's technical

support comes from Bank Windhoek, and suggested that we meet with Bank Windhoek's IT team to discuss alternative, potentially less expensive, options for hosting services.

To supplement our understanding of MSR's data management needs, we also surveyed 15 of MSR's members. Given that the feedback from these surveys was broadly consistent with the feedback from our interviews with MSR employees, we were confident that the list of data management needs gathered from Ms. Beukes, Ms. Kambanda, and Mr. Shilongo was fairly comprehensive and mindful of the members' best interests. Seven people (47%) mentioned the importance of employers knowing what training the members have had, which informed us that the database needed to be easily queryable so training could be searched. Two members mentioned that they believe it is also important for employers to be able to see their skills and experience. Additionally, two members suggested that making the information in the database internet accessible would be helpful to the employers. Overall, the members were pleased with what MSR has helped them to accomplish and were excited that the new system would make job placements more efficient.

4.1.2 MSR Employers Interview Findings

Conducting interviews with frequent employers of MSR members taught us more about what companies look for when hiring MSR members, the logistics of hiring these members, and whether they feel the process could be improved. We also discussed the interviewees' thoughts on online accessibility to basic member information. In this section, we summarize our interviews with Nadia Lawrence of Bokomo Foods, John Boois of CYMOT, Ben Saayman of Polyoak Packaging, and Sanet de Waal of Bank Windhoek, all of whom are the representative from their company responsible for contact with MSR. These companies hire MSR members for temporary general labor, such as packing shipments, cleaning, or organizing stock.

Based on our conversations with Ms. Lawrence, Mr. Boois, and Mr. Saayman, we gathered that the most commonly desired qualifications are the members' communication skills, education level, and prior employment/work experience. Both Ms. Lawrence and Mr. Saayman emphasized that they tend to only hire members who are comfortable enough with English to communicate with their employer and co-workers on the job. Ms. Lawrence also expressed that it was important for her to know members' educational attainment, as she typically only hires members who have completed Grade 12 (end of secondary education in Namibia, after which there is university). Similarly, Mr. Boois stated that while he usually only hires members who have completed Grade

12, he hires some members who have only completed Grade 10, so long as they have one or two years of work experience, as well. Ms. de Waal explained that she has no requirements when hiring members, but prefers to rehire members with whom she has worked in the past, likewise emphasizing the need for information on members' prior employment/work experience.

In terms of the logistics of hiring, all of the employers that we interviewed seemed satisfied with the current process, expressing that it was simple and generally provided all of the desired information. Both Ms. Lawrence and Mr. Boois were appreciative that they are always given more CVs for members than the number of positions they needed to fill, which allows the company to interview the prospective hires and determine which member would be best suited for the job. Overall, the interviewees were happy with their company's relationship with MSR, but suggested a few minor improvements. Mr. Boois and Ms. de Waal stated that they would like information about what training members have gone through, as they have found that the members that have completed trainings are especially committed to and appreciative of their job placements. Mr. Boois added that it would be helpful if employers were able to see a background check of MSR members rather than performing the check themselves (as MSR policy currently requires). To find out more about this, we spoke with Albius Mwiya, the Director of Market Labour Services at the Ministry of Labour, and he explained that this would not streamline the process, but make it more complex as employers would still need to verify the background checks even if MSR performed them initially. Mr. Saayman likewise suggested that MSR consider completing member background checks, and further mentioned that while the rudimentary CVs he receives are acceptable for the temporary contracts he signs with MSR members, he feels that more professional CVs would encourage employers to hire members for more permanent positions.

When we asked the employers if they would be interested in having access to an online database with basic member information, all of the interviewees expressed that this would be helpful to gauge how many members might be available to fill vacant positions. Mr. Boois explained how this would be much easier than the current process because he would be able to choose who he wants to interview without waiting for suggestions from MSR, and then could contact MSR for further information on the member. This would shorten the process but still require employers to go through MSR for hiring. Ms. de Waal noted that adding a section that detailed which days a member was available for work would be helpful when searching for a member to fill a position. Additionally, she mentioned it would be necessary to distinguish active members from inactive members so a user would know who was available for hire. Given that all the employers that we

interviewed were generally satisfied with the member hiring process, our interview results indicated that the list of system requirements compiled from our MSR employee interviews was comprehensive, particularly since what few improvements were mentioned echoed the suggestions of the MSR employees.

4.1.3 Employment Agencies Interview Findings

Conducting interviews with local employment agencies similar to MSR allowed us learn about how each agency decided to manage information related to employment qualifications, any other data management systems they had previously considered or implemented, as well as any challenges they have faced regarding data management. In this section, we summarize our interviews with Yvonne Le Roux of Elite Employment, Gerhard Jansen of Jobs Unlimited, and Albius Mwiya of the Ministry of Labour.

While the Ministry of Labour currently uses a single data management system to connect job seekers with employment opportunities, both Elite Employment and Jobs Unlimited seemed to use multiple data management system to organize their member/applicant information. Elite Employment uses Staff Match (an online pre-existing data management system), Excel, and paper files. Ms. Le Roux noted that it was useful to have data in Staff Match and Excel, even though not all of the categories overlapped. If the internet was down, she would not be able to use Staff Match, but could still use Excel to find some information. Similarly, if something ever happened to the Excel file, there was a backup of the data online. Mr. Jansen echoed these comments almost exactly: while the company currently uses Microsoft Access to store applicant information, the data is organized somewhat differently in this data management system than it is in their paper filing system. Therefore, the consulting staff typically uses a combination of both the data management system and the paper files when matching applicants with job placements, and feel that the paper files are a necessary backup of applicant data. Both Ms. Le Roux and Mr. Jansen found that it was important to keep members in the system even when they were not longer active (due to employment or ineligibility for a variety of reasons), because past members often contact the company, and it has proven useful to have a record of why the member became inactive. These findings reiterated the importance of archiving member files, as mentioned during our interviews with the MSR employees.

Although both of these companies use at least one form of computerized data management, the employees prefer to use paper files because they contain all of the information in one place.

Generally, an employee would search their respective data management system to get a preliminary list of members, and then use the paper files to get more detailed information on each, as neither Staff Match nor Microsoft Access have the ability to store all the information that Elite Employment and Jobs Unlimited have on each of its members. Ms. Le Roux also noted that performing searches using the system can be difficult if you are not typing in the exact word that is stored, such as typing "driver" versus "taxi driver."

Additionally, while Ms. Le Roux and Mr. Jansen expressed that their companies recognized the benefit of a data management system specifically tailored to the company's needs, they further emphasized that this can be a challenging task. For Elite Employment, financial constraints and resource availability were the main deterrents, and for Jobs Unlimited, it seemed that intuitiveness and maintainability were major concerns. However, Mr. Jansen did inform us that Jobs Unlimited is currently in the process of implementing a new data management system for their applicant information, and hired a South African company (DittoJobs) which specializes in the development of recruitment data management solutions. While he is hopeful that this new system will be more comprehensive and allow the staff to retire the paper filing system, he noted that he is somewhat wary of having an external party create the system for the company. Jobs Unlimited had hired an individual to develop a company data management system several years ago, and due to a lack of IT support resources, the system became obsolete soon after the developer left.

Even Mr. Mwiya emphasized that while the Ministry of Labour is generally satisfied with its data management system, the government hired a group of programmers and developers from South Africa to update the system features. He stressed that although the Ministry had been using the same system for approximately 20 years, the only reason it is still functional is because of the frequent updates made to accommodate the system's evolving content. All of these comments echoed concerns of MSR employees regarding the current Excel system and the previous database, which emphasized to us the importance of designing a system that is compatible with the data being managed (especially in terms of storage capacity, intuitiveness, maintainability, and cost effectiveness).

4.1.4 Selection of Best Data Management System

Using the feedback from stakeholder interviews and surveys, we determined which solution would best meet the data management needs that we identified. This section discusses how we

prioritized these needs, the Pugh analysis we performed to compare the potential solutions, and the solution we proposed.

To begin, we categorized all of the data management needs that we found through interviews and surveys into the following criteria: cost effectiveness, maintainability, intuitiveness/ease of use, ability to be queried, necessary storage capacity, and internet accessibility. We then distributed this list of criteria to each of MSR's three employees so that they could rank them in order of importance, giving each need a unique priority rating; higher rankings indicate a greater importance. Each employee reported different priorities (Figure 1).
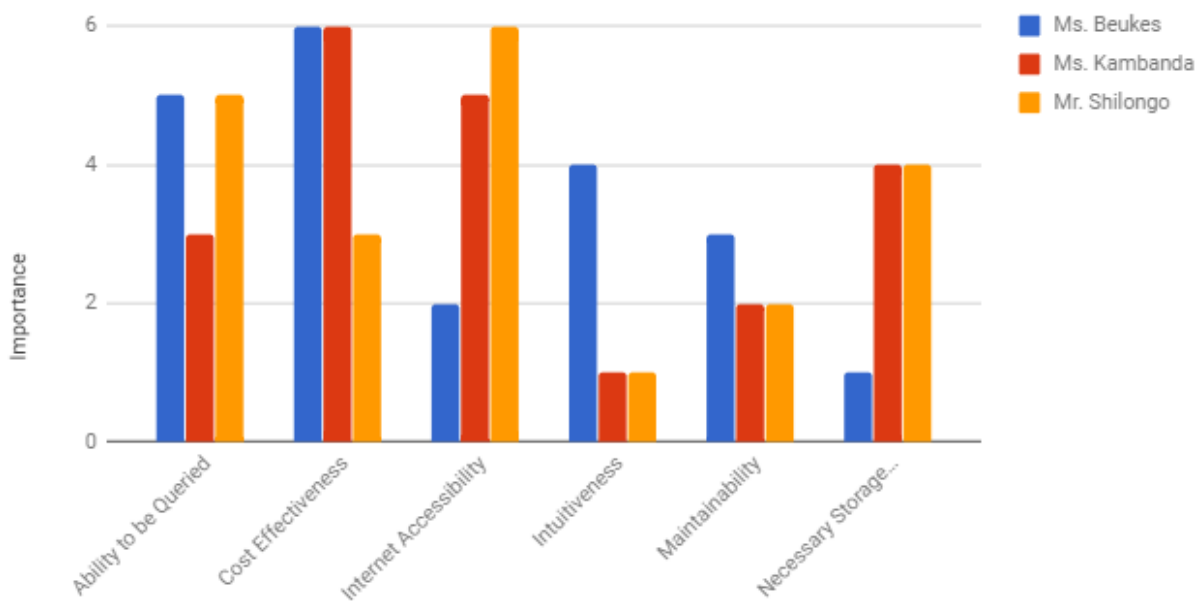

Figure 1: MSR employee priority ranking

Because there was not unanimous agreement among the feedback, we summed the employees' individual rankings for each criterion to create a single aggregate ranking: cost effectiveness, queryable and internet accessible, necessary storage capacity, maintainability, and intuitive/ easy to use.

Based on these rankings, we performed a Pugh analysis to compare the Excel sheet to three potential solutions: a pre-existing system, a modified version of MSR's previous data management system, or creating a new system. The results of the Pugh analysis, represented in the Pugh matrix, indicate that creating a new data management system specifically tailored to

MSR's needs would be better than using an existing software or modifying the previous system (Table 1).

Table 1: Analysis of possible data management solutions in the context of MSR's ranked needs (Pugh matrix)

Criteria	Priority ranking	Baseline Excel	Alternative solution		
			Use pre-existing data management system	Modify old data management system	Create a new data management system
Cost effective	6	0	-1	0	**-1**
Internet accessible	5	0	1	1	**1**
Intuitive	1	0	-1	1	**1**
Maintainable	2	0	1	-1	**1**
Necessary storage capacity	3	0	0	-1	**0**
Queryable	5	0	1	1	**1**
Sum of all positives		0	12	11	**13**
Sum of all negatives		0	-7	-5	**-6**
Sum of all neutrals		0	0	0	**0**
Total		0	5	6	**9**

4.2 Data Management System Design and Development Process

After deciding that creating a new data management system would best address MSR's needs, we designed and developed the database along with its associated client-side application (by which users interact with the database). In this section, we explain the process of creating the back end (the server) and the front end (the user interface) of the system, implementing the database, and populating it with MSR's member information. Finally, we discuss the results of our focus group with MSR's employees on how well they feel the system's design addresses the organization's needs, and how this feedback informed the adjustments we made to the system.

4.2.1 System Design and Development

To develop our own data management system, we chose a combination of web development tools that would enable us to have maximum control over the system, ensuring usability and

performance. We needed to consider the back end, the database, and the front end of the application. In practice, the back-end server application will connect to and run the database online, the database will store the data, and the front end will display it to the user and allow them to interact with the database.

We chose to design the back end of the server application using Node.js and Express because of their easy integration with the JavaScript programming language. Node.js is the most commonly used library for designing a constantly running web server in JavaScript, and Express is a library that builds on top of Node.js, thereby making it even easier to process requests to the web server. Using these tools, we were able to easily design a server that can efficiently retrieve information from our database, all while performing user authorization and general security checks.

For the database architecture, we used Microsoft SQL (MSSQL) because of its free testing environment on GearHost. When creating an internet accessible database, the database needs to be stored on an internet accessible server that is always running. Generally, serving a database or website requires purchasing extra computer hardware on which it can run, or paying a third party to do this. However, the GearHost service gives free MSSQL hosting for small databases, like the one we created.

We designed our front-end application using the React framework. React is a relatively new tool designed and popularized by Facebook that allows developers to integrate JavaScript programming with the HyperText Markup Language (HTML) that web browsers know how to render. This framework made it more efficient to create the client application and user interface. Because of this, we had time to implement web elements from the React Material Design libraries designed by Google to ensure an intuitive and aesthetically pleasing user interface. The code for the completed database web application is publicly stored online and can be found at https://github.com/mattmcd25/msrsite.

4.2.2 Database Implementation and Data Population

To accompany the web application we described above, we designed and implemented a relational database. The database was centered around the idea of a "Member," which had various properties and characteristics representing the information that MSR stores about each

of their members. Before implementing the database, we designed an Entity Relationship Diagram, or ERD, to visually lay out how we planned to organize the information (Figure 2).
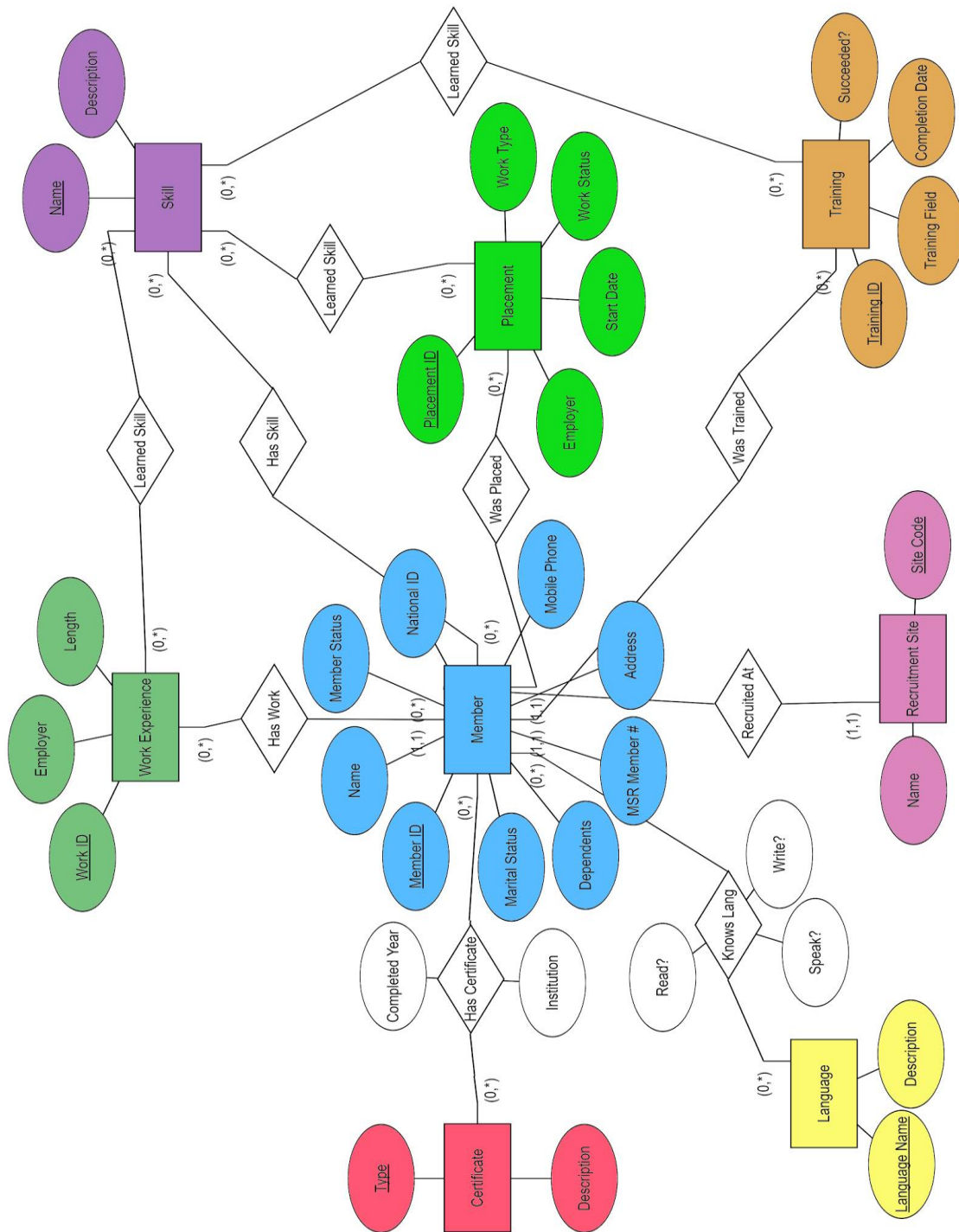

Figure 2: Color-coded entity relationship diagram

In the center of our ERD, in blue, is the Member entity, one of which we created for each of MSR's members. With each member, basic information unique to each person is stored, such as their name, address, marital status, and member number. The member entities are then connected to our other seven entities through a variety of relationships.

Certificates, in red, represent diplomas, vocational training, and other special certifications that a member may have received. Each certificate stores its type and description, and the relationship between the two keeps track of the year and institution at which it was completed. Languages, in yellow, similarly store a language name and description, while the relationship keeps track of whether the member can write, read, and speak this language.

Each member also has one site from which they were recruited, in magenta, and these sites keep track of their name and the one or two letter site code. Similarly, each member can possess skills, in dark purple, where each skill has a name and description.

The remaining three entities—work, placements, and training—represent the different events that the database keeps record of a member completing. Work (dark green) represents work experience that a member had when they first joined MSR and stores the employer and how long they worked there. Placements (light green) represent jobs that the member has had since becoming a member, and stores the employer, work type (full-time, part-time, etc.), work status (employed, completed, fired), and their start date. Lastly, training (orange) represents the training sessions MSR holds for their members, and stores the training field, completion date, and whether or not this member succeeded. Each of these three entities also have their own relationship with skills, to keep track of the skills the members exercised or learned during the job or training.

Once we completed the design and were satisfied with its layout, we created the database using DataGrip. From there, we populated the new database with test data that allowed us to try out the functionality of the full data management system prior to importing MSR's data. This functionality testing allowed us to confirm our design could sufficiently store all of MSR's information, and we then populated it with the real data. This was more difficult than we expected, as the member information that MSR was storing electronically was not consistently formatted. Nonetheless, we were able to write a script in the Python programming language to automatically clean, parse, and copy the data from the Excel file into the database. This method for data transfer was much more efficient than manual entry of MSR's members information.

4.2.3 System Effectiveness Focus Group Findings

Once the data management system was fully functional and had been populated with the member information, we held a focus group during which we demonstrated the system to the employees of MSR. The employers were generally satisfied with the system, and collectively expressed that it was user-friendly and met their needs in terms of querying member information and generating statistics for quarterly reports. Ms. Beukes was glad to see that the fields associated with each member accommodated all of the information collected during the application process (*e.g.* demographic information, prior work experience, education level), as well as the information gathered during the member's time at MSR (*e.g.* placements, trainings, new certifications). Ms. Lemos commented that the batch-add feature also contributed greatly to the system's user-friendliness. Additionally, the employees found that the advanced search was helpful when generating lists of members with specific qualifications. In particular, they felt that the ability to set a predetermined list of skills in the administrative settings will reduce human error when entering information into the system, making it easier to accurately query the data when conducting the advanced searches.

Although the employees were happy with the initial system design, they also provided critical feedback that allowed us to better tailor the system's user interface to the employees' needs. In terms of user-friendliness, Ms. Beukes suggested that we format the advanced search page such that the entered criteria appear in the page title after the search is submitted; the title would then serve as a reminder of how the search results were filtered. Additionally, the employees agreed that including gender and pertinent disability information for each member would be useful, as this information is frequently requested by employers. Ms. Lemos added that within each member's placement information, it would be helpful if we included a section to document the member's communication with the employees (*e.g.* who they spoke to during the hiring process, who they communicated with during their employment). Though she understood that it may be difficult given the limits of the system's structure, Ms. Lemos also suggested that we include a place to upload PDFs of various documents for each member (*e.g.* certificates, diplomas, photo ID), and program the system to send email reminders when their membership and certifications expire. Overall, MSR employees were pleased with our work, and the feedback we received during the focus group ensured that the final system would serve their data management needs for years to come.

4.3 Education on and Maintenance of the Data Management System

With our system completed, we focused on ensuring that it would be sustainable. This section describes the user manual that we developed to complement our data management system, as well as our assessment of the success of the training and user manual in educating MSR employees on the system's operation. Lastly, we describe the IT support network we established in collaboration with Bank Windhoek and NUST.

4.3.1 User Manual Development

After receiving feedback from the focus group on the effectiveness of the system, we created a user manual, which will be used by the staff of MSR for the operation and the maintenance of the data management system. We included an electronic copy of the user manual within a *Help* section of the data management system, so a user can quickly get help when using the system.

In terms of basic operation and user interaction, we placed an emphasis on those tasks which MSR employees will most frequently perform when using the system. We first explained how to sign in or how a new user can create an account, both of which are accomplished from the MSR Database sign in screen (Figure 3).
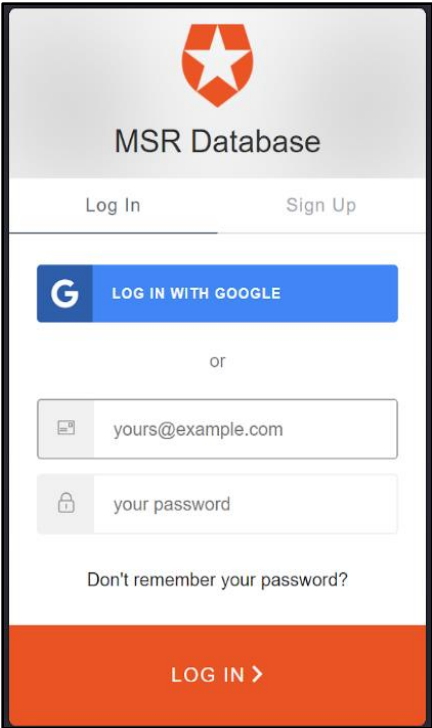

Figure 3: MSR Database Sign In Screen

From here, we explained the general user interface and how to get to different pages using the navigation panel (Figure 4).
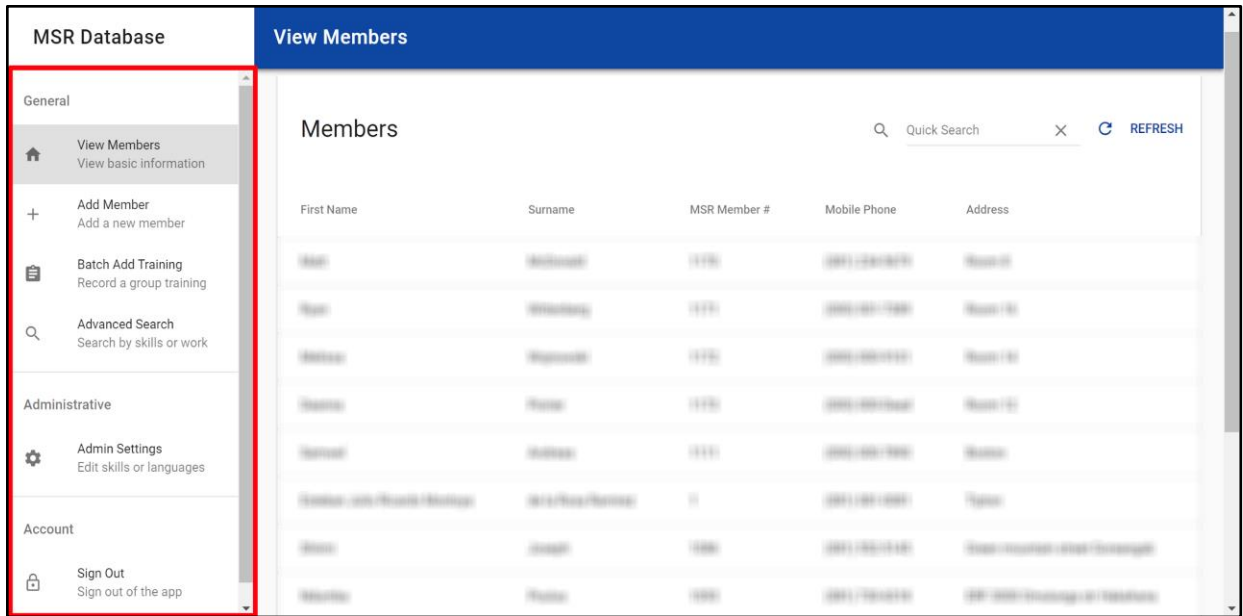

Figure 4: Navigation Panel. The navigation panel contains three categories—*General*, *Administrative*, and *Account*—that guide user interaction with the system

We then described each of the pages in the navigation panel, providing a detailed description of the features each page includes. *View Members* is the home screen, where a quick search can be performed. This feature will mostly be used when an employee needs to search for a specific member in order to find their phone number or other general information. Clicking on a member allows the user to see all of the information about that specific member (Figure 5). The *Edit* option allows one to directly edit a member's general information, language proficiencies, and skills, as well as add any past work experiences, new job placements, completed training, or new certificates.
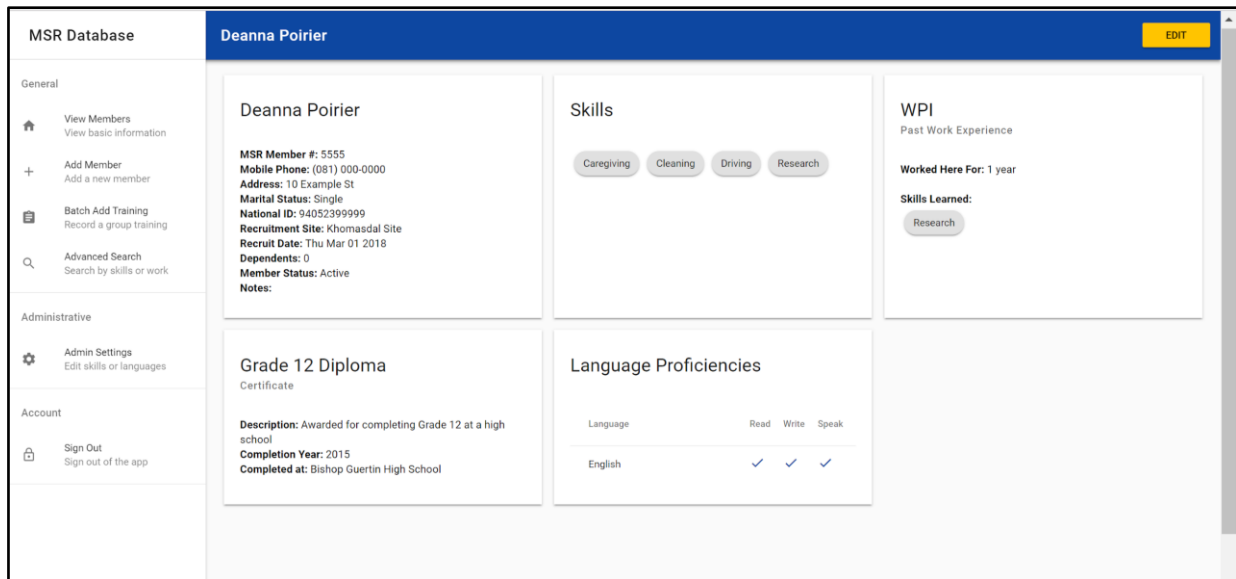

Figure 5: Member Information Screen. The member information page documents basic demographic information, skills, work experience, placements through MSR, completed training, certificates, and languages

Next in the navigation panel is *Add Member*, which MSR employees will use when new members join MSR. Similar to the *Edit* feature on the member information page (accessible by selecting a member from the *View Member* screen), the *Add Member* feature allows the user to add the member's basic demographic information, skills, work experience, completed training, certificates, and languages (Figure 6). However, rather than modifying information about an existing member, the *Add Member* feature creates and stores a new member within the system.

Figure 6: Add Member Screen. From the *Add Member* screen, users can create a new member within the system and input/store all of their associated information

After MSR holds their monthly training sessions, Mr. Shilongo can then add the members who completed the training using the *Batch Add* option. On this page, he is able to specify the training field and date as well as any skills that were learned from the training, then specify a list of member profiles to which he wants the training to be added. This feature is important because about 20 members attend each training session, and it would be tedious to add training outcomes one by one to individual member profiles.

Advanced Search will likely be the feature that is used most my MSR, as it allows the user to search for members who have certain qualifications. Each category has a drop-down section that allows users to specify multiple criteria at once (Figure 7).
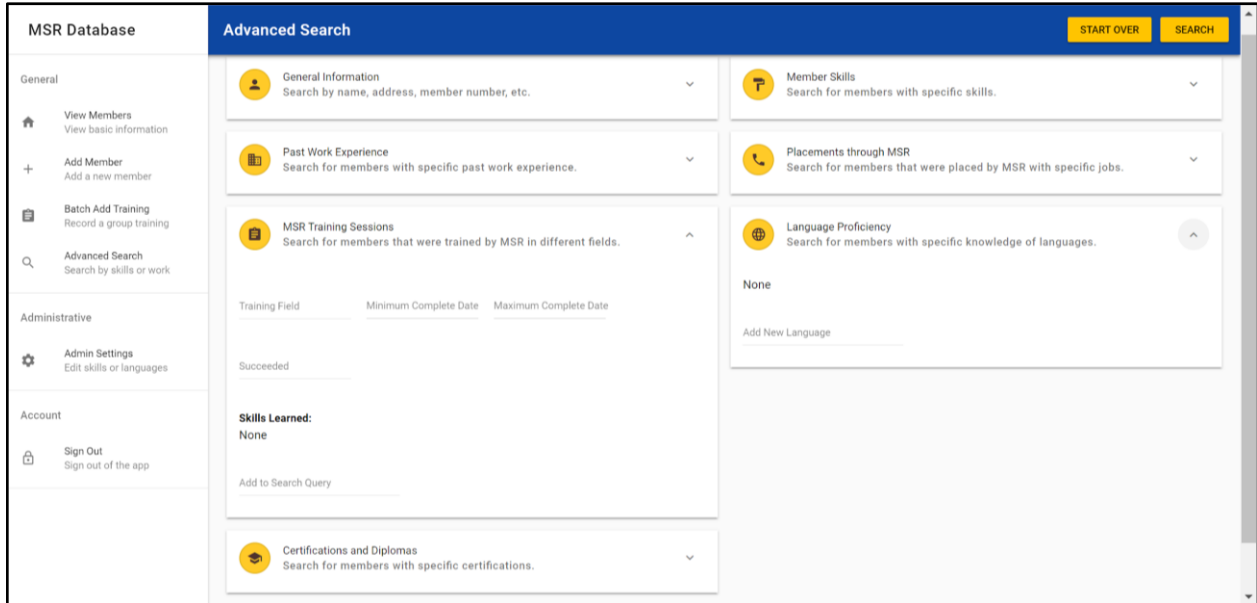

Figure 7: Advanced Search. Employees can use the *Advanced Search* when looking for members with certain qualifications to fill a job placement

Finally, *Admin Settings* allows the employees of MSR to modify the preset options for each category. For example, the system includes a preset list of skills members can have. If a member were to join MSR and have a skill that no other member has had, the employees could change the skills that the database stores (Figure 8).
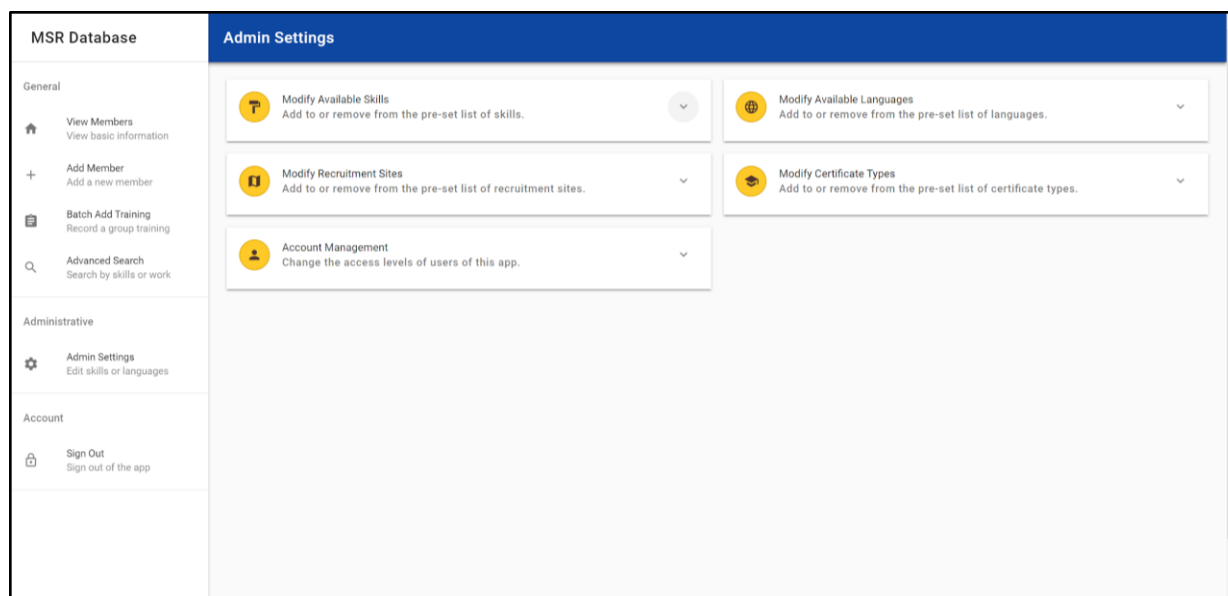

Figure 8: Admin Settings. *Admin Settings* allows employees to change preset lists and grant access to new users

Another important feature here is *Account Management.* When an employer creates an account, an employee of MSR will have to go to this section in order to allow the employer access. There are different access levels that can be selected: no access, limited access, and full access. While MSR employees will have access to all of the information in the database, employers will only be able to see basic information about the members, such as name and skills.

Additionally, because we created the data management system and customized a lot of its functionality, we needed to create a more technical user manual which described the back-end operations of the database. Should the users of the system encounter technical difficulties, they need to have the resources to understand how the system functions so that they or a local IT expert can resolve any problems. As we were already familiar with all of the operations, we were able to articulate how the system functions fairly easily.

4.3.2 Observation and Assessment of System Operation Training

For our data management system to be a sustainable and effective solution, we needed to ensure all of MSR's employees felt comfortable navigating and interacting with the system. Following their interaction with the database during the MSR employee focus group, both Ms. Beukes and Ms. Kambanda were confident that they would be able to use the system easily, especially with the supplemental reference material provided in the user manual. However, given that Mr. Shilongo will be responsible for all future member entries, we decided that it would be beneficial to hold a system operation training during which he could familiarize himself with all of the system's functionality.

In order to train Mr. Shilongo, we created a quick lesson plan to cover all of the features that he would use. Mr. Shilongo's primary interactions with the data management system are focused towards adding new information to the database. We therefore felt as though the best way to ensure his full understanding of the system would be for us to walk him through adding a new member, followed by him adding a new member on his own. After adding a few new members, Mr. Shilongo was able to add members to the system and to adjust the administrative settings to add skills or certificates that did not already exist.

4.3.3 IT Support Interview Findings

The interviews we conducted with Albe Louw from Bank Windhoek as well as Dean Anicia Peters and Professor Gereon Kapuire (Deputy Head of the Computer Science Department) from NUST provided us with an understanding of each stakeholder's IT knowledge and experience, particularly in relation to hardware and software maintenance. By evaluating the technical expertise of these individuals, we were able to gauge the capacity of Bank Windhoek and the NUST Department of Computer Science to maintain and update the system as necessary, helping us to ensure the system remains functional long term.

Mr. Louw explained that MSR's website is hosted by Bank Windhoek, but the data management system would need to be hosted on a different server. He informed us that Bank Windhoek would be willing to donate a server on which the data management system could be hosted. As Bank Windhoek sponsors MSR and is its main resource for IT support, MSR has many well-established contacts and will be able to reach out for future assistance if necessary.

During our interview with NUST, we were able to present the idea of a mutually beneficial relationship with MSR. When we met with Dean Peters and Professor Kapuire, they explained that NUST students must complete a three-month project to earn their undergraduate computer science degree. Should the employees of MSR decide that their data management needs have evolved beyond the functional capacity of our initial system design, Professor Kapuire, who coordinates the department's undergraduate projects, suggested that MSR reach out to him so that he can establish a team of students to further develop the system software as necessary. However, as we anticipate the system will not require any major developments for a few years, Dean Peters also agreed to establish a contact within the NUST Computer Science Department whom MSR can reach out to should our system software require minor debugging. This contact would then determine the faculty member or student best equipped to resolve the issue, and then put this individual in communication with MSR. Our interview with Dean Peters and Professor Kapuire allowed us to begin establishing a definitive contact in NUST to whom MSR can turn should our system require software maintenance, whether it be minor debugging or major development.

4.4 Summary

Using the feedback received from stakeholder interviews and surveys, we determined that a newly created data management system would best allow MSR to manage their member information. After developing the system, we held a focus group with the MSR employees to assess the effectiveness of our data management solution, and determine how the initial design could be improved to better suit their needs. Finally, by developing a user manual, holding system training with the MSR employees, and establishing a local IT support network, we ensured the sustainability of the implemented system, providing MSR with a long-term solution for its data management needs.

5. Recommendations and Conclusion

To ensure the system is a sustainable, long-term solution for MSR's needs, we have developed several recommendations and potential future directions for the organization's data management. It is important for MSR to keep all of the information in the database up-to-date, as well as upkeep the software and hardware of the system as necessary. In this section we provide our recommendations for a maintenance plan for the data management system and its relevant hardware, as well as options MSR could consider to continually improve their approach to managing their member information.

5.1 Software Maintenance Recommendations

The maintenance of the system is crucial, especially since the previous system had no major issues and the employees only stopped using it because they could no longer access it. If there is a problem with the system, our initial recommendation is to consult the user manual to see if it is a problem that can be fixed by the employees of MSR. If this is not the case, the next step would be to contact someone with the expertise to accurately evaluate the software, identify how to best address the issue, and subsequently perform the needed maintenance. We recommend that MSR continue communicating with Dean Peters and Professor Kapuire to establish such a contact at NUST, preferably a faculty member who will serve as a long-term resource rather than a student who will graduate in a few years' time. Additionally, after this contact is established, we highly recommend that MSR reach out to us so that we can provide the individual with access to the repository for all of the application's source code. We will review the source code with the NUST contact to ensure they have the technical understanding of our system to make necessary changes to the system and keep it running. Finally, if the NUST contact is unable to successfully resolve the issue, we will be available to help as much as we can.

5.2 Hardware Maintenance Recommendations

Hardware maintenance is imperative to ensuring that MSR's data management system remains operational, as without a functional server on which to host the system, it would be inaccessible to users. We recommend that MSR meets with the Bank Windhoek IT team annually to discuss the status of the hardware and its functionality. Just like any other computer system, software updates to the hardware itself (the server) will be required over time, and these may affect the functionality of the software we have written to serve the database. The MSR employees should make sure that the server is always up to date for security purposes, and if there is a problem

with the data management system, they should contact Mr. Louw to help update the server software. A consistent process for checking up on the health of the server hardware is important to make sure that the software will only need small changes at a time, if any.

5.3 Recommendations for Future Work

The research we conducted in the process of implementing a data management system, particularly during our training sessions and our interviews with frequent employers of MSR members, revealed ideas for improvements. While the stakeholder feedback that we received during this project generally indicated strong employee and employer satisfaction, a few of the interviewees offered minor suggestions as to supplemental information that MSR could collect in the member application process, as well as improvements that could be made to the member hiring process.

During our initial system training, the MSR employees made several recommendations as to how our data management system might be able to accommodate more comprehensive member information, which would in turn require that MSR expand the information requested from members during the application process. In addition to the information that is currently collected, we recommend that MSR consider collecting information on disabilities, as well. During our focus group, Ms. Lemos' suggested that MSR collect pertinent disability information within each member's application. All public and private employers are required to submit reports to the National Disability Council of Namibia detailing the status of their employees with disabilities. Consequently, information regarding MSR members' disabilities would be helpful for employers to have during the hiring process. From our research on the Namibian Disability Council Act of 2004, it is unclear whether MSR, a private organization helping people achieve employment rather than employing them directly, is legally permitted to collect and store this information, then distribute it to the employers with which they connect the members. MSR will need to conduct further research before incorporating this field into the member application, and we recommend consulting the Ministry of Labour to clarify whether MSR is allowed to do so.

Ms. de Waal from Bank Windhoek suggested that in addition to including basic demographic information about members in the database, we consider including pictures of each member. From the perspective of MSR employees, this may not make a significant impact in the process of searching specific members within the database, as they typically know the name or other demographic information about the member for whom they are looking. However, for employers

performing an initial search of members available to hire, this information is typically not known; consequently, should an employer be interested in hiring a member whom they have employed in the past, but cannot remember their name, having a photo ID with each member could be beneficial. Ms. de Waal stated that she would like to be able to first filter the members by known work experience and job placements (in this case, Bank Windhoek work experience and job placements), then search through the resulting list of members by their photo ID to identify exactly which member she had previously hired. By having an additional means of member identification available, Ms. de Waal feels that she and other employers would be able to more easily identify members they have employed in the past, and then make more informed and specific requests to MSR during the member hiring process.

As photo identification is not currently included in the member application material, and the database structure does not currently accommodate this information, including this feature would be a very involved undertaking. While MSR employees could scan each member's National ID Card or take the member's picture during future applications, photos would also need to be added for the thousands of existing members. Additionally, given that we received this suggestion late in the term, we did not have the time to code this feature into the system. Therefore, in order to electronically upload the file, MSR would need to work with a software engineer (or someone with similar expertise) to modify our system to develop and implement this functionality.

MSR would need to conduct further research on the legalities of including photo ID on the public accessible portion of the database, particularly in the context of member privacy, before adding this to the application process. We suggest communicating with the Namibian Ministry of Home Affairs and Immigration as well as the Ministry of Labour on this matter. While the photo ID feature would likely be beneficial to employers using the data management system, the implementation would be difficult on MSR's part; we recommend pursuing this improvement to the system only after employers have begun using the system regularly, and only if MSR feels that this feature would substantially streamline the member hiring process.

5.4 Conclusion

By evaluating MSR's specific data management needs, identifying and implementing a customized system, and training the MSR employees on the system's use, we provided the organization with the means to independently store its data in a more accessible and secure manner. Furthermore, by establishing an IT support network and creating supplemental reference

material, we equipped MSR employees with the resources to use the data management system for years to come, and the administrative adaptability of the system should accommodate the evolution of the information that is stored on each member.

In collaborating with the employees of MSR to enhance the organization's data management system, we hope our project supports MSR as it continues its mission of reducing unemployment in Namibia. As data management systems allow for streamlined organization of information, they can be useful in many situations where data needs to be efficiently stored and accessed. All organizations have different requirements for their data management systems, and it can be beneficial to take the time to design a system specifically tailored to an organization's needs. Through our project we have demonstrated how technology can help an organization increase its productivity and improve its relationships, thereby allowing for continued growth and progress.

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Appendix A: Interview Protocol for MSR Employees

Good Morning/Afternoon, [Interviewee].

As you know, we are the team from Worcester Polytechnic Institute (WPI) in the United States who is currently working with your organization, Men on the Side of the Road (MSR). From our understanding of the project proposal you provided to WPI at the beginning of the year, you have expressed concern that inefficiencies in your current system for managing member files may be hindering your efforts to represent your members to the best of your ability. We are under the impression that you are hoping to collaborate with us to develop a better organized and more user-friendly data management system so that you can more effectively market your members to potential employers while also marketing your organization to potential donors and local businesses. Through this interview, we are hoping to learn more about the functions you need/want this system to fulfill, as well as how you hope to use this new system in better marketing your members and your organization.

With your permission, we plan on using the results of this interview to guide our research and project development, and we hope to include your thoughts and opinions in our final paper. If at any point you would like to skip a question, remain anonymous, or end the interview, please let us know.

Before we begin, do you have any further questions?

Questions for all employees:
1) How did you hear about MSR, and why did you decide to work for the organization?
2) How long have you worked for MSR?
3) Can you tell us a little more about your specific role in working with MSR, and how you would personally use the data management system?
4) What aspects of MSR's current data management structure do you find make it most difficult to market members to potential employers? Is there anything about the current data management that you think is good?
5) How often is information from Excel accessed for different tasks? (i.e. How often do you search for members vs use the information to write reports for sponsors?)
6) What about the previously implemented data management system made it an ineffective choice for managing your member information? Were there any beneficial aspects of the database that you would like to see in the newly implemented data management system?
7) What capabilities do you believe your new data management system absolutely requires? Are there any additional capabilities that may not be critical, but would be nice to have?
8) Once people have found permanent employment, they could be moved to an archived section of the system. Have you thought about this, and does it sound like something you would be interested in?
9) With an internet accessible data management system, the privacy of member information may become a concern. What information currently stored in the system should be kept private, and how sensitive is this information?

10) Is there any other information that you think would be helpful for us that we didn't ask about?

Questions for Ms. Beukes:
1) From our understanding, Tomas will be using the data to match members with employers, and you will be using the data to write reports for sponsors. Is this accurate?
2) What are the financial limitations we should be considering when selecting a system?

Questions for Ms. Kambanda:
1) In order to get a better idea of what information employers find helpful when hiring MSR members, we hope to interview a few local businesses which have employed MSR members in the past. Do you have any recommendations as to the businesses with which we should speak? (i.e. Are there any employers which frequently hire MSR members, or employers with which MSR has a particularly successful partnership? Are there any businesses in particular with which MSR is not currently sponsored, but which you feel MSR could establish a successful partnership?

Questions for Mr. Shilongo:
1) How long does the process take when pairing a member to an employer?
2) How often do you add new members to the system?

Do you have any other questions or comments for us?
Thank you for your input and participation in this interview!

Appendix B: Survey for Members of MSR's Network

Good Morning, Everyone.

We are a team from Worcester Polytechnic Institute in the United States who is currently working with Men on the Side of the Road (MSR). As you may be aware, MSR's mission is to empower unemployed and underemployed individuals by providing training in soft skills and financial management, the ultimate goal being to pave the path to employment for its members. The employees of MSR are concerned that inefficiencies in their current system for storing member files may be preventing them from representing you and other members to the best of their ability, and they have asked us to design a data management system which allows them to better serve their commitment to help you on your path to employment. We are hoping to learn more about why you decided to join MSR, as well as the impact you feel MSR has had on your efforts to find employment.

With your permission, we plan on using the results of these anonymous surveys to guide our research and project development, and we hope to include your thoughts and opinions in our final paper. If at any point you would like to skip a question, please feel free to do so.

Before we begin, do you have any further questions about our project?

1) Why did you decide to become a member of MSR?
2) How long have you been a member of MSR?
3) How did you hear about MSR?
4) When applying to MSR, did you feel the application form gave you the chance to mention all of your skills and experiences?
5) Is there any additional information you wish you could have included in your application, or any information you feel would have increased your chances of being placed in a job?
6) Is there anything you believe MSR could do to better market your information to potential employers?
7) Is there any other information that you think would be helpful for us that we didn't ask about?

Thank you for your input and participation in this survey!

Appendix C: Interview Protocol for Local Employers Currently Working with MSR

Good Morning/Afternoon, [Interviewee].

We are a team from Worcester Polytechnic Institute in the United States who is working with Men on the Side of the Road (MSR). MSR is currently storing their members' information in Excel, but is looking for a more efficient way to store this information so that it is easier to access and navigate. For our project we will be proposing and implementing a solution to improve the efficiency of MSR's current data management system. We are hoping to learn more about why you decided to partner with MSR, and what kind of information you are interested in when hiring one of their members.

With your permission, we plan on using the results of this interview to guide our research and project development, and we hope to include your thoughts and opinions in our final paper. If at any point you would like to skip a question, remain anonymous, or end the interview, please let us know.

Before we begin, do you have any further questions about our project?

1) How long have you worked for this company, and what is your role within the company?
2) Why did your company decide to partner with MSR, and when did this happen?
3) When you hire MSR members, in what jobs or positions are they typically placed?
4) When you are looking to hire one of MSR's members, what is the process you go through?
5) What kind of information do you find out about the members you will potentially hire?
6) What additional information, if any, do you wish you could receive?

For our project, our first goal is to create a better data management system for MSR to store all of their information. Once this is complete, we are hoping to modify the database so that employers are able to look up some basic information about members on their own, such as skills. You would then be able to call MSR to request a specific member.

7) Would you prefer to be able to look up the information on your own in order to find a member, or do you like the current process?
8) Is there any other information that you think would be helpful for us that we didn't ask about?
9) Is there anyone else (either within your company or in another company) whom you would recommend we talk to in order to gain additional information about this topic?

Do you have any other questions or comments for us?
Thank you for your input and participation in this interview!

Appendix D: Interview Protocol for Employment Agencies

Good Morning/Afternoon, [Interviewee].

We are a team from Worcester Polytechnic Institute in the United States who is currently working with Men on the Side of the Road (MSR). MSR is a non-profit organization that aims to help its members find temporary employment while also giving its members the skills they need to find permanent jobs. They are currently storing their members' information in Excel, but are looking for a more efficient way to store this information so that it is easier to access and navigate. For our project we will be proposing and implementing a solution to improve the efficiency of MSR's current data management system. We are hoping to learn more about any methods you have used for data management, and any struggles you have run into with data management in the past.

With your permission, we plan on using the results of this interview to guide our research and project development, and we hope to include your thoughts and opinions in our final paper. If at any point you would like to skip a question, remain anonymous, or end the interview, please let us know.

Before we begin, do you have any further questions about our project?

1) To begin, can you tell us a little more about what your organization does?
2) How many people work for this organization?
3) What kind of information does your organization need to store and keep track of?
4) Who has access to this information, and are there different access levels?
5) Can you describe your current data management system?
6) How big is this system in terms of tables/size/storage?
7) How many people use this system?
8) Who is in charge of entering the information into the system? How did they learn how to do this?
9) Is your system accessible by internet or mobile app?
   a) If yes: Why is this beneficial?
   b) If no: How do you think operations would be improved if it was accessible by internet or mobile app?
10) How is the system hosted?
11) What kind of data management systems have you tried in the past (if any)? Why did you change systems? Can you explain any challenges you encountered in the transition?
12) Is there any other information that you think would be helpful for us that we didn't ask about?
13) Is there anyone else whom you would recommend we talk to in order to gain additional information about this topic?

Do you have any other questions or comments for us?
Thank you for your input and participation in this interview!

Appendix E: Focus Group Protocol for MSR Employees Regarding Database Effectiveness

Good Morning/Afternoon, Everyone.

Today we are hoping to share with you our proposed solution in order to receive feedback to determine what still needs to be improved before your organization implements the change. We have worked to make the data management system an efficient way to store information so that it is easier to access and navigate.

With your permission, we plan on using the results of this focus group to guide our research and project development, and we hope to include your thoughts and opinions in our final paper.

Before we begin, do you have any further questions about our project?

The team began by presenting the database to the employees and walking them through the major highlights

1) Can you realistically see yourself using this system?
2) In what ways would this system improve your ability to search for desired member information?
3) What do you like about the way that the information is presented?
4) What do you not like about the way that the information is presented? What suggestions do you have for ways to make the system more user friendly?
5) If this new database were implemented, how do you think it will improve your efficiency?
6) Can you suggest anything that should be changed/improved upon/added?
7) Is there any other information that you think would be helpful for us that we didn't ask about?

Do you have any other questions or comments for us?
Thank you for your input and participation in this interview!