Enhancing the Visitor Experience Along the Sibiu County Trails

Burnon Chen • Meredith Eddy • Edward Philippo
Marissa Thomas • Nicole Whipkey

SIBIU
See you in Transylvania!

WPI

Mioritics
Keep hiking

Enhancing the Visitor Experience Along the Sibiu County Trails

An Interactive Qualifying Project
submitted to the faculty of

WORCESTER POLYTECHNIC INSTITUTE

in partial fulfillment of the requirements for the
degree of Bachelor of Science

By:

Burnon Chen
Meredith Eddy
Edward Philippo
Marissa Thomas
Nicole Whipkey

Date:

May 12, 2021

Report Submitted to:

Mihai Dragomir and Simina Manea

Sibiu County Tourism Association and
Mioritics Association

Professors Melissa Butler and Robert Kinicki

Worcester Polytechnic Institute

Abstract

Tourism associations in Sibiu, Romania believe the hiking trails can become a major attraction but have limited knowledge of the trail user experience. The team remotely surveyed trail users; interviewed trail guides, trail managers, and businesses owners: and researched various technological solutions. Findings indicated that successful businesses encourage trail use by providing services like maps or boot repair, and by warning hikers of frequent incidents on the trails, such as encountering shepherd dogs. The team created an infographic for businesses detailing how these practices can benefit them, and also suggested more advertisement. Research showed that using an app like Wikiloc to plan hikes and integrating sensors to count patrons on trails can supplement improving experience.

Acknowledgements

We would like to thank everyone who helped make this project possible:

- Our project collaborators Mihai Dragomir of the Mioritics Association and Simina Manea of the Sibiu County Tourism Association for providing us guidance in all our ideas for the project, putting us in contact with all of our interviewees, distributing our surveys, and providing virtual tours around Romania to give us more of an immersive IQP experience.
- Our project advisors Professors Melissa Butler and Robert Kinicki for all of their insights on our project, helpful critiques on our writing and presentations, and teaching us how to produce a successful project throughout ID 2050 and IQP.
- Our site directors Professors Rodica Neamtu and Bogdan Vernescu for setting up the Bucharest Project Center and projects and for organizing weekly cultural events so we could learn more about Romania even remotely.
- All of the trail guides, trail managers, and business owners we interviewed for telling us their story of the Sibiu trail experience.
- All those that participated in our surveys for providing us with valuable data about the trail user experience.

Executive Summary

With the end of the communist era in 1990, Romania has recently begun to experience an upward trend in tourism. In 2006, Romania received 6.22 million tourist arrivals, and in 2019, this number peaked at 13.37 million (National Institute of Statistics Romania, 2020). Tourism serves as a driver of economic recovery and creates an opportunity to strengthen the Romanian economy in the post-communist era. Romania has a vast natural environment, rich culture, and complex history that make the country an exceptional tourist destination.

Sibiu County, located in the Transylvania region of Romania, possesses several hundred kilometers of marked trails, which enable a wide variety of activities including hiking, mountain biking, climbing, horseback riding, and caving (see Figures 0.1 and 0.2) (Asociatia Mioritics, 2015; Turnock, 1999). Despite this, Romania is not a popular hiking destination for tourists. Currently, Sibiu County's biggest draw is the capital city of Sibiu, which suggests that tourists do not recognize the county for its outdoor attractions (M. Dragomir, Personal Communication, February 18, 2021).

Figure 0.1 Tour group along the Făgăraș Mountains, Romania
(Dragomir, n.d.)

Figure 0.2 Bikers along the Sibiu trails
(Caba, n.d.)

In Sibiu, there are two organizations that help establish and promote tourism: The Sibiu County Tourism Association (SCTA) and the Mioritics Association. The SCTA focuses on expanding tourism in Sibiu County by bringing public and private organizations together to develop tourism strategies (Asciaţia Judeţeană de Turism Sibiu, n.d.). The Mioritics Association emphasizes the cultural and natural experience in Romania by providing maps, brochures, and guides for the Sibiu trails (Asociatia Mioritics, n.d.). Currently, both the SCTA and Mioritics Association are working to promote Sibiu County as a hiking and biking destination. However, they need more information about who uses the trails and their experience on the trails and in other cities in the county. Neither the SCTA nor Mioritics Association have any systems in place to profile trail users' needs, determine the frequency of trail use or monitor trail conditions. Areas of opportunity for both organizations to explore include strengthening tourist relations with businesses and implementing technology to improve communication between all types of trail users.

The team worked with both organizations to help make the Sibiu trails more attractive to tourists. The goal of this project was to investigate how to promote trails and enhance the trail user experience in order to assist the Sibiu County Tourism Association and Mioritics Association in improving relationships and communication between visitors, trail managers, and local businesses. The team accomplished the goal through the following four objectives: to understand the trail user experience, to identify how local businesses can address the needs of trail users, to develop a reporting system for trail users, and to propose a system to track the quantity and movement of trail users.

To gain knowledge on who uses the trails and their trail experiences, the Mioritics Association distributed two surveys (one in Romanian and one in English) that the team developed to local trail users. The surveys inquired about demographics, any problems encountered on the trails, experiences with local businesses in Sibiu, use of technology, and trail users' rating of their overall experience in Sibiu County.

In addition to the surveys, the team interviewed five trail guides, three trail managers, and three local business owners in or near Sibiu. Each type of interviewee provided a valuable perspective. Trail guides work on and use the trails more frequently than anyone else in the region, giving the team a better understanding of who uses the trails in Sibiu and why they come. Trail managers are familiar with the most common incidents someone may encounter on the trails and provide insight on how to resolve them. Lastly, the team interviewed three local lodging business owners. The team asked these business owners questions about who their customers are, what they need, and what their business is currently doing to accommodate people who come to Sibiu to use the trails and desire their services.

Since few foreign tourists took the surveys, the team conducted a content analysis and observational study of blogs and videos to gather data on international trail users. Since all but eight survey respondents were Romanian, and it was not feasible to contact individuals in other countries, analyzing content from trail users on the web allowed the team to gain some perspective on the international tourist experience. From the blogs, the team searched for common themes including trail navigation, where tourists stayed or received services, and comments about their overall experience. Viewing videos (see Figure 0.3) allowed the team to see the trails themselves and take note of current conditions.

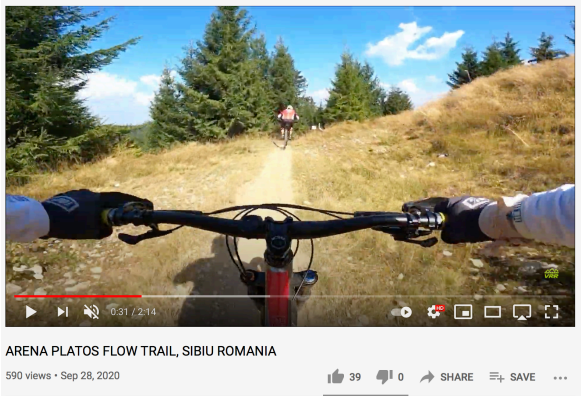


Figure 0.3 Video used in the observational study (Vertical Riding Romania, 2020)

Finally, the team researched different kinds of technology that can enhance the trail user experience. First, the team researched how to implement a problem reporting form for the trails and what features to include. From the surveys, the team identified frequent issues to put on the form. Second, the team researched popular mobile applications for hiking. The team's research included noting the features each hiking app provides and determining which is most useful for planning a hiking trip in Sibiu. Third, the team researched different kinds of people

counting systems for outdoor environments. Through their research, the team compared characteristics of various types of technology as well as specific products and companies to help the collaborators to decide which product would work best given their needs.

After completing their methods, the team had many findings. Survey results indicated that most trail users are from Romania (94%). However, this is likely because the team worked remotely and relied on convenience sampling. Interviews with trail guides, trail mangers, and local business owners helped the team get a more accurate picture of who uses the trails, with more than 70% of interviewees reporting that most foreign trail users come from other parts of Europe, and particularly Germany. When asked about the reason for their visits Figure 0.4 shows that over half of all survey respondents cited hiking or biking, while the second and third most common attractions were experiencing culture (18%) and watching wildlife (10%). Overall, the team discovered that while hiking and biking is a popular attraction, Sibiu's unique culture and wildlife are also significant parts of the trail user experience.

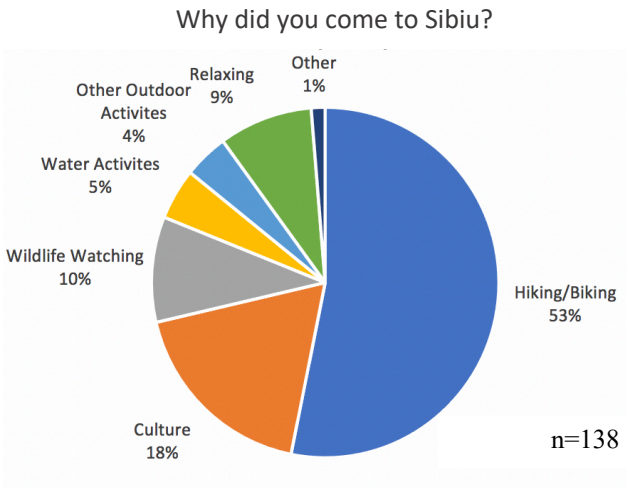


Figure 0.4 Reasons trail users come to the Sibiu region

Interviews with business owners combined with results from the English survey revealed practices that have helped lodging businesses succeed. Interviews discussed that successful lodgings actively encourage their visitors to use the trails and they offer additional services that support trail users, such as mountain bike repairs. Survey respondents indicated that lodging in Sibiu is, on average, somewhat easy to find, with no one indicating difficulty finding a place to stay.

The interviews and survey results also identified areas where businesses could improve. Approximately 40% of responses from the English survey considered prices of all businesses "somewhat expensive." This is difficult to interpret, as further research indicated that prices largely depend on the service and location (e.g., a resort is more expensive than a remote mountain chalet). Beyond prices, business owners expressed that they wanted to improve their advertising. Tour guides and guest house managers alike indicated that they rely primarily on word-of-mouth because they either do not have the resources to advertise or because they did not want to attract mass tourism.

After researching problem reporting forms and interviewing trail managers, the team specified technical requirements for a reporting form intended for Sibiu County. The form needed to let users choose their problem from common examples (such as encounters with shepherd dogs or missing signage) or describe it themselves, provide location information, and submit photographs. The prototype layout of the form is displayed in Figure 0.5. The team provided the collaborators with a temporary reporting form while the professionals work on developing a new form.

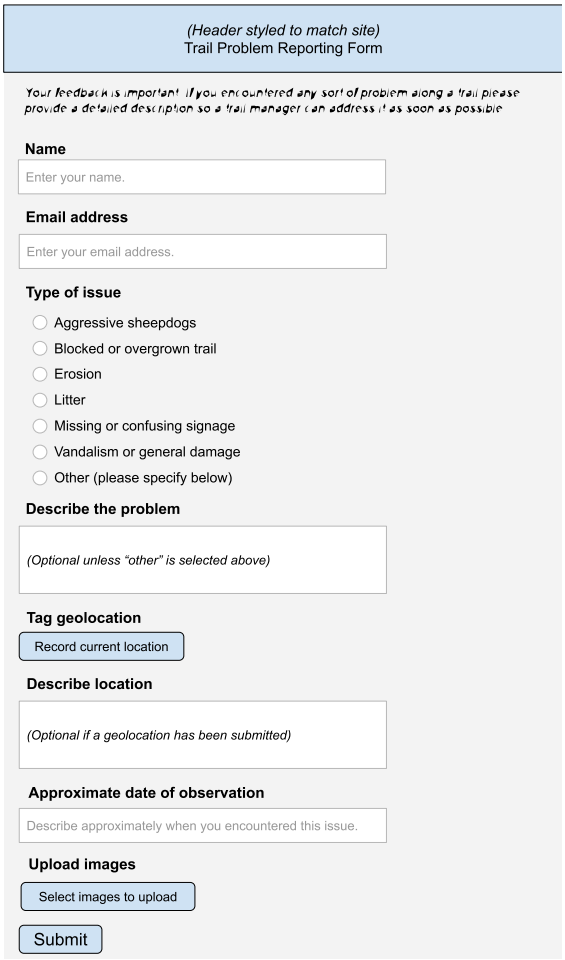


Figure 0.5 Prototype layout of the Sibiu problem reporting form

Survey results enabled the team to gauge which mobile applications trail users commonly use. Around 96% of respondents reported that they at least sometimes carry a mobile device as while on an outing, while 86% occasionally use a device before or during their outings. The most commonly used applications with route planning capability were AllTrails, Komoot, ViewRanger/OutdoorActive, and Wikiloc.

Research revealed two types of counting technology that fit the collaborators needs. Active and passive infrared beams can serve as short- or long-term applications and are relatively portable. They are not exceptionally accurate but draw very little power. On the other hand, radar sensors are very portable and intended solely for short-term applications. They can accurately track groups of people, their direction, and can distinguish between hikers and cyclists, but they require a power source and an Internet connection. Eco-Counter and SensMax, two Europe-based companies, sell these systems (see Figure 0.6), and their websites show more specific product details.

Figure 0.6 SensMax sensor (top) and Eco-Counter passive infrared beam (bottom)

Recommendations

Inform lodging businesses of ways they can attract trail users

Successful lodging businesses encourage their guests to use the trails. Businesses that offer additional services (like gear rental and bike repair) attract trail users and enhances their experience. In addition, providing maps and offering advice on how trail users can avoid shepherd dogs will make their navigation on trails easier. To inform lodging businesses of these recommendations, the team developed an

infographic about who the trail users are, why they come to Sibiu, how to promote the trails to tourists, and what businesses can do to make their visitors have the best experience. The team recommends that the collaborators distribute the infographic (Figure 0.7) to all lodging businesses near the trails in Sibiu.

Figure 0.7 Infographic for lodging businesses

Develop a centralized trail issue reporting system

Since no single trail authority exists, a centralized system to report trail issues could greatly improve trail maintenance. Such a system would increase the information available to trail managers and would greatly streamline the reporting process for trail users. A well-designed reporting form, like the one detailed in Figure 0.5, would minimize the burden on reporting parties.

Partner with a hiking app

Partnering with an existing hiking mobile application would consolidate information in one place and serve to promote Sibiu's trails. Applications like Wikiloc, ViewRanger/OutdoorActive, or AllTrails would make it easier for trail users to plan trips, ultimately benefitting the region.

Incorporate a counting system on the trails

A counting system would provide valuable trail usage information to land managers. European companies Eco-Counter and SensMax offer sensors intended for short- and medium-term applications that would be well suited to the Sibiu trails. The collaborators can choose between high-accuracy radar sensors and low-maintenance infrared sensors depending on trail conditions and the desired results.

This project aimed to assist the SCTA and Mioritics Association to promote trail usage and enhance trail user experience in Sibiu. The report details the steps the team took to present the SCTA and the Mioritics Association with a set of recommendations with regards to promoting the trails through a hiking app and improving trail user experience by promoting successful business practices and the integration of technology. Overall, this project provided the SCTA and the Mioritics Association with key information on several ways to further enhance the tourist experience in the Sibiu region.

Executive Summary References

Asciaţia Judeţeană de Turism Sibiu. (n.d.). Despre noi [About us]. Retrieved February 22, 2021, http://www.sibiu-turism.ro/Profesionisti-Despre-noi.aspx

Asociatia Mioritics. (n.d.). Despre noi [About us]. Retrieved February 22, 2021, from https://mioritics.ro/despre-noi/

Asociatia Mioritics. (2015). Trasee de drumetie si biciclete [Hiking and biking trails]. Retrieved February 22, 2021, from https://mioritics.ro/trasee-de-drumetie-si-biciclete/

National Institute of Statistics Romania. (2020). Number of tourists accommodated in tourist establishments in Romania in 2019, by destination (in 1,000s) [Graph]. In Statista. Retrieved February 26, 2021, from https://www.statista.com/statistics/1123281/romania-tourists-accommodated-by-destination/

Turnock, D. (1999). Sustainable rural tourism in the Romanian Carpathians. *The Geographical Journal,* 165(2), 192-199.

Vertical Riding Romania. (2020, September 28). *Arena platos flow trail, Sibiu Romania.* [Video]. YouTube. https://www.youtube.com/watch?v=KZiAfA7GPwg

World Bank. (2019). Proportion of Romania covered by forest area from 1990 to 2016 (percentage of land area) [Graph]. In Statista. Retrieved February 22, 2021, from https://www-statista-com.ezpxy-web-p-u01.wpi.edu/statistics/435973/forest-area-as-percentage-of-land-area-romania/

Authorship Page

Section	Primary Author(s)	Primary Editor(s)
Abstract	Nicole Whipkey	All
Executive Summary	Nicole Whipkey, Edward Philippo	All
Chapter 1.0: Introduction	All	All
Chapter 2.0: Background	All	Marissa Thomas
2.1: Geographical and Historical Tourism Context	Nicole Whipkey	Marissa Thomas
2.2: Recent Tourism in Romania and Sibiu	Marissa Thomas	Burnon Chen, Marissa Thomas
2.3: The Relationship Between Trails and Trail Users Around the World	Edward Philippo, Burnon Chen	Meredith Eddy, Marissa Thomas
2.4: Data Collection in Other Parks	Meredith Eddy, Burnon Chen	Nicole Whipkey
2.5: Internet-Connected Solutions	Meredith Eddy	Burnon Chen
2.6: Summary	Nicole Whipkey, Edward Philippo	Edward Philippo
Chapter 3.0: Methodology	Burnon Chen, Nicole Whipkey	Meredith Eddy
3.1: Understand the Trail User Experience	Marissa Thomas, Nicole Whipkey, Burnon Chen	Edward Philippo, Marissa Thomas
3.2: Identify How Local Businesses Can Address the Needs of Trail Users	Burnon Chen, Nicole Whipkey	Edward Philippo, Marissa Thomas
3.3: Develop a Reporting System for Trail Users	Edward Philippo, Meredith Eddy	Edward Philippo
3.4: Propose a Counting System to Track the Quantity and Movement of Trail Users	Nicole Whipkey	Nicole Whipkey, Meredith Eddy
3.5: Gantt Chart	Meredith Eddy	Nicole Whipkey
4.0 Results and Analysis	Nicole Whipkey	Meredith Eddy
4.1 Trail Users	Burnon Chen, Marissa Thomas	Meredith Eddy
4.2 Interactions Between Trail Users and Local Businesses	Marissa Thomas	Meredith Eddy
4.3 Implementing Technology on the Trails	Edward Philippo, Meredith Eddy, Nicole Whipkey	Burnon Chen, Marissa Thomas

4.4 Summary of Findings	Marissa Thomas, Nicole Whipkey	All
5.0 Conclusion and Recommendations	Marissa Thomas	All
5.1 Conclusion	Marissa Thomas	Nicole Whipkey
5.2 Recommendations	Burnon Chen, Marissa Thomas, Meredith Eddy	Nicole Whipkey
5.3 Limitations	Meredith Eddy, Burnon Chen	Marissa Thomas
5.4 Future Research	Marissa Thomas, Burnon Chen	All
Appendix A: Trail User Romanian Survey Questions	Edward Philippo, Meredith Eddy	All
Appendix B: Trail User English Questions	Edward Philippo, Meredith Eddy	All
Appendix C: Core Interview Guide	Edward Philippo	Marissa Thomas, Edward Philippo
Appendix D: Trail Guide/Trail Manager Questions	Edward Philippo	Marissa Thomas, Edward Philippo
Appendix E: Business Interview Questions	All	All
Appendix F: Reporting System Specifications	Edward Philippo	All
Appendix G: Romanian Survey Results	Meredith Eddy	All
Appendix H: English Survey Results	Marissa Thomas	All
Appendix I: Ranked Report of Potential Hiking Apps	Meredith Eddy	All
Appendix J: Spreadsheet of All Counting Systems Researched	Nicole Whipkey	All
Appendix K: Report of Recommended Counting Systems	Nicole Whipkey	All

Table of Contents

List of Figures

List of Tables

1.0 Introduction

In 2019, 1.5 billion people traveled internationally, creating $1.75 trillion USD in total international tourism exports: 7% of all exports worldwide (World Tourism Organization, n.d.a). Mr. Zurab Pololikashvili, Secretary-General of the World Tourism Organization, claims that developing countries need a strong tourism sector to advance their economy, plus effective tourism practices that preserve their natural and cultural heritage (World Tourism Organization, n.d.c). According to an Adventure Travel Trade Association study, hiking is the single most popular outdoor activity for tourists (Martin, 2017). However, tourists prefer hikes with accessible information (e.g. maps, suggested routes), nearby tourism facilities (e.g. hotels), and well-maintained trails. These features are critical for the hiking tourism industry to grow to its full potential (Scuttari, 2016).

Romania attracts tourists eager to explore its association with vampiric legends and its communist history. However, this so-called "Dracula Tourism" and "Dark Tourism" often overshadow the nation's other merits (Light, 2007; Light & Dumbrăveanu, 1999). Encompassing over half the Carpathian Mountain Range and with forests covering 30% of the country (World Bank, 2019), Romania has a natural environment well-suited for hiking. Sibiu County, located in Romania's Transylvania region, is no exception. The county possesses several hundred kilometers of marked trails, which enable a wide variety of activities including hiking, mountain biking, climbing, horseback riding, and caving (Asociatia Mioritics, 2015; Turnock, 1999). Despite these natural assets, Sibiu County's biggest draw is the capital city of Sibiu, which suggests that tourists do not recognize the county for its outdoor attractions (M. Dragomir, Personal Communication, February 18, 2021).

To enhance Sibiu County's tourism industry, organizations in the region expanded the hiking infrastructure. Since 2015, the Mioritics Association has marked over 500 km of trails with signage in southern Transylvania and is currently working to mark the nearby Carpathian trails (M. Dragomir, Personal Communication, February 18, 2021; Cononovici, 2015). In September of 2021, the Sibiu region is set to host Eurorando, one of the largest pan-European walking events. The host entity expects Eurorando 2021 to draw over 3,000 hikers from 30 different countries, making Eurorando a prime opportunity to spotlight Sibiu as a tourist destination (Romania Insider, 2019).

Despite considerable progress, neither of the project collaborators—the Sibiu County Tourism Association and the Mioritics Association—have any systems in place to profile trail users and their needs, determine the frequency of trail use, or monitor trail conditions. Currently, local businesses could better cater to tourists if they better understood who their patrons are and what they desire. Plus, trail managers currently struggle to maintain the region's vast trail network because they lack the staff to manually locate issues and track the number of users (M. Dragomir, Personal Communication, February 18, 2021). Addressing these issues will help the collaborators make the region more attractive to tourists.

The goal of this project was to investigate how to promote trails and enhance the trail user experience in order to assist the Sibiu County Tourism Association and Mioritics Association in improving relationships and communication between visitors, trail managers, and local businesses. The team accomplished the goal through the following four objectives:

1. To understand the trail user experience
2. To identify how local businesses can address the needs of trail users
3. To develop a reporting system for trail users
4. To propose a system to track the quantity and movement of trail users.

Interviews, surveys, and research revealed several key findings, including business best practices and technological solutions that altogether can improve tourists' experiences on the Sibiu County trails and promote the region. Findings showed that successful lodging businesses encourage their visitors to use the nearby trails and provide services (such as boot repair) to help prepare them. Common issues on the trails included damaged signage, erosion, and encounters with shepherd dogs. AllTrails, Komoot, ViewRanger/OutdoorActive, and Wikiloc, are all popular hiking apps used to plan a hiking trip. Eco-Counter and SensMax are both well-known European companies that sell people counting technology designed for outdoor environments. From these findings, the team recommends that the collaborators inform lodging businesses of ways they can attract trail users, develop a centralized trail issue reporting system, partner with a hiking app, and incorporate a counting system on the trails.

2.0 Background

This chapter begins with a brief history of Romania and Romania's tourism before introducing the project collaborators, the Sibiu County Tourism Association and Mioritics Association. The chapter then describes the current condition of the Sibiu County trails and potential improvements. Next, the background discusses systems other countries use to determine the needs of trail users, count visitors, and obtain feedback. Finally, this chapter investigates possible solutions and existing reporting forms designed to meet tourist expectations. Knowing these topics is essential to understanding the social implications of this project, how Sibiu can apply methods used around the world, how to encourage better tourism practices, and how to improve the experience of trail users in Sibiu.

2.1 Geographical and Historical Tourism Context

2.1.1 Geographical Region

Romania is a southeastern European country bordered by Ukraine, Moldova, the Black Sea, Bulgaria, Serbia, and Hungary. The landscape in Romania is roughly one-third mountains, one-third forests, and one-third hills and plains, with great diversity in topography, geology, climate, hydrology, flora, and fauna (Mihai Dragomir, Personal Communication, February 9, 2021). Romania's geographical structure centers around the Transylvania Basin and the Carpathian Mountains, whose subranges form a series of crescents that divide Romania into ten regions. Bucharest, the nation's capital and main economic and cultural center is in the Muntenia historic region (shown in Figure 2.1 in mint green) (Cucu et al., 2021).

Figure 2.1 Romania regions counties map
(JewishGen, 2016)

Sibiu County, located in the historical region of Transylvania (shown in peach in Figure 2.1) of Romania, is 2,097 square miles (5,432 square kilometers) in area, with an estimated population of 401,168 (as of 2020-01-01). The Transylvanian Alps (Southern Carpathians), including the Sebeş, Lotru, and Făgăraş ranges, run through the southern portion of Sibiu. Sibiu County is more rural than other areas in Romania, with settlements found amongst intermontane valleys (Britannica, 2019). The capital of Sibiu County, aptly named Sibiu, lies along the Cibin River on the northern side of Turnu Roșu ("Red Tower") Pass, which links Transylvania to southern Romania across the Southern Carpathians. The city of Sibiu is a "cultural and industrial center" because of its large production of machine tools, textile machinery, foodstuff, leatherware, textiles, and clothing. Possessing an international airport, along with roads and railways connecting Sibiu to Cluj-Napoca, Brașov, and Bucharest, Sibiu is easily accessible from outside regions (Britannica, 2018).

2.1.2 Decline of Tourism in the Communist Era

Occupied by Soviet troops in 1944, Romania joined the Union of Soviet Socialist Republics (U.S.S.R.) and fell under communist control in 1948. Before the Second World War, Romania experienced a slow, steady growth in tourism as a result of establishing a National Tourism Office in 1936. However, this progress stopped due to the war and communist influence. By 1961, Romania had only 134,000 tourists annually. In the 1960's and 1970's, Romania invested in more tourism infrastructure, focusing on its border with the Black Sea. As an inexpensive alternative to Greece or the Spanish coasts, Romania attracted 2.9 million foreign tourists in 1972. Most of these tourists came from neighboring countries, but 600,000 came from Western Europe (Light, 1999). The government also encouraged domestic tourism, and most people visited areas with spa and mountain resorts along with the Black Sea.

However, tourism began to decline again as Dictator Nicolae Ceaușescu consolidated power in the mid 1970's. In 1974, he passed a law requiring all tourists to spend a minimum amount of currency each day during their visit. Additionally, Ceaușescu forbade local Romanians to accommodate tourists in their homes and demanded them to report all interaction with foreigners to the Securitate (the internal security services). This restricted tourism to the Black Sea and put tourists under surveillance. Ceaușescu's plan to reduce Romania's debt involved decreasing domestic consumption and investment, rationing energy supplies, and exporting nearly all agricultural produce. As a result, the Romanian standard of living significantly declined and citizens had to ration food, electricity, and fuel (Light, 1999). In the 1980's, tourism declined rapidly, making Romania an unattractive, repellent place for tourists (Light, 2000).

2.1.3 Tourism Stereotypes

After the demise of Ceaușescu's reign in 1989, Romania transitioned to democracy in 1990 which significantly increased the number of arrivals (Cucu et al., 2021). 3.1 million tourists visited Romania for holiday in 1990—a 67% increase from the previous year—with the majority from neighboring countries and about half a million from Western Europe. In 1992, the number of tourists arriving for holiday peaked at just over 3.5 million, as seen in Figure 2.2.

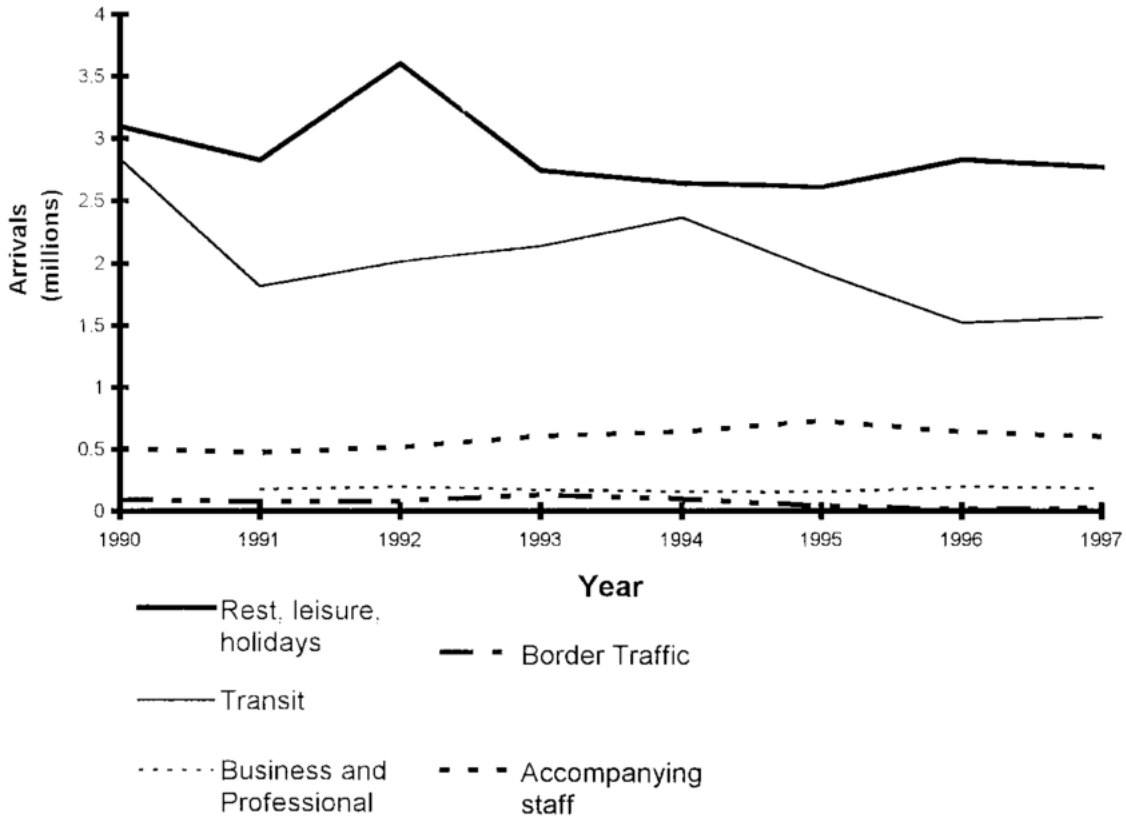


Figure 2.2 Foreign arrivals by purpose of visit from 1990 to 1997 (Light & Dumbrăveanu, 1999).

With Ceaușescu's downfall broadcast on national television, Romania wanted people to experience the revolution themselves. During the transition period, the Romanian government provided guided tours associated with sites highlighting the downfall of communism to help rebuild the economy (Light, 2000). Even after decades of post-communism, Romania still draws tourists to learn more about its communist legacy, a phenomenon now known as "Dark Tourism," (Light, 1999) or "Communist Heritage." This concept keeps Romanians in a dilemma between maximizing profit from tourism and moving past the country's communist legacy (Light, 2000).

In addition to "Dark Tourism," another reason tourists visit Romania is because of the association with the fictional character Dracula. Even though sites associated with Dracula serve as a good marketing strategy to attract tourists, Romanians would rather have tourists visit to appreciate their society, culture, and vast natural attractions. So-called "Dracula Tourism" upsets Romanians because it does not display Romania as the modern, developed country it desires to be (Light, 2007). This poses a predicament on how to reconcile these two conflicting approaches.

2.2 Recent Tourism in Romania and Sibiu

Currently the tourism industry in Romania is experiencing a significant upward trend. Figure 2.3 displays this movement and details the number of arrivals in tourist accommodations in Romania in the last fifteen years, which have grown from 6.22 million in 2006 and peaked at 13.37 million in 2019. The year 2020 is a special case as the outbreak of COVID-19 vastly reduced travel globally. The most popular tourist locations in Romania are cities, accounting for over half of domestic tourists and almost 90% of international tourists in 2019. In comparison, only about 20% of domestic tourists and less than 10% of international tourists stayed in the mountains in the same year (National Institute of Statistics Romania, 2020). Overall, the tourism scene in rural regions of Romania is less popular than that of more urban areas.

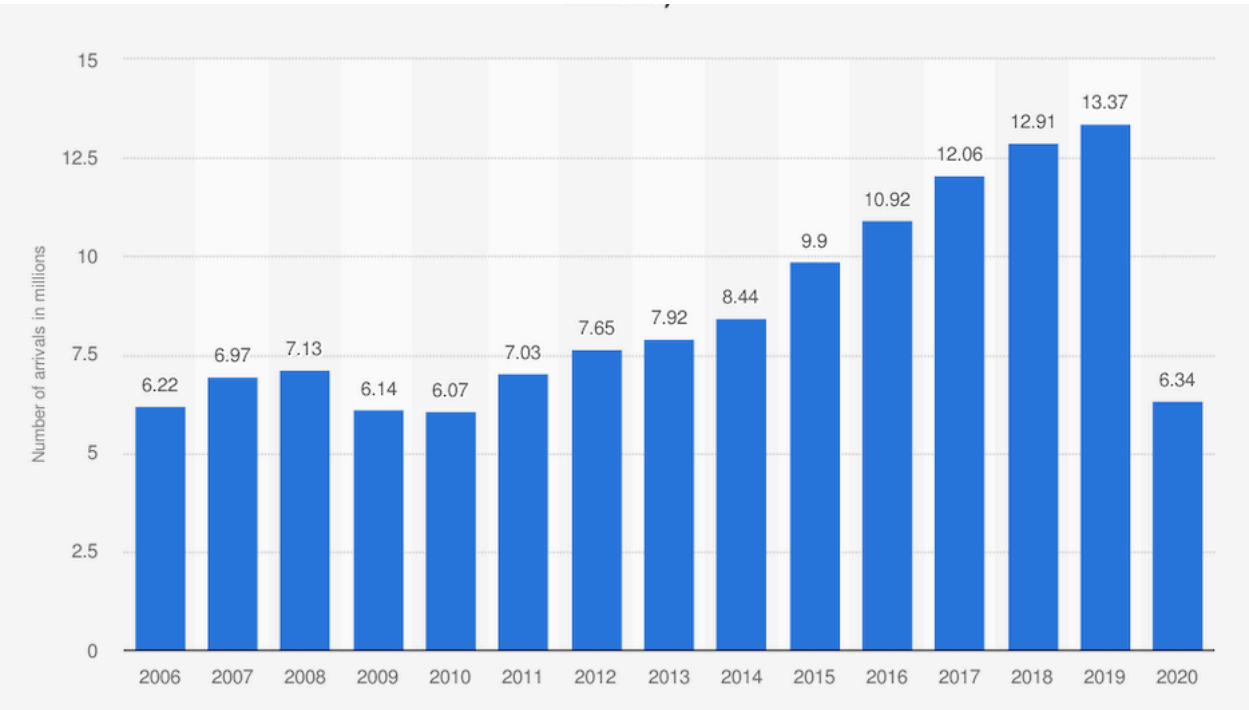


Figure 2.3 Number of arrivals in tourist accommodations in Romania from 2006 to 2020 (in millions) (Eurostat, 2021).

However, there is potential for tourism growth in the rural areas of Romania due to its vast mountain ranges and cultural history. These areas offer a wide variety of tourist activities, such as hiking, biking, horseback riding, viewing historical monuments, and experiencing the traditional culture of the communities (Turnock, 1999). For example, one study examined the possibility for agrotourism (farmer supported rural tourism) to encourage sustainable development within Sibiu county, and found that tourists' desire to reconnect to nature and to

learn more about tradition and culture has strongly motivated rural tourism in the region (Mirela, 2017).

Though Sibiu contains the beautiful landscapes and deep cultural heritage that tourists seek, tourists often favor other destinations. In a survey asking Central Europeans to assess the attractiveness of Central European countries for hiking and winter sports, only 39.0% of respondents rated Romania as a desirable location for mountain hiking. Other countries such as Austria and Slovakia respectively received 74.9% and 79.0% approval ratings for hiking, making it clear that Romania is not the first choice for Central European hikers (Krzesiwo et al., 2018). Following the trends of the country at large, the main attraction of Sibiu County is the city of Sibiu itself (Figure 2.4). In 2007, the European Union recognized the city of Sibiu as a European Capital of Culture; and European Best Destinations ranked the city sixth in the "20 Best European Destinations to Visit in 2020" (Romania Insider, 2019; Rodriguez, 2020). Despite this positive recognition, Sibiu County in total receives only 4.20% of the total tourists in Romania (Popescu, 2015). Generally speaking, tourists overlook the rural regions of Sibiu in favor of staying in the city or traveling to other mountainous Central European countries.

2.2.1 Organizations Involved in Promoting Tourism in Sibiu

Due to limited tourism activity in the Sibiu region, several organizations aim to promote tourism and culture in Sibiu. In 2005, the Sibiu County Council established the Sibiu County Tourism Association (SCTA) as an organization focused on the management and marketing of Sibiu County as a tourist destination. The SCTA's goals include expanding and promoting tourism in Sibiu County, building a framework for the creation of various forms of tourism services, and utilizing internal and external promotion tools to support the implementation of local, regional, national and European tourism development strategies (Asciaţia Judeţeană de Turism Sibiu, n.d.). The organization's website, www.sibiu-turism.ro, strives to make Sibiu an attractive tourist destination by listing a wide variety of useful information, such as popular destinations, activities, travel methods, and accommodations.

Figure 2.4 Sibiu, Romania
(Stanley, 2017).

The Mioritics Association—another organization that promotes tourism in Sibiu—specifically emphasizes cultural tourism: a type of tourism activity where the visitor's main motivation is to learn, discover, experience, and consume cultural attractions or products in a tourism destination (World Tourism Organization, n.d.b). A non-governmental and non-profit organization founded in 2004, the Mioritics Association's main goal is to protect and promote cultural and natural heritage in Romania and to expand cultural tourism in Romania. The Mioritics Association contributes to the Sibiu and Transylvania region by producing promotional materials for the Transylvanian area such as maps, brochures, and guides, and marking over 250 kilometers of hiking and biking trails in Sibiu (Asociatia Mioritics, n.d.). Figure 2.5 displays a map of the hiking and biking trails in the Transylvanian Highlands, located in the northern portion of Sibiu county. It also shows blue and red trail markings from the Mioritics Association. Since the rural population in Romania takes pride in their location and lifestyle (Turnock, 1999),

it is important to the Mioritics Association to promote and take care of these rural regions in order to preserve that culture.

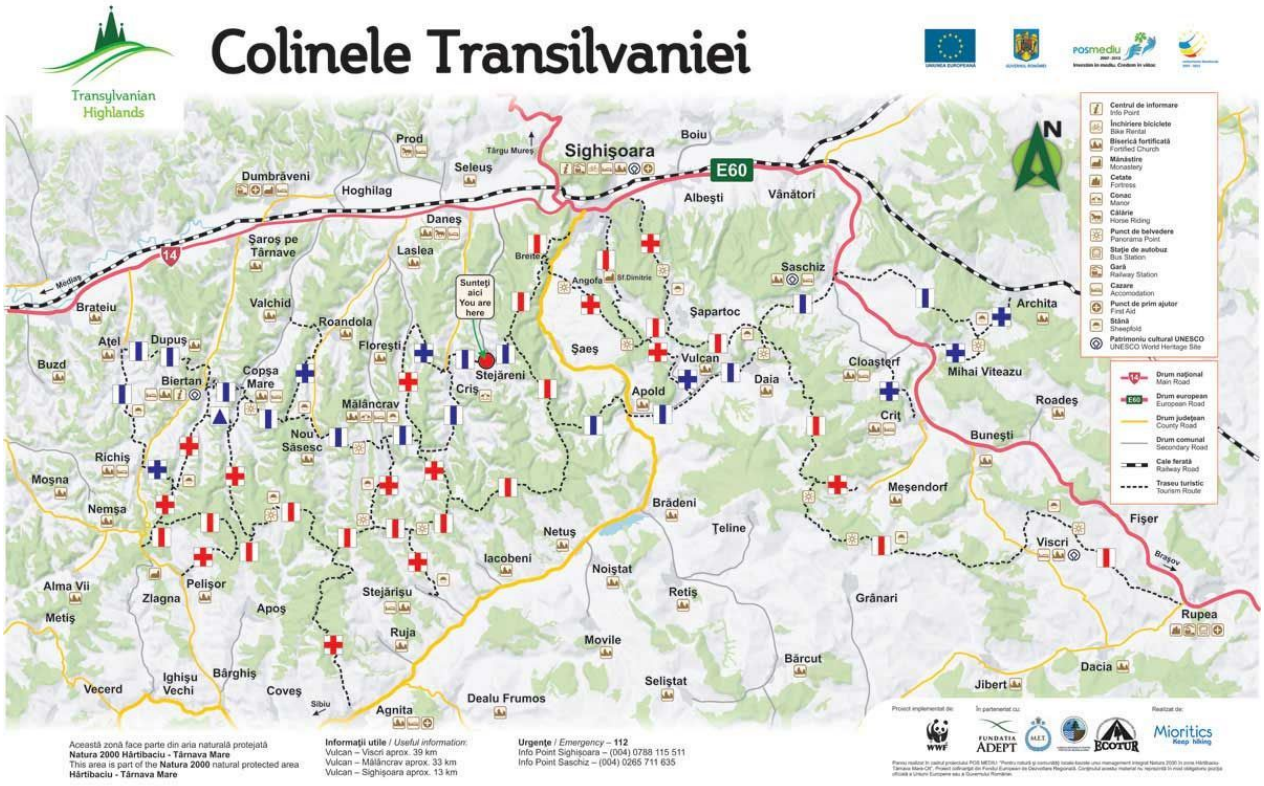


Figure 2.5 The network of hiking and biking trails in the Transylvanian Highlands (The Ecotourism Association of Romania, 2020).

2.2.2 Businesses in Sibiu County

Sibiu County is growing as a tourist destination and between hotels, hostels, villas, chalets and campsites, the region already has over 400 facilities (Sibiu County Tourism Association, 2021). The SCTA website also advertises a number of travel agencies and tour guides specialized in the Sibiu County area. However, researchers that analyzed Sibiu County indicated that these businesses (shown in Figure 2.6) have room for growth. They concluded that "the Sibiu destination looks to be a fragile complex system in which the stakeholders do not seem to be particularly inclined in forming cooperative groups" (Grama & Baggio, 2013). They claim that collaboration and cooperation between businesses may serve to strengthen the business network.

Type of business	%
Associations	6.9%
Café-Bar-Pubs	5.9%
Camping	0.4%
Hotels	7.9%
Motel/Hostel	3.1%
Pensions	52.5%
Private accommodation	1.5%
Restaurants	8.4%
Travel Agencies	13.4%

Figure 2.6 Types of businesses included in the Sibiu destination network (Grama & Baggio, 2013).

Rural tourism in Sibiu County provides an opportunity for economic growth. The historical region of Transylvania has become the strongest example of rural tourism in Romania. Rural businesses could reap numerous benefits by accommodating tourists, including supplementing their income, breaking down rural isolation, and highlighting cultural heritage (Iorio & Corsale, 2010). However, barriers such as a lack of funds and skills impede their ability to cater to tourists. Additionally, visitors need accommodations in order to visit the rural areas, and as seen in Figure 2.7, Sibiu County only has 11-50 rural accommodation structures. In comparison, the neighboring county of Brasov has over 100 (Iorio & Corsale, 2010). This may limit rural tourism in Sibiu, despite the region's many offerings.

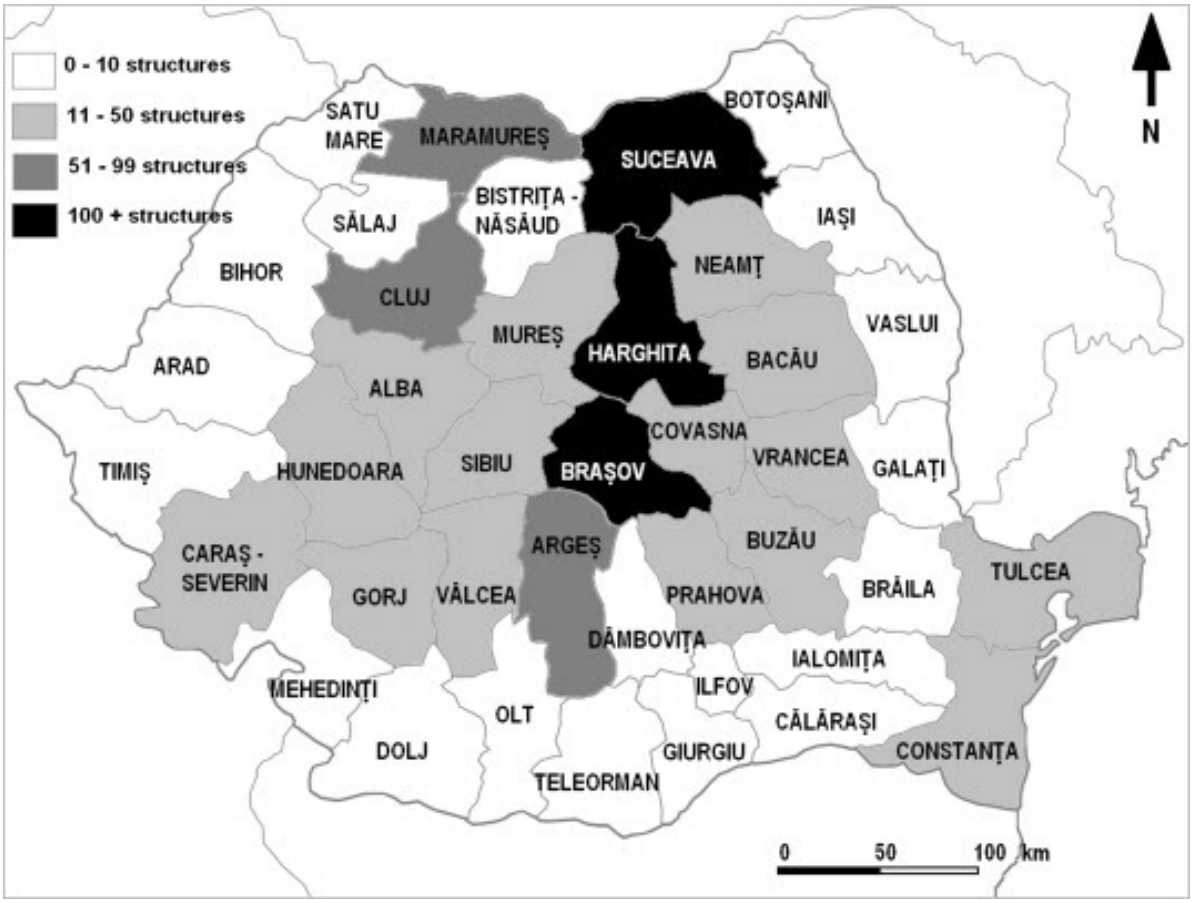


Figure 2.7 Distribution of rural accommodation structures in Romania by county (Iorio & Corsale, 2010).

2.3 The Relationship Between Trails and Trail Users Around the World

Most hiking in Sibiu County takes place in three regions. Mărginimea Sibiului, a pastoral area with low and middling difficulty trails provides a cultural experience with the locals. Next are the Transylvanian Highlands, a hilly region boasting 500 km of hiking/biking trails, traditional villages with fortified churches, and the Via Transylvanica, a 1000 km long-distance trail comparable to the Appalachian Trail in the Eastern United States. Finally, the Țara Făgărașului area (see Figure 2.8), also known as the Carpathian Gates, lies in the middle of the Southern Carpathians. Experienced hikers and mountain bikers favor this mountainous area for its higher difficulty and a stop along the 6000 km E8 path that snakes across Europe (S. Manea, personal communication, February 9, 2021).

Figure 2.8 Făgăraș Mountains, Romania
(Dragomir, n.d).

There are two important caveats about the trail networks in Sibiu County. Firstly, no single entity manages these properties. Trails run through land owned by local governments, private citizens, and non-governmental organizations (NGOs), making organized maintenance difficult (M. Dragomir, personal communication, February 9, 2021). This divided ownership has caused local political clashes: often, the interests of trail users do not align with those of the property's owners. In interviews, participants expressed their concerns regarding the balance of power between the different parties. A trail guide mentioned how foreign landowners and hunting organizations often restrict access to their land, while loggers demolish entire areas which leaves them unsightly and difficult to navigate. Despite their concerns, these groups typically generate substantial local income and hold significant political influence, rendering them untouchable by local trail users.

Secondly, the region's trail network is expansive but not well mapped. To combat this obstacle, there are organizations addressing this issue. In recent years, the Mioritics Association led multiple projects to map and mark existing trails, expanding the documented trail network by over 550 km in total (Asociatia Mioritics, 2015 and 2016). While the added infrastructure is a

sign of significant progress in trail management, there are still more trails in Sibiu county left without any marking or mapping.

2.3.1 Attracting Visitors

Natural attractions compete for visitors with other attractions, such as shopping centers and movie theatres. By analyzing parks across Europe, certain recurring factors impact the popularity of national parks. Researchers analyzing these factors in the Czech Republic, Germany, and Austria found two key factors: park budget and the number of park employees (Stemberk et al., 2018). Interviews with park managers and a retrospective analysis of recorded park data suggested that increasing park budget increases the national park attendance (Stemberk et al., 2018).

Another study, focused on Finland, found that across 35 national parks the two key factors impacting the number of park visitors are the number of recreational activities and the number of biotopes (Neuvonen et al., 2010), which are regions with uniform environmental conditions and species (Merriam-Webster, n.d.). Parks with more unique ecosystems and breathtaking scenery attract more visitors, while increasing the number of recreational activities available within a park also improves park popularity (Neuvonen et al., 2010). Examples of recreational park activities include lodging, viewing towers, and extensive trail networks.

While only 4.20% of the total tourists in Romania (Popescu, 2015) come to Sibiu, there is potential for growth in Sibiu's tourism industry. From mountain peaks to rolling hills and plains, as well as many animals specific to the region, Sibiu has multiple biotopes. With over 500 km of trails, Sibiu county has an extensive trail network attractive to visitors. Coupled with an opportunity to witness landscape and wildlife not seen elsewhere in Europe (bears, wolves, and lynx are examples), Sibiu can attract tourists looking for a chance to observe nature up close without straying far from the beaten path. By taking advantage of the natural attractions and already existing trail network, Sibiu can promote itself to potential tourists, growing the county's tourism industry.

2.3.2 Catering to Trail Users

Businesses in Vietnam and Malaysia practice strategies that encourage tourists to spend more time and money at local businesses. Customers in these areas have desired comforts including access to information, nearby food and lodging, and often guided tours. Businesses that

adapted to customer expectations experience increased customer satisfaction and spending. While businesses in both countries addressed different demands, their general method and results of their efforts can serve as an example for Sibiu businesses.

Vietnamese Traveler Cafes

Because of the language barrier between locals and tourists in Southeast Asia, backpackers have flocked towards traveler cafes (similar to an internet cafe). In Vietnam, these cafes became a part of backpacker enclaves, a cluster of cafes, cheap housing, and budget restaurants (Lloyd, 2006). Despite a lack of 'up-scale' tourist services, local businesses provide tourists with everything they desire (food, accommodation, information), all with convenient access to transportation and the inner city (Lloyd, 2006). Furthermore, workers in the tourist trade adapted to the origins of their visitors by offering new cuisines and providing information in multiple languages (Lloyd, 2006). The success of these cafes and other enclave businesses boils down to identifying the required accommodations for tourists. Recognizing the cultural backgrounds, preferred languages, and reasons for tourist visits pushed entrepreneurs to communicate in French and English. The switch from Vietnamese to French and English improved traveler experience, making information more accessible and conversation more feasible between both visitors and locals. With an improved experience, travelers became more inclined to extend their stays while supporting local businesses.

Malaysian Mountain Climbers

Looking to create a successful marketing and management campaign, researchers in Malaysia studied the pull-factors of certain mountains. These factors are the accessibility, landscape, the tour company, and perceived risks (Mohd Taher et al., 2015). Analyzing mountains based on these factors provided insight into the type of potential visitor. By surveying visitors at multiple mountains, the researchers drew conclusions based on visitor perception and hiker demographics. One of these conclusions was that a mountain with higher perceived risks draws more experienced hikers while inexperienced hikers prefer mountains with lower perceived risks (Mohd Taher et al., 2015). Knowing about the type of hiker attracted to their region, businesses and tour companies can tailor their services to the desires of the visitor. By acknowledging the consumer base, tour companies can tailor tour packages to target a specific type of tourist, improving the visitor experience.

While businesses in Vietnam and Malaysia adapted differently, there is similarity in their approach. In each case, businesses built profiles of their visitors and adapted accordingly which positively impacted them and their customers. The SCTA and Mioritics Association look to improve the entire visitor experience, on and off the Sibiu trails. Since businesses contribute to the visitor experience, it is crucial that they adjust their practices to meet and exceed the needs of trail users. But before businesses can adapt to trail users, they must be aware of the gaps between the expectations of trail users and the reality of services they currently provide.

2.4 Data Collection in Other Parks

National parks and trail systems require consistent visitor data and feedback to anticipate the behavior of visitors and to effectively maintain the land. Counting systems track visitor movement in particular areas, allowing trail managers to identify the most popular trails, peak visiting times, and other important information. Feedback systems allow trail managers to recognize when and where the trails need improvements. This section provides examples of counting and feedback systems that other trail systems and park areas have in place to collect visitor data.

2.4.1 Counting and Feedback Systems

Monitoring the Socioeconomic Impact of the National Park Service

The National Park Service (NPS) of the United States has a strong demand for a socioeconomic monitoring system (SEM) to track the economic impact their parks have on the populations living in and around them (NPS, 2021). Previously, the NPS conducted small-scale surveys on topics from park visitation to park progress measurement, but lacked a cost-effective, system-wide program to collect and organize the survey data. Therefore, the NPS designed and implemented a pilot SEM system into 14 of their parks in 2015 to assess the effectiveness of the system in improving management and visitor experiences.

The NPS designed the SEM questionnaire as a standardized survey to gather system-wide information. Chosen through a pilot development workshop, the survey questions asked visitors to choose from a list of response options, providing open response opportunities where appropriate (NPS, 2021). The questionnaire used English as the primary language, but additional languages were available depending on the area. Researchers administered the SEM visitor survey at 14 pre-selected NPS locations as a personally delivered, self-administered, mail-back

survey (NPS, 2021). The study population included visitor groups with at least one group member aged 18 or older in the park during the survey period. The NPS completed a nonresponse bias analysis for each park included in the pilot study. In an attempt to counteract the nonresponse bias and collect more information, park staff conducted a short, five-question interview of all eligible visiting groups. Results indicated that the pilot system served as an effective strategy to compile data. With at least two years of implementation, aggregated data from this system can reduce the margin of error in national studies and subsample analyses such as comparing park types and visitors (NPS, 2021).

Counting Visitors with Acoustic Slab Sensors in the Swiss National Park

For Swiss National Park (SNP), located in the Western Rhaetian Alps in eastern Switzerland, monitoring visitor flow is essential for park management. The SNP looked to develop an accurate counting system that required minimal human resources. Hikers are forbidden from straying off the trails, making acoustic slab sensors a viable option to indirectly count trail visitors (Siegrist et al., 2006). Caretakers installed four of the acoustic sensor slabs at the Mingèr and Margunet Valley, and two more at Trupchun Valley. Each sensor consists of two pressure sensitive slabs buried under an 8-10 cm thick layer of soil (Siegrist et al., 2006). Each sensor connects to a data logger that registers the visitors hourly. To calibrate and check the accuracy of the sensors' automatically collected data, caretakers manually counted the number of visitors for two days. The difference between the human-collected data and the automatically collected data provided the resources necessary to calculate a calibration factor to apply to future data collections (Siegrist et al., 2006). However, the study left researchers with numerous questions and concerns, such as: What is the sensitive area of the counter? How does step length affect the counting? Can sensors count the number of individuals walking in a group? Does composition of covering material affect the sensors counting? Due to all these uncertainties, the sensors consistently underestimated or overestimated the number of passing visitors and the sensors ended up as an unreliable source of data. A sensor, no matter the type, needs further testing, but it is difficult to get perfect results when human behavior itself is unpredictable.

Tracking Tourists in Real-Time in Portugal's Naturtejo Global Geopark

The Naturtejo Global Geopark located in Portugal features extensive walking and hiking trails for visitors to use at no charge. However, with no registry of visitors, there is no concrete knowledge about how the tourists use the various walking routes. In order to make more

informed decisions, park managers proposed a two-phase visitor counting system to count and track tourists' movements in real-time using light beams and the Media Access Control (MAC) addresses of tourists' own smartphones (Dionisio et al., 2016).

In phase one, an electronic system remotely counted people passing on the trails. To withstand the elements, a small solar panel powered each sensor and its 3G/4G wireless communication module (Dionisio et al., 2016). For narrow paths, Naturtejo Geopark adopted an inexpensive sensor solution with low power consumption and easy installation. The system consisted of a horizontal infrared light beam with an opposite reflector (as seen in Figure 2.9). This type of light beam system counts a 'tick' each time a passing guest breaks the beam. However, people must pass with a gap of at least 10 cm in between each other for the sensor to count them as two separate people (Dionisio et al., 2016). Despite this constraint, the Fossils Trail counting system in Penha-Garcia showed an accuracy level of 95 percent: adequate to estimate visitor flow. The light counting system updates a Google Maps-based web interface that Geopark managers can monitor in real time.

Figure 2.9: Installed light beam sensor in Naturtejo National Park (Dionisio, 2016).

Phase two of the visitor tracking made use of the Wi-Fi communication's technology that is standard on most smartphones and other portable electronics. A MAC address is a 12-character identifier unique to a device (Dionisio et al., 2016). Smartphones use the MAC address to connect to public Wi-Fi spots and consequently broadcast this address constantly. Naturtejo National Park implemented data collection using the MAC address by installing sensors that act as Wi-Fi receivers to pick up unique MAC addresses emitted from the smartphones with a range up to 100 meters (Dionisio et al., 2016). Monitoring the MAC addresses on different Wi-Fi hotspots located throughout the park yields estimates of visitor movement. Despite not every

guest having a smartphone, Wi-Fi tracking is still representative of the population due to the large sample size.

Background knowledge on both feedback and counting systems was essential for the team to appreciate prior to completing the project. The Sibiu Country Trails currently lack high tech data collection methods and can learn from other existing practices. The NPS posed a strategy to collect trail user information through surveys and interviews. The Swiss National Park and Naturtejo Global Geopark created unique mechanisms to count the number of people who use their trails. The Sibiu County Trails can potentially adapt these methods to implement their own feedback and counting systems in order to more effectively collect visitor information.

2.4.2 Crowdsourcing Information

While many parks desire to collect data to assist with park management, limited funding has led them to turn towards crowdsourcing their data. Crowdsourcing is a method of obtaining data through the Internet from a large number of typically unpaid people. Several parks, like Asylum Lake Preserve (AL) at Western Michigan University have utilized a crowdsourced reporting system to decrease resource strain from park management. To test the effectiveness of crowdsourced data, developers built a reporting system for AL using a smartphone app as a platform. The reporting system serves as a low maintenance data collection service for the preserve managers, with each report including a location tag, description, and picture (Ebenstein, 2015). During a testing period, users submitted eight issues, including trash reports (bottles, plastic bags, styrofoam), trail maintenance issues (holes in the trail, large trenches, large stumps), and misplaced canoes (Ebenstein, 2015). Because of the crowdsourced nature of the reporting system, managers found that they did not have to traverse the park's trails themselves to find problems since trail users provided all relevant information. The app, with its integrated reporting system, greatly sped up the response time of the park management, decreased the number of issues present, and left more trail users satisfied with their visit.

The Mioritics Association is interested in crowdsourcing information from trail users in Sibiu. With insufficient staff, it is nearly impossible to keep the trail network well-maintained year-round. For AL, the crowdsourced reporting system decreased the number of staff necessary to properly manage and oversee park land. The Sibiu County trails can apply the same principle. Additionally, the trail managers can use crowdsourcing information for other purposes such as

obtaining and synthesizing trail user feedback to help address other issues such as hunting and logging and share positive experiences within a promotional strategy.

2.5 Internet-Connected Solutions

2.5.1 Romanian Internet Speed and Access

Romania has the third fastest average fixed broadband speeds in the world as of August 2020 (Speedtest, 2020). However, Romania is not exempt from technical issues typically found in rural areas. In a survey regarding how respondents would rate high-speed access in rural areas of Romania, one third of participants claimed “fairly bad” or “very bad” transmission speeds (European Commission, 2020). While the ready availability of technology (especially smartphones) in Romania makes it tempting to use online platforms, solutions should not rely heavily on high-speed capacities given that Sibiu is a mostly rural county. In addition, while a purpose-built application could be a convenient option for hikers, the cost of creating and maintaining such an app may be prohibitive. In Romania, app development costs at least 570 euros but could potentially cost hundreds of dollars more (Marcoianu, 2019). As a result, the following research details some applications that already exist on the market.

2.5.2 Existing Reporting Forms

Many parks and trail networks make use of reporting forms to ascertain knowledge of when to address issues along the trails. The trail issues include but are not limited to sign damage or vandalism, impassable trail conditions, and abundant trash along the trails. Trail visitors fill out reports, either online or on paper, allowing trail managers to assess and solve problems in an effective and timely manner. Reporting forms can benefit understaffed areas like Sibiu, which are unable to constantly monitor the trails in search of problems.

The project collaborators provided the team with four examples of online reporting forms for trail networks in the United States, Canada, and France. The four organizations that created and actively monitor these forms are Keystone Trails Association in Pennsylvania (KTA, 2021), Island Trails in Canada (Report, 2021) (see Figure 2.10), Tahoe-Pyramid Trail in California and Nevada (Tahoe-Pyramid, 2020), and Suricate in France (Signaler, 2021). Each of the reporting forms has similar questions that enable trail managers to address issues as they appear. Each form asks the user to identify the problem through a drop-down menu, written description,

photos, or a combination thereof. The other important question that all the forms have in common is reporting the location of the issue. There are several apparent methods to gathering location information including selection of the trail name from a drop-down menu, GPS coordinates, description of nearby landmarks, and connecting location with the location of the users' smartphone. Lastly, each form requests contact information of the reporter to allow trail managers to contact them for further information if needed.

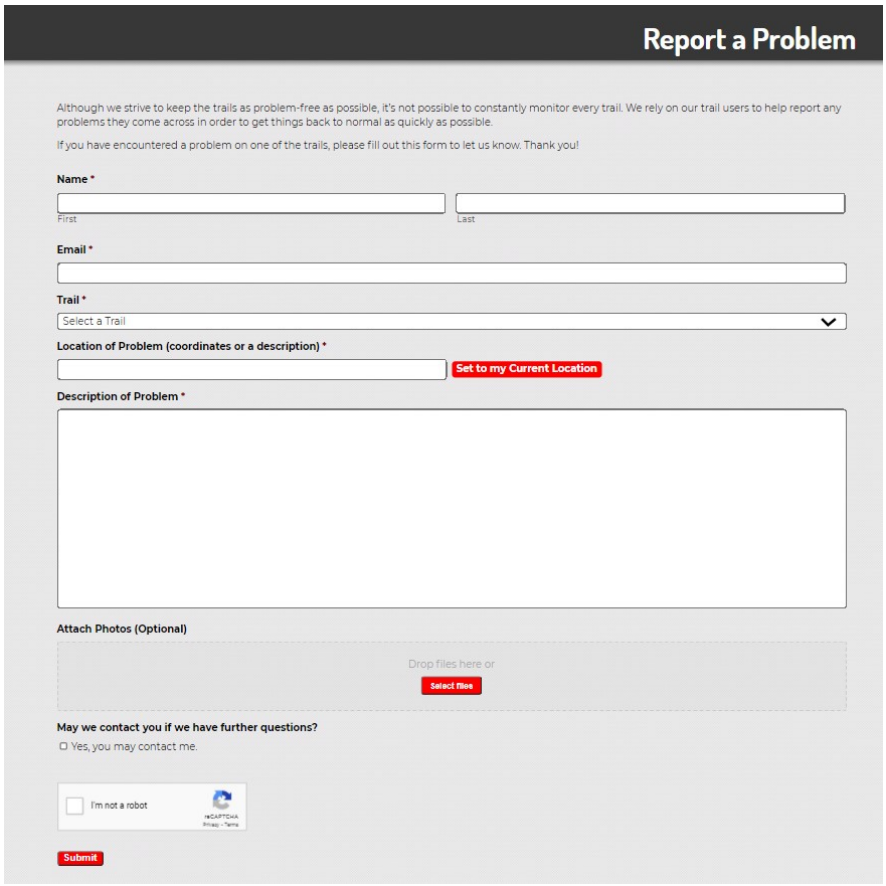


Figure 2.10: Example reporting form from Island Trails, Canada (Report, 2021).

2.6 Summary

This chapter reviewed the history and dynamics of tourism in Romania. The Sibiu County trails have great potential as a tourist attraction, but the key to unlocking that potential is information. Land managing organizations in other countries proactively gather data on how many people use trails, who the users are, the problems they encounter, and what these trail users need—all of which enables them to directly address tourists' expectations. If trail managers and

businesses in Sibiu County adopt these practices, they can better cater to tourists, which in turn will attract more visitors and yield local economic benefits.

Before advancing with the project, the team considered the project stakeholders: the Sibiu County Tourism Association and Mioritics Association, the local businesses in Sibiu, and the trail users—including domestic and international tourists, tour guides, and trail managers. The Sibiu County Tourism Association and the Mioritics Association are official collaborators for this project and serve as our connections to the Sibiu region. The intent is to build off these organizations' previous work and deliver useful products. Since local business owners depend on the success of their business, the project's end result will ideally deliver useful information to keep them profitable. And of course, the project will heavily impact trail users. Whether they are visiting or working on the trails, interested in Transylvanian culture, or keen for outdoor activities, this project ultimately aimed to better the trail user experience.

3.0 Methodology

The goal of this project was to investigate how to promote trails and enhance the trail user experience in order to assist the Sibiu County Tourism Association and Mioritics Association in improving relationships and communication between visitors, trail managers, and local businesses. The team addressed this goal through four objectives:

1. To understand the trail user experience
2. To identify how local businesses can address the needs of trail users
3. To develop a reporting system for trail users
4. To propose a system to track quantity and movement of trail users.

To achieve these objectives, the team established a set of remote tasks to complete with collaborators in Sibiu, Romania from March 24, 2021 to May 13, 2021. The team focused on the Sibiu region, specifically targeting hiking, biking, and cultural trails. These trails have varying levels of signage and infrastructure, but all require improved promotion and data collection (M. Dragomir, personal communication, February 18, 2021). The objectives aimed to improve the user experience on the Sibiu County trails by creating an infographic about trail users and by proposing both reporting and counting systems for the trails. To achieve the project goal, the team conducted interviews, surveys, and a content and observational study, researched data collection systems, and evaluated the findings to provide recommendations to the collaborators for improving the relationship between visitors, trail managers, and local businesses. Figure 3.1 illustrates the relationship between the goal, objective, tasks, and deliverables of this project.

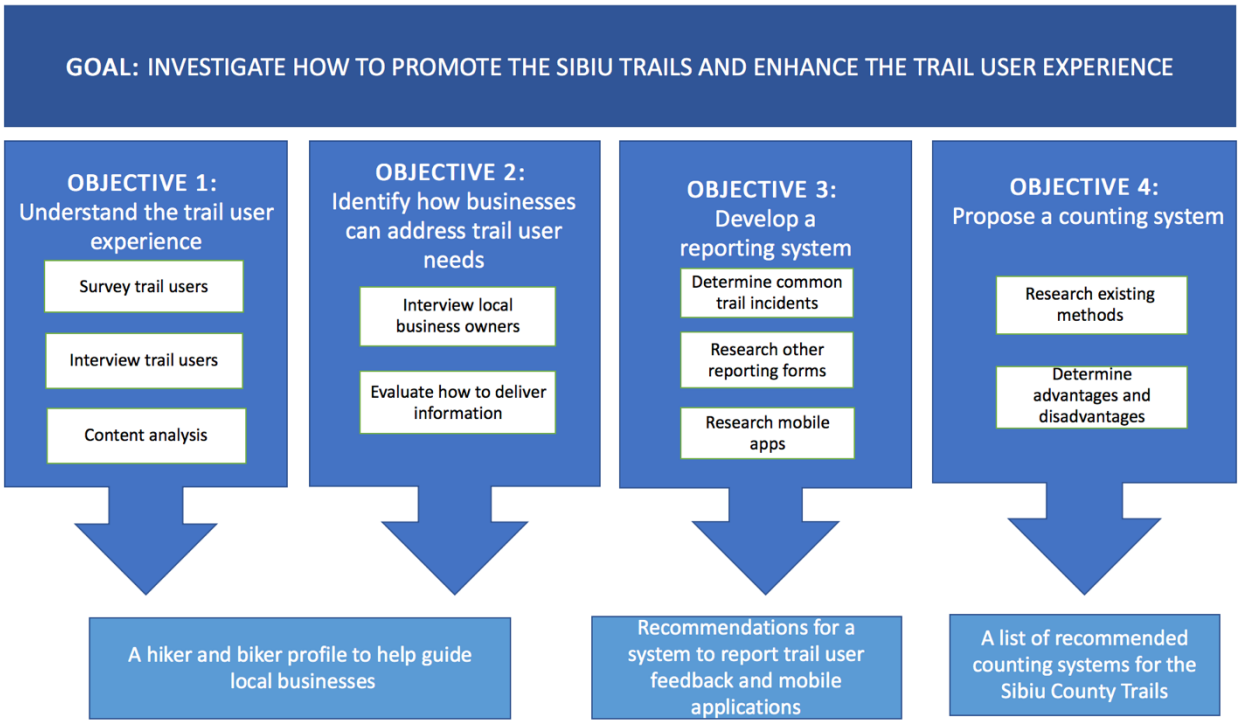


Figure 3.1 Flow chart of the project goal, objectives, tasks, and deliverables

3.1 Understand the Trail User Experience

The first objective was to determine the current trail user experience in Sibiu. The methods in this section collected data on common remarks trail users have about their experiences, enabling the team to analyze trends and improve the trail user experience. The team collected information from trail users, trail guides, and trail managers in order to achieve this objective. With the help of the Mioritics Association, the team administered surveys and conducted interviews with these groups to gain insights regarding their first-hand experience of the trails. In addition, the team conducted both a content and observational analysis by studying blog posts and videos that provided information about the trail user experience.

3.1.1 Survey Trail Users

Surveying trail users helped the team determine the demographics of tourists that use the trails and opinions they have regarding their visit to the trails and the surrounding communities. The team prepared a series of both open and closed ended questions that allow for both structured and detailed responses using Qualtrics. The WPI project team sent their questions to the collaborator Mihai Dragomir, who forwarded them to a student team at the University of

Bucharest working on a communications project. The Romanian team translated the WPI team's questions and combined them with their own survey into one Google form (see Appendix A). The Bucharest student team also ensured that each of the translated questions adapted to the Romanian culture and made the overall tone more lighthearted. The Mioritics Association distributed the survey on their Facebook page in Romanian since it primarily reaches local trail users. The topics covered in the survey included trail user demographics (A.1-4), their experiences using the trails (A.4-9, A.13-18), and their thoughts on using a mobile application to help improve their experience (A.10-12). However, the Bucharest student team removed important questions regarding interactions with local businesses from the survey. This information was critical for achieving objectives 1 and 2, therefore the team decided to send out a second survey with the original questions, this time in English, and aimed towards foreign trail users (see Appendix B). The survey included the same topics as the first but in a more formal and professional tone（B.1-20). The new survey asked about visitor experience with local businesses in Sibiu (B.21-34). Additionally, the survey's format allowed for some questions to trigger additional follow-up questions to extract more details about the respondent's answers.

The Mioritics Association helped distribute the English survey targeting visitors outside of Romania through promotion on the Transylvanian Highlands Facebook page, paid Facebook advertisements, and distribution through tour guides to previous customers.

The team guaranteed confidentiality and anonymity of survey responses, since the final report does not contain any names of the participants. The Mioritics Association distributed the first (Romanian) survey on April 1, 2021, and the second (English) survey on April 8, 2021. The Romanian survey closed on April 15, 2021 and received 106 responses, and the English survey closed on April 23, 2021 and received 42 responses. Google Translate assisted in converting the responses of the first survey to English for analysis.

3.1.2 Interview Trail Guides, Trail Managers, and Business Owners

Trail guides are individuals who tourists hire to help them navigate the Sibiu region. They have extensive knowledge about the region's trail networks, and because of the nature of their job, they are intimately familiar with visitor expectations and concerns. On the other hand, trail managers are individuals associated with the NGOs that maintain the trail networks. They include rangers, executives, or maintenance workers. Interviewing trail managers and trail guides

contrasts the perspectives both of those maintaining the trails and of perceived trail user experiences. For this reason, the team interviewed five trail guides and three trail managers (shown in Figure 3.2) with a list of core guiding questions (Appendix C), plus additional questions related to their specific occupation (Appendix D). Semi-structured interviews covered topics including the interviewee's general thoughts about Sibiu as a hiking tourism destination, what a typical day on the trails involves, their thoughts on trail conditions, and discussions about local businesses if the conversations led us there. Additionally, since the team only received 42 responses on the English survey, they decided to interview three lodging businesses owners in Sibiu to gain a better idea of the types of people they serve and how they currently cater to trail users. Using the same core interview guide (Appendix C), the project team developed a set of additional questions to ask the business owners (Appendix E). These questions covered topics such as the demographics of their guests, ways in which the business caters to trail users, and how their business promotes itself to trail users.

The collaborators provided contact information of the trail guides, trail managers, and business owners willing to meet for an interview. Then, the team connected with the participants through email to schedule an interview. Interviews took place using the Zoom video conferencing platform and occurred at a time convenient for the interviewee. At the start of each interview, participants gave verbal consent to record the session and use the responses for this project's research. One trail manager preferred to answer the questions through a translator. The manager received the interview questions via email and one of his bilingual colleagues translated them into Romanian. The colleague then translated the manager's written responses from Romanian to English and sent those responses to the team via email. Table 3.1 provides details for the 11 interviews the team conducted while hiding interviewee names to preserve confidentiality. Because the team told each interviewee that they would not publicize their recordings and transcripts, the team excluded the transcripts from the report.

Table 3.1 Overview of the team's interview schedule

Interviewee	Interviewers	Date Interviewed	Approx. Duration (minutes)
Trail Guide 1	Edward & Meredith	April 1, 2021	60
Trail Manager 1	N/A (written responses)	Received April 5, 2021	N/A
Trail Guide 2	Burnon & Meredith	April 6, 2021	40
Trail Guide 3	Edward & Marissa	April 6, 2021	38
Trail Manager 2	Marissa & Nicole	April 7, 2021	32
Trail Guide 4	Burnon & Nicole	April 8, 2021	34
Trail Guide 5	Edward & Meredith	April 8, 2021	33
Trail Manager 3	Burnon & Marissa	April 21, 2021	33
Business Owner 1	Marissa & Nicole	April 26, 2021	40
Business Owner 2	Burnon & Meredith	April 27, 2021	36
Business Owner 3	Edward & Nicole	April 27, 2021	36

3.1.3 Content Analysis of Online Resources

While the team scheduled interviews and waited for survey results, they conducted a content analysis of online resources. Surveys are useful for gathering large amounts of data within a relatively short amount of time; however, they are most effective when the sample represents the total population. The team noticed the surveys (both English and Romanian) did not reach many foreign tourists. Therefore, there was a bias towards domestic trail users, making the sample unreflective of the total population of Sibiu trail users. They decided to supplement this survey data with a content analysis that provided the perspective of foreign tourists.

During the first week of the project, the team searched the web using search terms such as "Sibiu hiking review" and "Sibiu mountain biking" to identify blogs and videos which contain information about international trail users' experiences using the trails (shown in Table 3.2 and Table 3.3). The team found nine online blogs and reviews that contained information regarding accommodation hospitality, ability to use the trails, and positive or negative experiences with shops and restaurants. Additionally, this search uncovered 13 videos from hikers, mountain bikers, and Enduro (cross country motorcycle) riders, showing footage of the trails including physical aspects such as obstacles, signage, and wildlife presence. Two team members took notes on each source with a focus on interactions with businesses, physical trail features, and any technology used for planning trips or trail guiding. The members coded their notes following the

same procedure as the interview transcripts and then combined similar themes from both sources into a single document for further analysis.

Table 3.2 Blog posts about travel in Sibiu, Romania

Name	Trail User	Link
11 fang-tastic things to do in Sibiu Romania	Culture	https://adventurousmiriam.com/sibiu-romania/
Everything you need to know about hiking in the Carpathian Mountains from Sibiu	Hiker	https://sibiutourguide.com/wp/2020/12/05/hiking-in-the-carpathian-mountains-from-sibiu/
Hiking in Romania	Hiker	https://hikingbeast.com/romania/
Hiking in Romania & Transylvania	Hiker	https://www.romanianfriend.com/blog/hiking-guide-romania-transylvania
Hiking the Cindrel Mountains	Hiker	https://www.trvbox.com/hiking-in-the-cindrel-mountains-in-the-sibiu-district-romania/
Sibiu Travel Guide	Hiker	https://www.nomadicmatt.com/travel-guides/romania-travel-tips/sibiu/
Sunday walk around Paltinis	Hiker	https://thechocolatesoflife.com/2016/01/18/sunday-walk-around-paltinis/
Unfinished Hike	Hiker	https://medium.com/@cezarymorga/unfinished-hike-2f1898221d22
Visit Sibiu, Romania	Culture	https://www.mywanderlust.pl/visit-sibiu-romania/

Table 3.3 Videos about travel in Sibiu, Romania

Name	Trail User	Link
Ride Xpower Dracula Trail	Enduro	https://www.youtube.com/watch?v=0YIh9qs4PR8
Ride Xpower Enduro Touring/Trekking	Enduro	https://www.youtube.com/watch?v=g_YcYUEKT8g
Ride Xpower Trekking 2018 Day 1 & 2	Enduro	https://www.youtube.com/watch?v=g_YcYUEKT8g
Sherco Enduro Tour Day 1	Enduro	https://www.youtube.com/watch?v=GVcqbm7rUWw
Hiking the Romanian Carpathians - The Făgăraș Mountains	Hiking	https://www.youtube.com/watch?v=ajGSpIO2UV0
Hiking through Villages in Transylvania	Hiking	https://www.youtube.com/watch?v=8YLlSetDHP8
Transylvania Trail Camp 2019	Hiking	https://www.youtube.com/watch?v=5lP09BPcQ-0
Arena Platos Flow trail	Mountain Biking	https://www.youtube.com/watch?v=KZiAfA7GPwg
Chica Pietrelor (Rocky Ridge)	Mountain Biking	https://www.youtube.com/watch?v=RzgyB-GCf68
Suru Refuge (Caban Suru)	Mountain Biking	https://www.youtube.com/watch?v=Tr63tB7Bac0

3.1.4 Analyze Information Collected from Interviews, Surveys, and Content Analysis

After executing the surveys, conducting the interviews, and taking notes on online content, the final step involved analysis that merged the data from these method streams. To begin, the team coded the interview transcripts and content analysis notes for common themes, using the same method for both. While reading through the transcripts and notes, the team highlighted important information with the designated color of the corresponding pre-made category. The team decided on the coding categories based on their recollection of general topics from the interviews and content analysis along with topics that they needed information on to achieve the four objectives.

The overarching topics are the main categories, which the team split into relevant subcategories to further organize the information. The team looked for subcategories and highlighted them while reviewing the collected information. As seen in Table 3.4, each main category contains 2-3 subcategories except for tourist experience, which the team just coded for that overall topic.

Table 3.4 Coding categories and the designated highlight color for each

Main Category	Sub Categories		
Businesses	Restaurants	Lodging	Merchants
Trail Problems	Political	Maintenance	Problem Reporting
Trail Attractions	Physical/Landscape	Cultural	-
Trail User Demographics	Country of Origin	Spoken Language	-
Technology	Mobile Apps	Counting Systems	-
Tourist Experience	-	-	-

The surveys provided quantitative data that allowed the team to perform a numerical analysis on the frequency of shared experiences, as well as qualitative data in the form of trail user anecdotes. Each survey question fell into one of the main categories in Table 3.4, allowing the responses to contribute to final analysis and conclusions. Afterwards, the team compiled all the analyzed information from the interviews, content analysis, and surveys into one Excel spreadsheet to draw conclusions on each of the main categories in Sibiu County.

3.2 Identify How Local Businesses Can Address the Needs of Trail Users

The second objective focused on identifying how local businesses can address the needs of trail users. A large issue in Sibiu's ecotourism industry is the lack of communication between the local businesses and trail users. This causes a discrepancy between amenities businesses currently provide and the features trail users hope to find in Sibiu, leading to disappointed visitors and subpar sales (Mihai Dragomir, Personal Communication, February 9, 2021). By identifying the needs of trail users through surveys and interviews, the team was able to provide businesses with trail user information through an infographic, which provides information about trail users and different ways to meet their needs. This will allow them to inform themselves on how to cater more effectively towards hikers and bikers.

3.2.1 Develop and Deliver an Infographic for Businesses

The team used results from the coded information and surveys to create an infographic about trail users and ways to attract them to local businesses. In this case, local businesses refer to places that offer lodging to trail users, since all business owner interviewees worked at lodging companies. The team decided that the infographic should contain information on trail user demographics, the reasons that trail users come to Sibiu, the motivation for promoting trails, and actions businesses can take to improve experience for trail users. After collecting this information, Marissa used a popular graphic design platform, Canva, to construct the infographic displaying the findings. The collaborators suggested the infographic should have a lighthearted tone, balance of text and pictures, and an explanation of why attracting trail users is beneficial. Following these guidelines made the infographic more visually appealing while still containing important information.

The team delivered the finished infographic in English to the collaborators, who then translated it to Romanian to make it accessible in both languages. The collaborators distributed the infographic to local lodging businesses via email. In addition, they plan to print and distribute a PDF of the infographic so businesses can display it in their offices for more frequent viewing.

3.3 Develop a Reporting System for Trail Users

The third objective was to develop a reporting system that would allow trail users to inform trail managers of any addressing issues. Example issues include inadequate or damaged signage, incidents with shepherd dogs, or weather-related trail damage.

The SEM system discussed in section 2.4.1 inspired this form. The SEM system allowed the NPS to gather large scale data on park management and visitors in order to address internal issues impacting visitor experience. The Sibiu County trails can implement similar methods to follow their success.

3.3.1 Designing an Online Reporting Form

Citing several example forms used for trails in other countries, the collaborators named certain "must-have" features but otherwise left the form's design to the team. The collaborators specified two mandatory features for the reporting form: a photo submission and location/GPS coordinate tagging. To supplement these features, the team examined other reporting forms to investigate more useful functions. They also referenced interviews and survey results (English survey Q11-Q12) to determine the issues most commonly encountered along the trails.

The collaborators' original request was to host the new form on their website; however, since web design falls outside the scope of the project, the team instead decided to deliver technical requirements for a reporting form. The final technical requirements include a list of features, their functionality, and an example wireframe as a visual aid. As the Mioritics Association plans to hire professional developers to redo their website in the near future, the professionals could use these requirements to guide their work. However, the collaborators still need a functional reporting form for the upcoming summer season. As a result, the team created a Google Form that will provide feedback until the professionals integrate the custom form.

3.3.2 Researching European Hiking Apps

The plan to design a reporting system detailed in section 3.3.1 will result in a product that allows trail managers to address small incidents and problems as they appear. However, this system does not return any broader feedback that is valuable to improve overall visitor experiences. In the future, the collaborators want to promote the Sibiu County trails through one

or more popular hiking apps, in order to spread awareness and knowledge of their existence and obtain visitor reviews. Hiking apps such as AllTrails and ViewRanger provide general information about trails for the user to plan their trip, but also permit trail users to leave ratings, reviews, and pictures for other potential visitors to see. Partnering with one of these apps to expand their trail database to include Sibiu County will give trail managers and future tourists access to visitor reviews. Because of the significant impacts of hiking apps on the trail user experience, the team researched popular European hiking apps and compiled a list of apps, along with a short summary about each app. The collaborators received the list to explore potential partnerships between the app company and the Sibiu trails.

3.4 Propose a System to Track the Quantity and Movement of Trail Users

The fourth objective was to provide a list of recommended counting systems that can track the number of people that use the Sibiu trails each day. The Sibiu County Tourism Association and Mioritics Association expressed interest in implementing a counting system in order to determine whether or not to limit the number of people on certain trails and to decide specific trails to promote more.

3.4.1 Research and Recommend Other Counting Practices

To determine the counting systems best suited for Sibiu's trails, the team researched other types of counting technology beyond the two discussed in section 2.4.1. This included researching systems that would work in the Sibiu region, since the trails vary in terrain ranging from plains to mountains and have no electricity connection. The team compared characteristics of five different systems, such as the method of operation, expected lifetime, ability to detect the counted object, range, accuracy, physical dimensions, power supply, and cost. The information sent to the collaborators, visible in Appendix J, includes contact information for the companies that make each system.

3.5 Gantt Chart

Figure 3.2 depicts a Gantt chart detailing the tasks the team completed during D-term. In the task completion timeline, shown to the right of the task list, green highlights indicate the tasks worked on and completed each week. Each green cell contains a checkbox which allowed the team to record their progress and ensure they stayed on track throughout the term. As the

team completed each task, they recorded and analyzed data and results to gain knowledge and work towards completing each objective. The next chapter provides in depth results of the methods.

Category	Task	Week 1 3/24-3/31	Week 2 4/1-4/7	Week 3 4/8-4/14	Week 4 4/15-4/21	Week 5 4/22-4/28	Week 6 4/29-5/5	Week 7 5/6-5/13
Profile	Send out surveys to trail users	✓						
Profile	Contact trail managers	✓						
Profile	Contact trail tour guides	✓						
Profile	Contact business owners			✓				
Profile	Observe trail user vlogs and blog posts	✓	✓					
Profile	Interview trail managers		✓	✓				
Profile	Interview trail tour guides		✓	✓				
Profile	Interview business owners				✓	✓		
Profile	Analyze interview/survey/observational study content		✓	✓	✓	✓		
Outreach	Decide delivery method of trail user profile to businesses					✓		
Outreach	Create the trail user profile to deliver to businesses					✓	✓	✓
App	Compile list of popular European hiking apps	✓	✓					
App	Decide which hiking app is most viable for the collaborators		✓					
App	Research on the decided hiking app			✓	✓	✓		
App	Create a report analyzing the decided hiking apps					✓	✓	
Counting	Research the different visitor counting methods	✓	✓	✓				
Counting	Decide which counting method is most viable for the trails			✓				
Counting	Research on the decided counting method				✓	✓	✓	
Counting	Create a report analyzing the decided counting methods					✓	✓	
Feedback	Develop a guide to build a trail feedback form to report damage			✓	✓	✓	✓	
Feedback	Develop a tempoary trail feedback form to report damage					✓	✓	
Project	Prepare and showcase final presenation						✓	✓
Project	Adjust and add to written report	✓	✓	✓	✓	✓	✓	✓

Figure 3.2: Gantt Chart describing the anticipated timeline for each task

4.0 Results and Analysis

After implementing the proposed methods, the team discovered three sets of factors that may influence the trail user experience. First, the team obtained more demographic knowledge about the trail users and their reasons for coming to Sibiu County. Second, the team identified how local businesses can take part in enhancing tourist experience. This includes highlighting current successful practices and indicating where customers felt the businesses fell short. Third, the team selected technological solutions to present to the collaborators. This consists of a short-term and long-term reporting form, popular hiking apps, and outdoor people counting systems. This chapter presents the findings from each method in greater detail.

4.1 Trail Users

To accomplish the first objective, to understand the trail user experience, the team needed to learn who the trail users are and identify the attractions that draw them to Sibiu County. Using two surveys, the team collected information from 138 respondents. The surveys included questions on demographics, experiences on the trails and with local businesses in Sibiu, and desired mobile applications and features. Interviews with trail guides, trail managers, and local lodging businesses also provided data about types of trail users. The next section presents project findings about typical trail users and current local attractions.

4.1.1 Trail User Demographics

Figure 4.1 showing combined data from both surveys suggests most trail users in Sibiu County originate from Romania (94%) and are between the ages 22 and 64 years old. However, the country-of-origin statistic may not accurately represent the whole picture as the remote nature of the project means the survey respondents did not come from a random sample. At the time of writing, COVID-19 has halted travel, which may skew the data from tourism seasons when COVID-19 was not present. The team gained additional data from their interviews about the places that trail users tend to come from. Eight out of eleven interviewees (73%) mentioned that foreigners make up at least 50% of trail users. Seven interviewees also indicated that Europeans make up the majority of international trail users, particularly Germany, Austria, and Switzerland. These demographic findings suggest that physically active Romanians and Europeans are the most common type of tourists to visit the Sibiu trails. This information may be

helpful to trail managers and local business owners because knowing the types of people that use the trails can help them cater their trail experience more towards the right group of people.

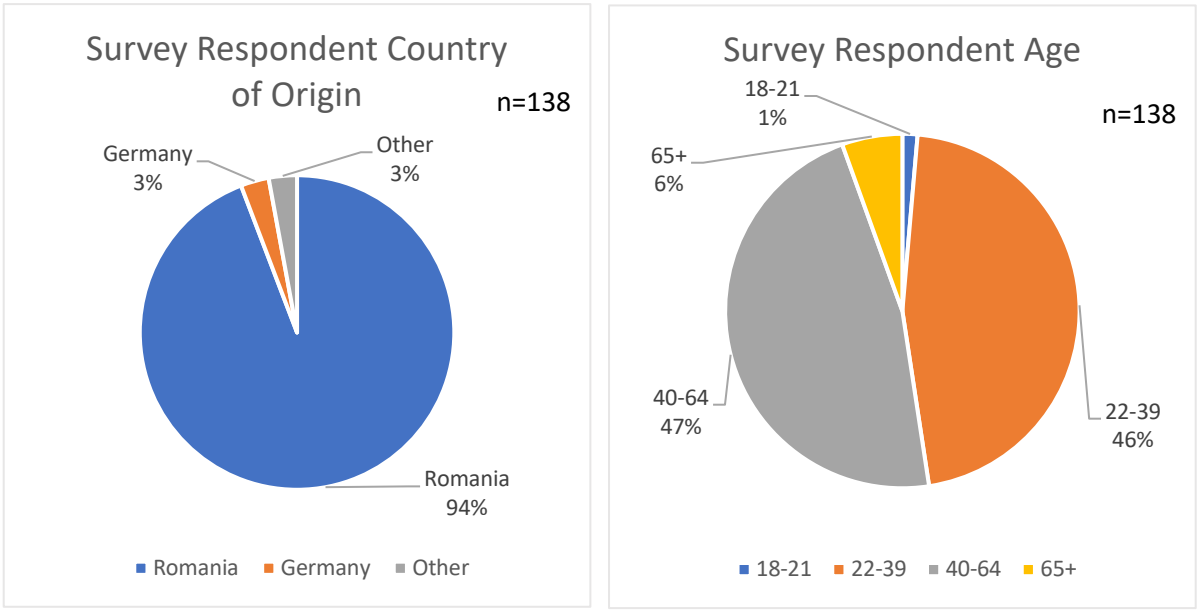


Figure 4.1 Trail user country of origin (left) and age (right)

Twelve percent of trail users from the English survey experience some type of language barrier. Additionally, one trail user from the content analysis mentioned they were lost for hours after misreading a sign while they were on the trails. It is important to try to eliminate all language barriers for trail users to make the trails more accessible. Of course, trail managers and local businesses need to know which languages trail users do speak so they can cater more to them.

All survey respondents spoke either Romanian or English. Table 4.1 shows the percent of respondents from the English survey fluent in each respective language. When analyzing by nationality, all Romanians spoke Romanian, and all foreigners spoke English. This is likely because survey was in English. However, interviews indicated a majority of foreign tourists come from Europe, where English is widely spoken. Therefore, it appears English is still a common language spoken among trail users. Additionally, while only 32% of survey respondents indicated they spoke German, interviews suggested this number is much higher. As mentioned previously, German speaking countries account for a large portion of foreign tourists. One trail guide provided a reasoning for this German population by saying, “In Romania there are also German tourists coming because, especially in Transylvania, you have some German heritage and plus Germany is the biggest EU European country, and they also tend to travel more than the

other Europeans." Knowing that most foreign tourists come from Europe (and specifically Germany), it appears that most foreign tourists can speak English or German, if not both. Therefore, trail signage that displays Romanian, English, and German should accommodate most trail users. Alternatively, trail managers could use recognizable icons on their signs rather than words to overcome any possible language barrier. Local lodging businesses that cater to trail users would also benefit by offering their information in these three languages.

Table 4.1 Language fluency of respondents from the English survey

Language	**Fluency (percent)** n=38
Romanian or English	100%
Romanian	90%
English	82%
German	32%
French	16%
Spanish	16%
Polish	8%
Other	11%

4.1.2 Trail Attractions

Hiking and biking are the main reasons why trail users visit Sibiu; however, the county has several other popular attractions. Figure 4.2 shows responses to the question "Why did you come to Sibiu?" from both the Romanian and English survey. Over half (53%) of the respondents cited hiking and biking as a reason why they came, and 18% cited cultural attractions. Interviews with trail guides and managers further strengthened these findings, with participants indicating that individuals come to hike trails like the Via Transylvanica and to explore fortified churches and villages surrounding Sibiu.

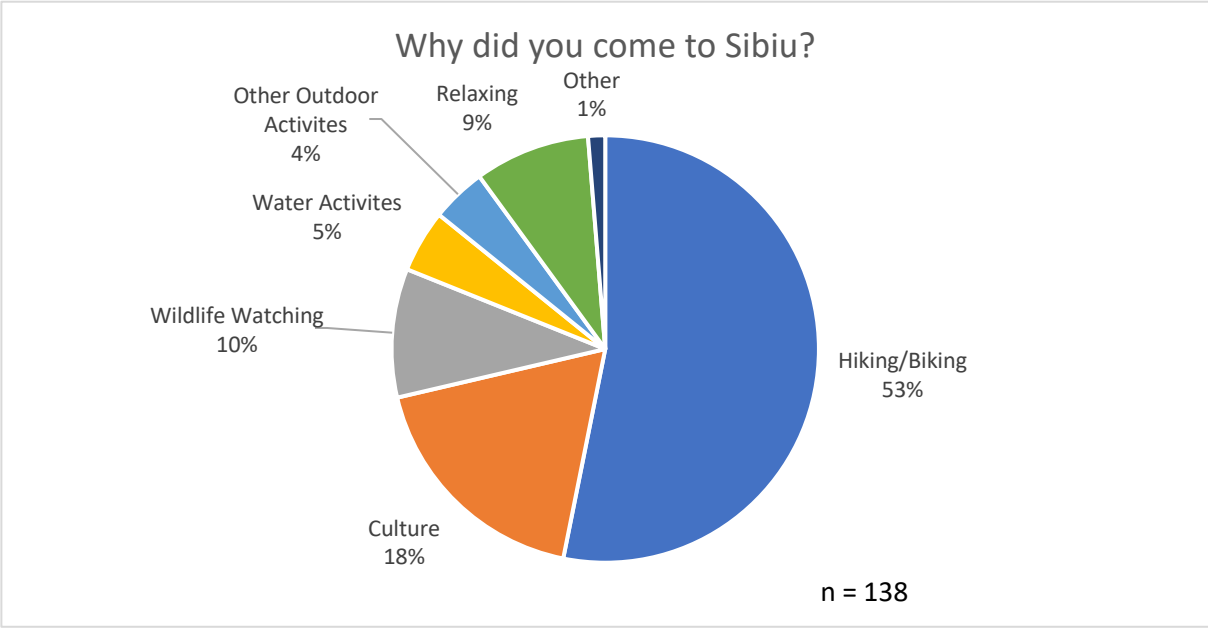


Figure 4.2 Reasons trail users come to the Sibiu region

Understanding the reasons people visit Sibiu is important because, while it makes sense that trail users come to Sibiu to hike and bike, the team did not expect almost a fifth of respondents to indicate they also come for the culture. Lodging businesses can use this information to cater to trail users so that they can focus on promoting these attractions along with hiking and biking.

4.2 Interactions Between Trail Users and Local Businesses

An important aspect of the trail user experience is the way in which trail users interact with local businesses, and particularly with local lodging. The team gathered data about these interactions through their English survey, interviews with lodging business owners, and the content analysis. This data was valuable in helping the team achieve Objectives 1 and 2: understand the trail user experience and identify how local businesses can address the needs of trail users. Using the data collected from the described methods, this section discusses where businesses have succeeded in catering to trail users and identifies areas for improvement.

4.2.1 Qualities of Successful Businesses

Most of the collected data centers around businesses that are already successful at catering to trail users. The most critical business type for trail users is lodging: many tourists visiting Sibiu come for multiple days and need a place to stay. In fact, all of the trail guides and

one-third of the trail managers talked about tourists that spend multiple days exploring the trails. The content analysis further attested to these findings by revealing the mountain chalets and guest houses are the most popular types of lodging. Of the nine blogs that talked about places to stay, six (67%) mentioned chalets and three (33%) mentioned guest houses.

Trail users indicated that lodging was easy to find and provided all of the amenities they needed and expected. Figure 4.3 graphs the responses to the survey question, "How easily could you find lodging?" based on the count of each response choice. Notice that no survey respondents expressed difficulty in finding lodging in the Sibiu region. Additionally, when the survey asked trail users if their lodging had all the amenities they needed and expected, not a single respondent answered "No."

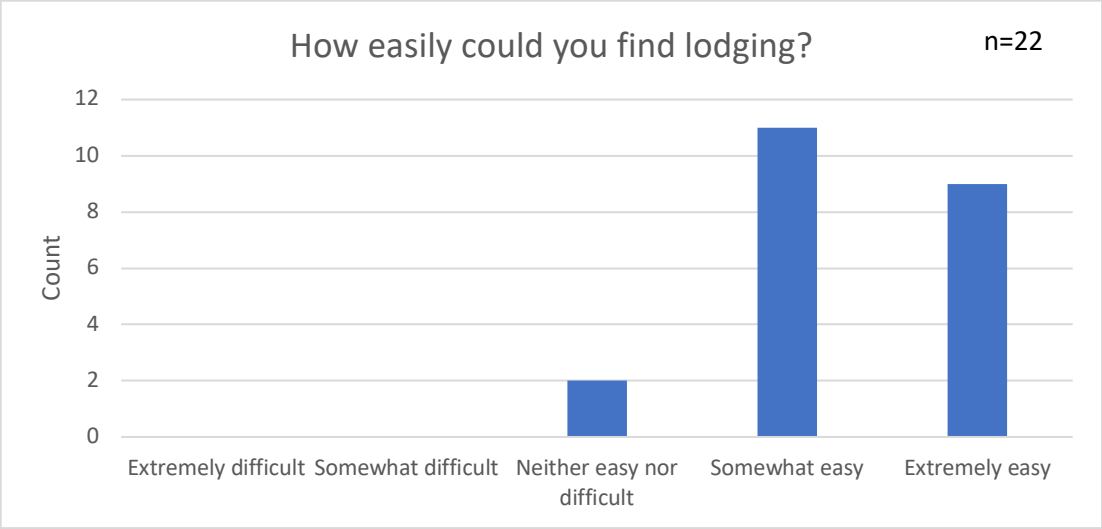


Figure 4.3 Opinions of survey respondents on the difficulty of finding lodging

To gain a better perspective of the exact strategies that businesses employ to cater to trail users, the team interviewed business owners of three successful businesses. Each business owner runs a different type of lodging: one guest house, one mountain chalet, and one resort. All three businesses encouraged visitors to use the nearby trails. The owner of the guest house rents bikes for visitors to take on nearby trails and offers bike repair services should a biker get a flat tire. The mountain chalet owner provides trail maps and can repair hiking boots and gear. Lastly, the resort owner advertises and encourages their guests to go out and explore the beautiful surrounding area rather than staying inside the hotel all day. They stated, "you are not just a hotel to come to sleep and then go away; it's more than that, it's an experience." Overall, our research

indicates that the best businesses for Sibiu trail users are the ones that encourage and enable their guests to use the trails.

4.2.2 Reviews of Sibiu Businesses

While many of the trail users' comments regarding businesses were positive, several responses were critical of certain aspects of the local businesses. Figure 4.4 graphs the ratings that survey respondents had to the prices of businesses in Sibiu. Although between 40% and 55% of respondents had no strong opinion on whether prices were cheap or expensive, approximately 40% of respondents did rate prices as somewhat expensive. After further investigating through content analysis and interviews; however, the team discovered that price varied considerably depending on the product/service and the location within Sibiu. For example, the three lodging owners set varying prices because they provide different services. The guest house and resort are much more expensive than the mountain chalet. Additionally, one source in the content analysis indicated the available food options in Sibiu depend on a tourist's comfort zone for price range.

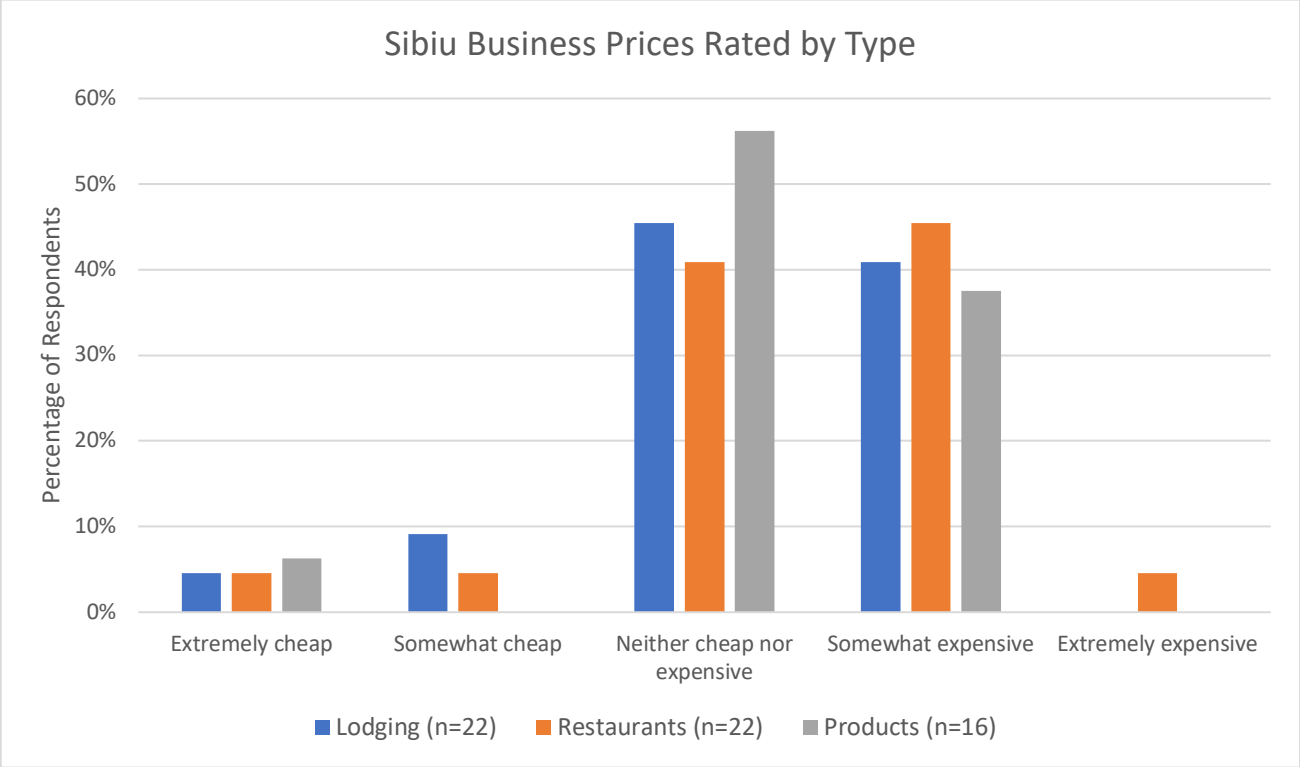


Figure 4.4 Sibiu business prices rated by type

Another aspect of businesses that the owners indicated needed improvement was advertising. Two of the three business owners the team interviewed mentioned issues

experienced advertising their business. The owner of the mountain chalet indicated that they do most of the advertising for the chalet via word of mouth from previous customers. While they do have a website, they would like to expand the methods they use to advertise. In contrast, the owner of the guest house indicated that the surrounding areas sometimes become overcrowded with the "wrong type of guests," or those who do not appreciate the surrounding village. He would rather attract people that come for the nature and culture.

These findings suggest that trail users have some level of concern over business prices and lodging businesses have concerns about advertising and how to target marketing to attract certain kinds of people.

4.3 Implementing Technology on the Trails

Beyond the physical nature of the trails and tourists' interactions with local businesses, technological solutions have unrealized potential to enhance the Sibiu trail user experience. Objective 3 of this project focuses on researching how to integrate a problem reporting form and which mobile applications hikers use to plan their trips. Objective 4 involves researching which people counting systems the collaborators can use on the trails. The following section presents the teams' research findings for each type of technology.

4.3.1 Problem Reporting Forms

The team developed the core of the problem reporting form by analyzing four existing reporting forms from four other parks first mentioned in background section 2.5.2. Table 4.2 details the features that each form contained (sorted by count) and the features the team chose for their suggested form.

Table 4.2 Features observed on each problem reporting form and corresponding links (linked in first row)

Feature	**Suricate**	**Tahoe Pyramid**	**Island Trails**	**KTA**	**Suggested Form**
Reporter name	X	X	X	X	X
Reporter email	X	X	X	X	X
Trail name		X	X	X	
File upload	X	X	X		X
Select type of problem	X	X		X	X
Describe problem	X	X	X		X
Describe location		X	X		X
Date				X	X
GPS button			X		X
Consent to contact			X		
Related activity	X				
Problem severity	X				

Based on these findings, the team decided all but four features were useful for the recommended form, prototyped in Figure 4.5. The first of these cut features, the trail name, is not a helpful identifier in the Sibiu trail network where most trails are several miles long and certain sections may not even have a name. GPS coordinates are a far more useful identifier. Second, explicit consent to contact is not necessary, as a reporting party effectively consents by submitting their contact information. Next, a standalone feature identifying what activity the problem relates to is not necessary. If a particular activity (e.g., biking) is relevant to the report, the reporter can mention that in the problem description. If no activity is relevant to the problem, this feature is pointless. Lastly, the form should not ask for a problem's severity, as submitters may not be able to accurately gauge a problem's severity. Trail managers should be the ones to assess a problem's priority, and they can do so using submitted descriptions and photographs.

Finally, the team used surveys and interviews to identify the most common trail issues, which became preset options for the "problem selection" feature of the form. The English survey (seen in Figure 4.6) noted seven common trail issues. The team then finalized the options by cross-referencing the survey results with interviews (which consistently mentioned sheepdogs, signage, and litter) and with existing reporting forms (which consistently mentioned erosion and overgrowth). The final options cover the most common problems, and if a problem

is not listed, the reporter can also select “other.” Reporters always have the choice of describing the problem further, but if they select “other,” a description becomes required.

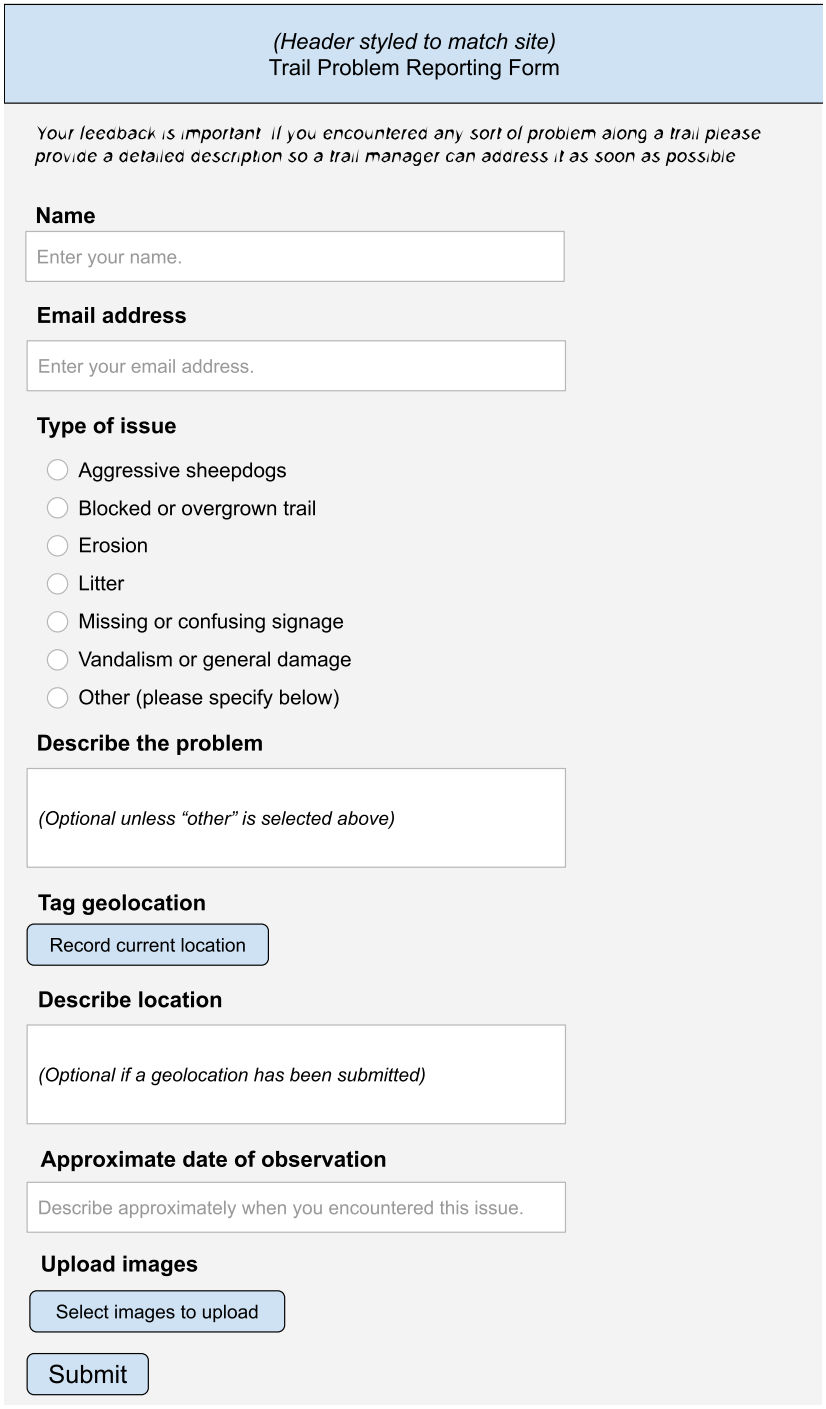


Figure 4.5 Prototype layout of the Sibiu problem reporting form

Figure 4.6: Count of commonly encountered problems

4.3.2 Popular Hiking Apps

Before obtaining and analyzing the survey results, the team performed preliminary research to uncover hiking/biking applications and websites that might be potential partners for promoting the Sibiu County Trail network. These apps already have trail coverage in Europe, and some have even expanded into Romania. Popular apps like ViewRanger/OutdoorActive and AllTrails showed the most potential after preliminary research.

Both the Romanian (Appendix G) and English (Appendix H) surveys asked respondents about their use of mobile devices and applications on a trip along the trails. On average, 96% of respondents at least sometimes carry a mobile device on a trip and 86% at least sometimes use a mobile application before or during their trip. These statistics show that trail users are already utilizing technology on their outings, so an application containing information about the trails in Sibiu has potential for widespread use. The surveys also asked about the most desirable features for a hiking app. Both surveys showed similar results, with downloadable maps for offline use as the most popular choice, followed by general trail information (length, elevation gain, difficulty, etc.) and information on trail facilities (visitor centers, campsites, etc.). This was valuable information for the team as it helped create the criteria used to determine the final app recommendation. Surprisingly, one of the features that was least important for trail users was a way to report problems.

The surveys also specifically asked trail users what apps they currently use. The results, shown below in Figures 4.7 and 4.8, uncovered 17 new apps in addition to the ones from the team's preliminary research with Muntii Nostri, a Romanian app, proving to be the most popular. This is likely because it is currently the only application to contain information about all of the major trails in Romania. Despite its popularity, however, Muntii Nostri does not have the route planning capabilities that the project collaborators desire. Additionally, the app is only available in Romanian, making it difficult for foreign guests to use. For these reasons, Muntii Nostri was not considered as a final option. The other prominent hiking apps that appeared in the results were AllTrails, ViewRanger/OutdoorActive, Komoot, and Wikiloc.

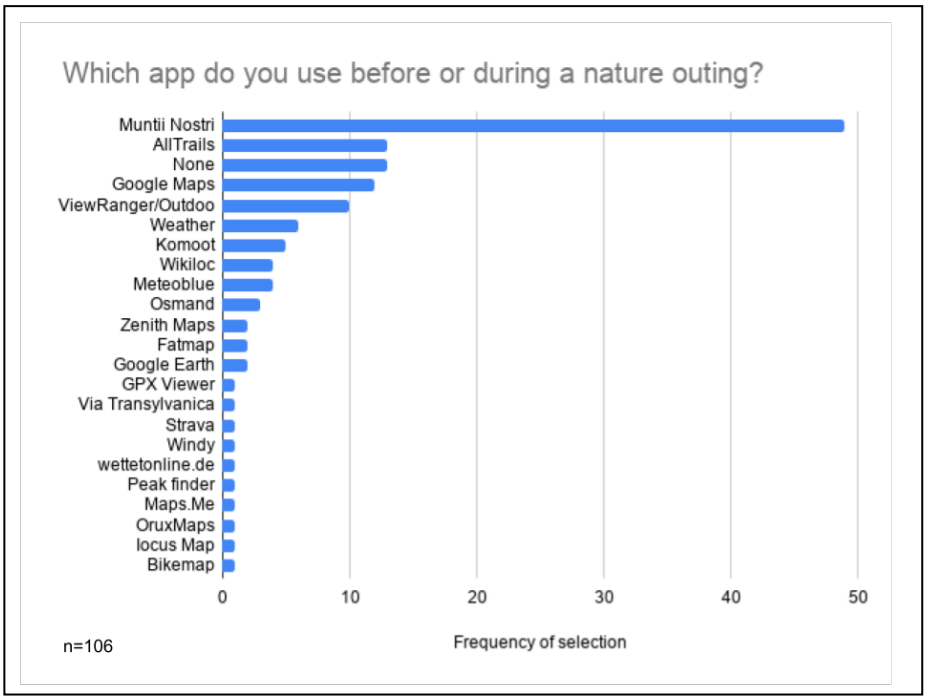


Figure 4.7 Romanian survey results – mobile apps used

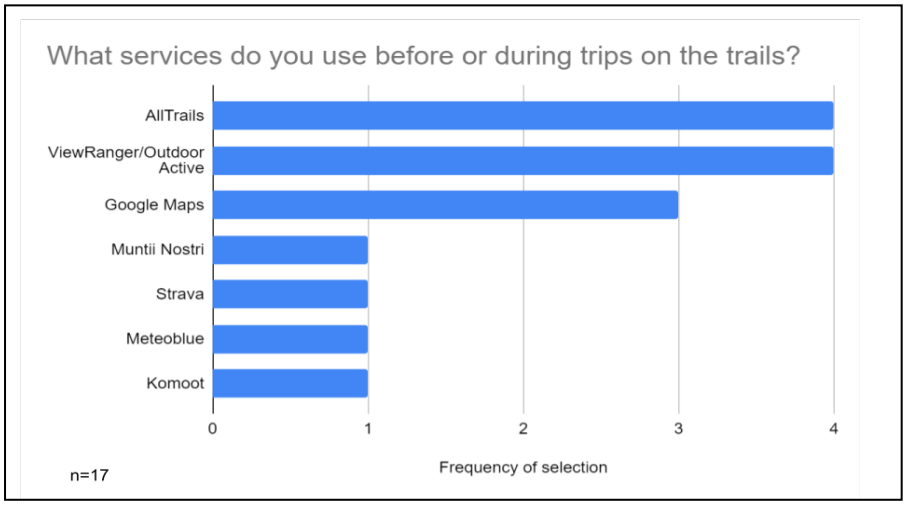


Figure 4.8 English survey results – mobile apps used

Through additional research, the team found that Wikiloc already has a feature available for organizations to upload new trails and create their own trail list in order to be promoted to the app's community. This feature is called WikiOrg and trail organizations can purchase it with a yearly payment of 120 euros. This feature would make working with Wikiloc very easy for the collaborators, since they would not have to contact any of the app developers to expand the trail database. Additionally, if an organization uses WikiOrg, their followers can download any of their trail maps for offline use, free of charge. Survey respondents indicated offline maps as the app feature they find most useful, so this feature has potential to be a key factor in promoting the use of this app to the trail users.

After the team researched these four apps to compare for the final recommendation, they compiled the information (see Appendix I for all details) to discuss with the collaborators. The team then created a final ranking of the researched apps to recommend to the collaborators which can also be found in Appendix I as indicated by the order in which the apps are listed. The report ranks Wikiloc first because of the WikiOrg feature that could make it easier for the collaborators to upload their own trail maps for trail users. Since AllTrails, ViewRanger/OutdoorActive, and Komoot all have very similar features, the team ranked them second, third, and fourth respectively because this was the order of their popularity among survey respondents.

4.3.3 Assessment of Potential Counting Systems

By using technology to count trails users, trail managers can more accurately identify the most popular routes, predict trends in trail usage, and develop maintenance schedules. Initially,

the team researched a broad scope of counting technologies designed for outdoor environments (Appendix J) and presented their findings to the collaborators. The collaborators indicated that they prefer a temporary system that they can move between trails and that they would rather purchase the system from a European company to make installation and support easy. One example of a temporary solution are the active infrared beams used in Naturtejo National Park, described in the background in section 2.4.1. On the other hand, this criterion eliminates the acoustic slab sensors used in the Swiss National Park, since those are a permanent solution. The team narrowed their scope to the types of counting technology that adhere to the collaborators' requirements (Appendix K).

First, the team considered temporary outdoor counting systems. Through their findings, the team evaluated active infrared technology (Figure 4.9), passive infrared technology (Figure 4.10), and radar sensor technology (Figure 4.11). Table 4.3 provides a comparison of how each technology works, its applications, and its strengths and weaknesses.

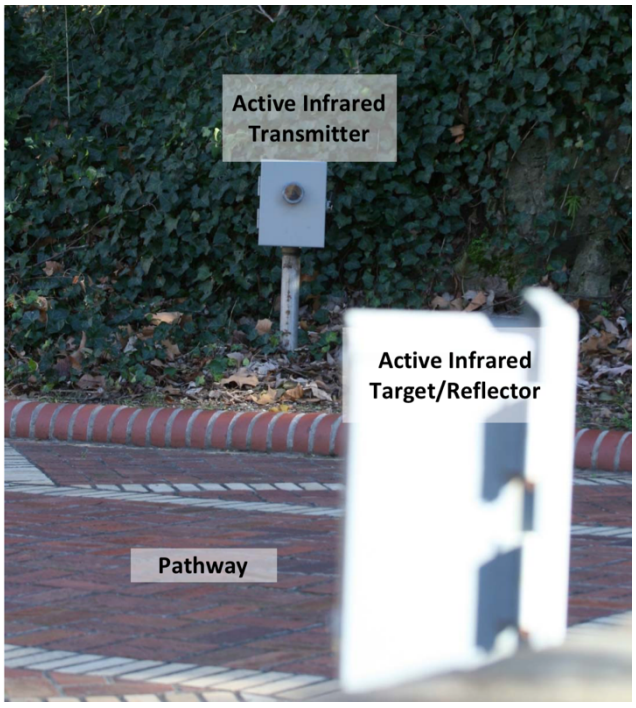


Figure 4.9 Typical configuration of active infrared beams (Texas A&M Transportation Institute, 2013)

Figure 4.10 Typical configurations of passive infrared beams
(Eco-Counter, n.d.)

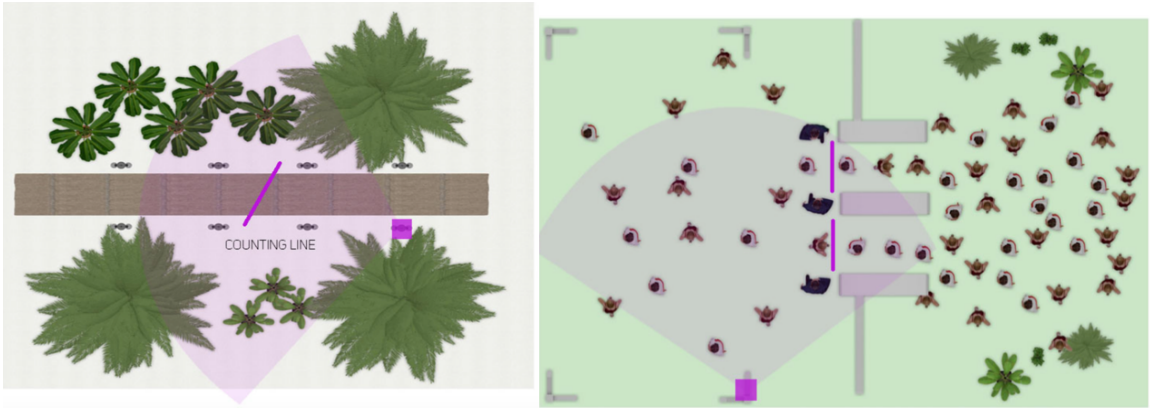


Figure 4.11 Drawings of the radar sensor position and range in a natural environment
(SensMax, 2018)

Each type of technology can serve as a short-term application and is capable of counting both hikers and bikers. The strengths of both active and passive infrared beams are very similar: each system is portable, and the owner can easily hide it in the environment. Likewise, the weaknesses for these two systems are almost the same. In each case, beams cannot distinguish between hikers and bikers unless combined with another technology and are less accurate for pedestrians traveling in lanes or groups. Passive infrared beams also risk becoming less accurate when outdoor temperature nears human body temperature, as this is how the system counts pedestrians (Texas A&M Transportation Institute, 2013).

The strengths of a radar sensor are that it is portable, more accurate than infrared beams, and can track the amount of time that a pedestrian spends in the specified zone. Weaknesses

include that the sensor has a less camouflaged appearance, it requires a connection to a power source and an Internet router or hotspot, and it is less accurate if the user defined zones become crowded (SensMax, 2018).

Table 4.3 Characteristics of Active Infrared Beams, Passive Infrared Beams, and Radar Sensors

Technology	**How It Works**	**Applications**	**Strengths**	**Weaknesses**
Infrared Beams: Active	Transmitting and receiving devices set up across from each other; a count is registered when the infrared beam across them breaks	Short term or permanent; counts hikers and bikers combined; install in narrow trail passages	Relatively portable; low profile, unobtrusive appearance	Cannot distinguish hikers and bikers unless combined with a bike counter; difficult to use for lanes; may have a higher error for groups
Infrared Beams: Passive	Transmitting device only; registers a count by detecting changes in temperature (usually uses body temperature)	Short term or permanent; counts hikers and bikers combined; install in narrow trail passages	Very portable with easy setup; low profile, unobtrusive appearance	Cannot distinguish hikers and bikers unless combined with a bike counter; difficult to use for lanes; may have a higher error for groups or if the temperature reaches close to body temperature; direct sunlight may cause false counts
Radar Sensors	Millimeter wave (mmWave) technology counts and classifies pedestrians based on changes of wavelength	Short term; counts hikers and bikers separately; mount on a sidewall or pillar	Very portable; most accurate; tracks duration of time spent in the zone; supports live data analysis	Less camouflaged appearance; must be connected to the internet and a power bank; less accurate with dense crowds of people

With these three types of counting technology in mind, the team considered the collaborators' second requirement and selected the companies Eco-Counter and SensMax since both companies are based in Europe. Table 4.4 outlines a comparison of five counting devices offered from either company. All of the devices listed can withstand different kinds of weather and terrain on the Sibiu County trails. Almost all devices require a cellular connection to transmit the count data, but the team's survey results indicated that 88% of respondents (n=25) had Internet access while on the trails, so a cellular connection is not likely to be an issue.

Table 4.4 Comparison of Trail Counting System Devices

Company and Product Name	Technology	Tracks Direction	Range	Accuracy	Report Cycles	Size	Power and Maintenance	Cost	URL
Eco-Counter; PYRO Sensor	Passive Infrared	Yes	Up to 15m	Not available	Every 15 min or 1 hour	1.8 x 4.0 x 9.0 cm	LS batteries; change every 10 years	Quote Request	https://www.eco-counter.com/produits/pyro-range/pyro-sensor/
Eco-Counter; PYRO Box Evo-Nature	Passive Infrared	Yes	Up to 10m	95%	Every 6 hours	2.6 x 12.6 x 5.35 cm	LS batteries; change every 2 years	Quote Request	https://www.eco-counter.com/produits/pyro-evo-range-en/pyro-boxevo-nature-2/
SensMax; SE Unidirectional Sensor	Active Infrared	No	Up to 9m	95% within 2m, >2m -1% per m	Hour, day, week, month, or year	6.7 x 6.7 x 2.5 cm	AA batteries; change every 2 years	241 EUR	https://sensmax.eu/devices/outdoor-people-counting-wireless-sensor-sensmax-se/
SensMax; DE Bidirectional Sensor	Active Infrared	Yes	Up to 9m	95% within 2m, >2m -1% per m	Hour, day, week, month, or year	6.7 x 6.7 x 2.5 cm	AA batteries; change every 1 year	255 EUR	https://sensmax.eu/devices/outdoor-wireless-people-counting-bidirectional-sensor-sensmax-de/
SensMax; TAC-B Real Time Bidirectional Sensor	Radar Sensor	Yes	Up to 14m	99% per person per m^2; 93% for crowded areas	Shares live and stores data as collected	8.0 x 8.0 x 3.5 cm	Internet and power source connection	590 EUR	https://sensmax.eu/solutions/outdoor-people-counting-in-parks/

Eco-Counter (https://www.eco-counter.com/), based in Lannion, France with subsidiaries in Montreal, Canada, and Köln, Germany, offers two passive infrared counting systems: the PYRO Sensor and PYRO Box Evo-Nature. Eco-Counter includes a subscription to Eco-Visio, their data analysis platform, with every counter. Through Eco-Visio, the owner of the counting device can manage counting sites and data, analyze data, share data between multiple users, and export graphics for external information. The owner does not need to have prior data analysis skills since there are tutorial videos.

SensMax (https://sensmax.eu/) customers can purchase their counters through two distributors in Romania: 4Retail Romania (http://www.4retail.ro/) and GO DIGITAL LTD (http://www.go-digital.ro/). SensMax makes two active infrared counters, the SE Unidirectional Sensor and the DE Bidirectional Sensor, and one radar sensor, the TAC-B Real Time Bidirectional Sensor. To make the SE and DE sensors compatible with data analysis, SensMax offers the SE/DE Data Collector that can read and transmit count data. To download and analyze statistics, the owner must preinstall the SensMax EasyReport software on their PC and connect it

to the Data Collector. On the other hand, the TAC-B Sensor requires an Internet connection on site so the user can view the count data live (or later) on a cloud platform. In natural environments, the TAC-B sensor can use mobile phone hotspots and temporary power banks to meet this requirement.

4.4 Summary of Findings

The team's results are not only important for the collaborating organizations, but also the hiking industry in general and the Romanian economy. As discussed in the introduction chapter, hiking is the most popular outdoor activity in Romania, but it is only successful when information, facilities, and well-maintained trails are available to tourists. In Sibiu, the team identified specific ways businesses can cater to trail users, such as advertising their business as part of the natural cultural experience. Furthermore, the team explored different technology to implement to improve the trail users' trip to the Sibiu trails. Possibilities include designing a reporting form, encouraging more use of hiking applications, and suggesting a counting system for the trails. Having systems to efficiently resolve trail problems and centralize trail information will encourage more trail usage and likely result in more spending at local businesses, ultimately benefiting the economy. With this new information, the team developed guidelines for local businesses to better understand who their customers are and suggested certain actions for the collaborators to take to integrate new technology.

5.0 Conclusion and Recommendations

This chapter discusses final reflections the team has about the project and provides an overview of the report as a whole. It contains a set of final recommendations for the collaborators, as well as suggestions for future projects at the Bucharest Project Center. Additionally, this chapter names limitations the team realizes may have impacted their research.

5.1 Conclusion

The primary results relate to trail users, local businesses with whom trail users interact, and the technology necessary to enhance the trail users' experience. Survey results indicated that most trail users come from Europe, with the majority originating from Romania and Germany, and that the most frequently spoken languages are English, Romanian, and German. Additionally, results showed that people visit Sibiu due to its unique characteristics such as distinct nature, landscape, culture, and history. Interactions between businesses and trail users are overall very positive, especially for businesses that focus on providing opportunities for their guests to enjoy the trails. These opportunities both help promote the trails as well as improve the visitor experience. Lastly, the team evaluated the best types of reporting forms, hiking apps, and counting systems that the SCTA and Mioritics Association can utilize. Although it is difficult to measure technology's impact on someone's experience, the team's findings show that it can certainly help influence it. If trail managers and users implement technology, the opportunity to maintain the trails more efficiently and to streamline planning a hike is promising.

5.2 Recommendations

Based on the findings, the team developed a set of recommendations for the project collaborators to promote trails and enhance the trail user experience. These recommendations come from analyzing trail user demographics, successful business practices, and technology use along trail networks. They provide a path forward towards promoting and enhancing trail experience.

5.2.1 Inform lodging businesses of strategies for attracting trail users

Based on interviews with lodging businesses, the team noticed that these businesses encouraged visitors to use the trails and succeeded at retaining repeat consumers. The team recommends that other lodging businesses that do not already do this start implementing this

practice. This includes advertising Sibiu alongside their business as a beautiful location to explore the trails and experience the authentic culture and heritage. As described in section 3.2.1, the team developed an infographic describing trail users as a method of displaying everything a lodging business should know about promoting the Sibiu trails and how to enhance a trail user's experience. This infographic is displayed below in Figure 5.1 in both English and Romanian and is split up into sections explaining key trail user demographics, why Sibiu is attractive to trail users, ways to promote the trails, and how to improve their experience.

One of the most important pieces of information on the infographic is the second box explaining why trail users enjoy Sibiu. It emphasizes that Sibiu is a beautiful destination and that its spectacular landscapes and rich cultural heritage make it a unique location for trail users. To better accommodate trail users, the team suggests that businesses provide maps, first aid and boot repair services, bike rentals, a warning of possible issues encountered on the trails (such as encounters with shepherd dogs), and advice on how to stay safe. The team recommends the collaborators distribute this infographic to lodging businesses in Sibiu so that they can follow the presented recommendations and attract more trail users to Sibiu.

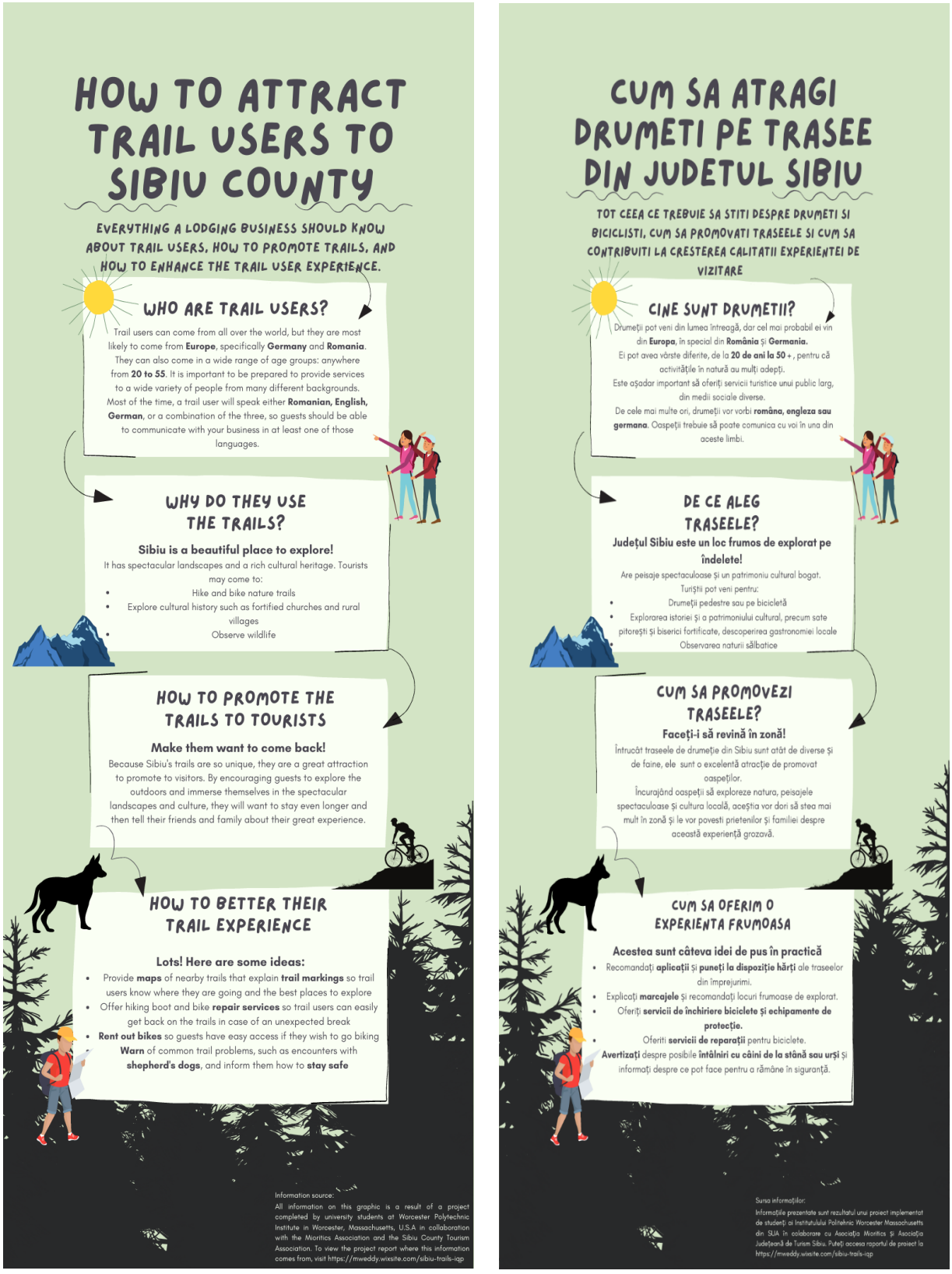


Figure 5.1 Infographic for lodging businesses in English (left) and Romanian (right)

5.2.2 Develop a centralized reporting form for trail issues

Multiple trail guides and trail managers discussed the logistical challenges with reporting a problem on the trails. Using a reporting form that serves as input to a centralized system can organize and systemize the problem reporting process. This decreases the response time from trail managers, which in turn improves the trail user experience. To help achieve this, the team developed a set of guidelines for the construction of a reporting form.

Similar to the prototype layout of a reporting form (see Figure 4.5 in section 4.3.1), the reporting form should ask for the reporter's name and email address followed by a set of questions regarding the problem. The reporter may select common problems, such as encounters with shepherd dogs, a blocked trail, or confusing signage, or they can describe a problem not listed. The finished form should allow users to attach their current GPS location, and give them the option to manually describe their location if they cannot or choose not to attach GPS coordinates. Ideally, the form should record the date and time of a submission automatically. However, it should still have a field for the trail user to express when they experienced the problem in case they are reporting a long time after the issue occurred. Finally, the reporter will have the option to upload images of the trail problem. This will help trail managers preview the problem and plan for any necessary future actions. Including these key features will make the future reporting form user friendly and will deliver all of the information needed to effectively resolve any trail issues.

The collaborators intend to develop a new website; however, website development was out of the scope of this research project. The organization that develops the website will want to provide the reporting form on the website and ensure that the form is mobile friendly. In the meantime, the team developed a simple reporting system using Google Forms (see Figure 5.2) as a temporary solution for the current tourist season until the collaborators build their new website.

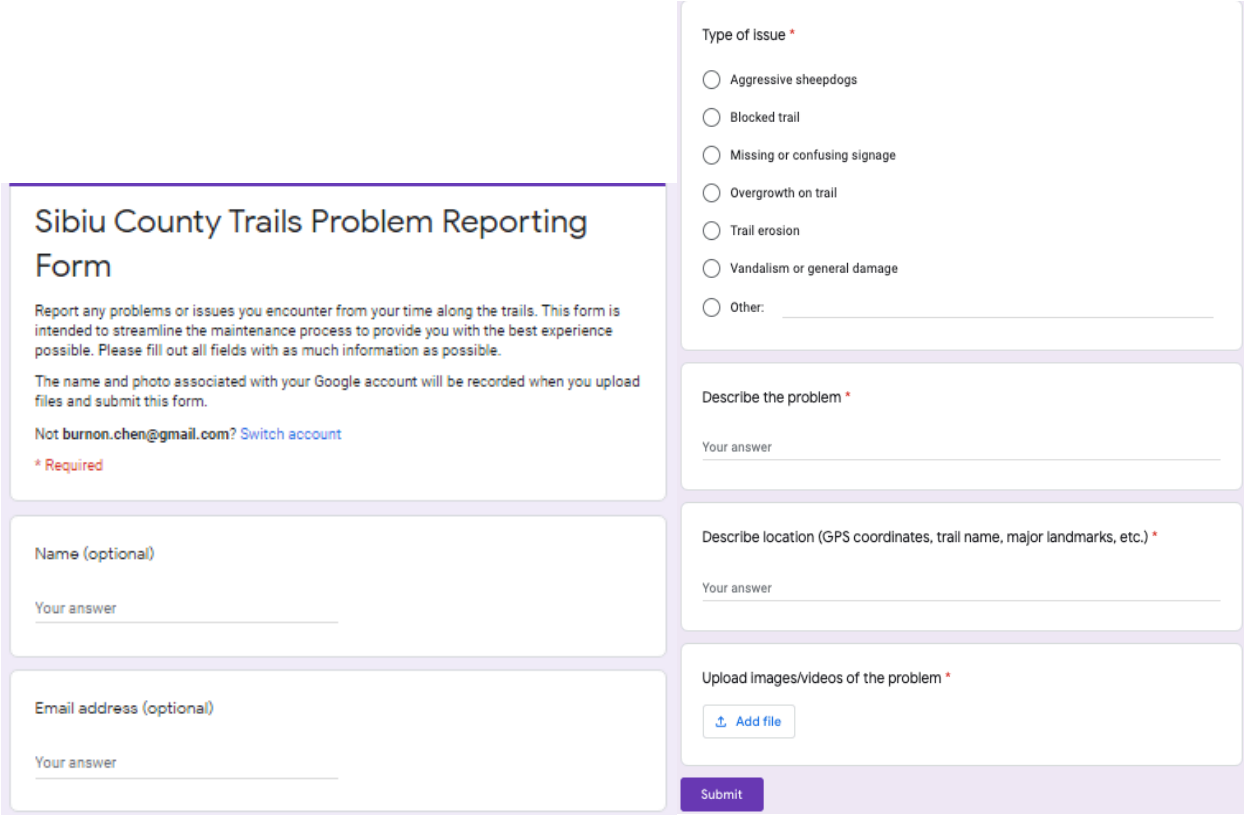


Figure 5.2 Temporary reporting form made with Google Forms

5.2.3 Partner with a popular hiking app

The team recommends that the collaborators partner with a mobile app. From the results, a majority of surveyed trail users already use mobile applications while hiking on the Sibiu trails. Partnering with an app company to consolidate trail information into a centralized database will make information easily accessible to all trail users with a compatible device. Additionally, apps can draw in new trail users by adding and promoting new trails in their database.

All of the researched apps have features popular with Sibiu trail users. These features include general trail information (length, elevation gain, difficulty, etc.), information on trail facilities (visitor centers, campsites, etc.), and a route planning feature. More information about particular app features and rankings is located in Appendix I.

Based on the team's research, the collaborators should partner with Wikiloc as the primary choice because of its pre-existing feature WikiOrg that makes it easy for organizations to upload and promote their own trails. AllTrails, ViewRanger/OutdoorActive and Komoot have similar features, but the team recommends AllTrails as the second choice followed by

ViewRanger/OutdoorActive and Komoot respectively in order of their current popularity level amongst trail users in Sibiu County that the Romanian survey suggests.

5.2.4 Contact counting system companies to track quantity and movement of trail users

There are two European based companies, Eco-Counter and SensMax, that offer counting system technology that the team recommended to the collaborators to track quantity and movement of trail users. Both companies offer infrared beam technology and sensor technology that fit the requirements for where and how to place the counting sensors on the trails. Since both companies sell to European countries, the collaborators could contact other customers to ask for feedback on the products. Being European based makes communication between the companies and the collaborators more convenient (e.g., faster response times, product service accessibility). If the collaborators decide to purchase one of these systems, they can then test it on a popular trail to start collecting data and assess the product. Hopefully, the collaborators will adopt a technology and have it in place for the large, anticipated influx of trail users Sibiu for Eurorando in September 2021.

5.3 Project Limitations

COVID-19 challenged the team's research throughout the project. Since the team was unable to travel and see the trails in Sibiu County firsthand, this forced them to build a perspective of the area and situation through pictures of the region and discussions with collaborators and interviewees. If the team were in Romania for the project, they could have gained their own perspective, potentially leading to different and novel ideas to approach the problem. They also could have distributed their surveys in person to tourists and gained a higher response rate. Furthermore, the seven-hour time difference narrowed the ideal time frame for interviews and made scheduling more challenging, especially as the peak visitor season began in late April leading up to Orthodox Easter (May 2, 2021) and the team needed to schedule interviews with business owners. Interviewing on a Zoom call is a different experience than interviewing in person. It is more challenging to build rapport and ensure a comfortable environment for the interviewee. Finally, Internet communication reliability presents a set of challenges including poor connections or audio quality that can disrupt the flow and ease of interviewing.

Another limitation the project faced throughout was the survey sample population. The first survey experienced a high response rate, receiving 106 responses from domestic Romanian tourists, but did not contain all the information the team desired. So, the team sent out a second survey in English hoping to target foreign visitors as respondents. However, this survey garnered only eight foreigners among 42 respondents. Consequently, our methods provided a very limited picture of the foreign trail user experience in Sibiu. Due to the low foreigner response rate, the team relied on information from the interviews and content analysis to understand their experience. This is how they determined that many foreign trail users tend to come from Europe, specifically Germany, and will often hire a trail guide since it can be difficult for a foreign tourist to plan a trip to Sibiu themselves. While this finding was valuable, interviews do not provide the complete picture of the foreign trail user experience and a larger survey sample population could have provided valuable information about that experience. Relying on content analysis is also not the best method to determine exactly who uses the trails because it is limited by the number of trail users that actually post blogs and videos about their experience. There are likely many visitors that do not post anything on the Internet when they take a trip to Sibiu.

A final limitation was the small number of business owners the team interviewed and the lack of variety in the businesses. There are many businesses in Sibiu, but the team was only able to interview three owners. In addition to the small sample, the team only interviewed lodging business owners, but they are not the only businesses that trail users interact with. Trail users may also buy food and souvenirs from local restaurants and shops, but these businesses were left out of the project. The trail users that interact with these businesses may differ from those staying in accommodations and without interviewing these business owners, those trail users are left out of the picture for this project. Had the team managed to set up an interview with one of these business owners, they could have discovered even more ways businesses can cater to trail users.

5.4 Future Research

There are several areas of further research that could become future projects at the Bucharest Project Center. As mentioned in background section 2.3, a reoccurring issue along the trails is that outside organizations and individuals use the trails for purposes other than hiking or biking. This was a common theme when the team interviewed trail guides and trail managers

about common problems. Examples included logging organizations that clear-cut trees along the trails, aggressive shepherd's dogs scaring and endangering hikers, and foreign landowners restricting access to the trails that lie on their property. While these problems clearly impact trail user experience, they were not within the scope of this project. Therefore, one possible project for future research could focus on investigating the impact of these problems for Sibiu trail user experiences and explore how to resolve them.

Future projects could also center around compensating for the limitations of this project. Because of the lack of foreign trail user responses in the surveys and conducting interviews with only accommodation businesses, the understanding of trail user experience is incomplete. There is not enough information about foreign trail users and those who interact with businesses that are not just for lodging. Creating a study focused on forming a better understanding of foreigners' experiences in Sibiu and a broader understanding of how businesses (not just hotels) cater to hikers would expand on understanding the trail user experience in Sibiu, building on the goal of this project.

Finally, because this project developed a reporting form for trail managers and an infographic for informing lodging businesses in the area, more research could focus around analyzing the impact that theses deliverables have on the actual trail users. It is useful to know whether the reporting form is resulting in faster resolution of trail problems or if trail users are noticing local lodging businesses catering more to them because of the infographic. Currently, the effects of this project are unknown and a future project monitoring the implications of the deliverables may lead to new conclusions regarding the effectiveness of these tools. If the deliverables have a positive impact in Sibiu, this could lead to the development of similar applications elsewhere to increase economic development and enhance the trail user experience.

References

Asciaţia Judeţeană de Turism Sibiu. (n.d.). Despre noi [About us]. Retrieved February 22, 2021, http://www.sibiu-turism.ro/Profesionisti-Despre-noi.aspx

Asociatia Mioritics. (n.d.). Despre noi [About us]. Retrieved February 22, 2021, from https://mioritics.ro/despre-noi/

Asociatia Mioritics. (2015). Trasee de drumetie si biciclete [Hiking and biking trails]. Retrieved February 22, 2021, from https://mioritics.ro/trasee-de-drumetie-si-biciclete/

Asociatia Mioritics. (2016). Dezvoltare durabilă prin ecoturism în Colinele Transilvaniei Retrieved February 22, 2021, from [Sustainable development through ecotourism in the Transylvanian Hills]. https://mioritics.ro/dezvoltare-durabila-prin-ecoturism-in-colinele-transilvaniei-2/

Britannica, T. Editors of Encyclopaedia (2018). Sibiu. *Encyclopedia Britannica.* Retrieved February 8, 2021, from https://www.britannica.com/place/Sibiu-Romania

Britannica, T. Editors of Encyclopaedia (2019). Sibiu. *Encyclopedia Britannica*. Retrieved February 8, 2021, from https://www.britannica.com/place/Sibiu-county-Romania

Cononovici, A. (2015, December 6). The Mioritics association. Radio Romania International. Retrieved February 20, 2021, from https://www.rri.ro/en_gb/the_mioritics_association-2540162

Cucu, V. S., Latham, Ernest, Turnock, David and Hitchins, Keith Arnold (2021). Romania. Encyclopedia Britannica. Retrieved February 13, 2021, from https://www.britannica.com/place/Romania

Deloitte. (2020). Most popular sports in Romania in 2019 [Graph]. In Statista. Retrieved March 5, 2021, from https://www.statista.com/statistics/1187490/romania-most-popular-sports/

Dionisio, R. P., Marques, P. J., Silva, F. P., Rodrigues, J. N., & De Carvalho, C. U. (2016). Real-time tourists counting and tracking system for management of nature trails in Naturtejo Global Geopark (Portugal). *The Romanian Review Precision Mechanics, Optics & Mechatronics*, *50(1),* 1-15.

Ebenstein, A. (2015). Using an interactive mobile application to crowdsource data collection for management issues in Asylum Lake Preserve, Kalamazo, MI. [Master's thesis, Western Michigan University], Scholarworks Western Michigan University.

Eco-Counter. (n.d.) PYRO Range. Retrieved on April 28, 2021 from, https://www.eco-counter.com/produits/pyro-range/pyro-sensor/

European Commission. (2020). How would you rate the access to high-speed internet connections in rural areas in Romania? [Graph]. In Statista. Retrieved February 16, 2021, from https://www.statista.com/statistics/1194462/romania-access-to-high-speed-internet-connections-in-rural-areas/

Eurostat, & National Institute of Statistics Romania. (2020). Number of domestic arrivals in tourist accommodations in Romania from 2006 to 2019 (in millions) [Graph]. In Statista. Retrieved February 16, 2021, from https://www.statista.com/statistics/614559/number-domestic-arrivals-spent-in-accommodation-in-romania/

Eurostat, & National Institute of Statistics Romania. (2020). Number of international arrivals in tourist accommodation in Romania from 2006 to 2019 (in millions) [Graph]. In Statista. Retrieved February 16, 2021, from https://www.statista.com/statistics/614379/number-international-arrivals-spent-in-accommodation-in-romania/

Eurostat, & National Institute of Statistics Romania. (2021, March 5). Number of arrivals in tourist accommodations in Romania from 2006 to 2020 (in millions) [Graph]. In Statista. Retrieved February 16, 2021, from https://www.statista.com/statistics/413253/number-of-arrivals-spent-in-short-stay-accommodation-in-romania/

Grama, C., & Baggio, R. (2013). A network analysis of Sibiu County, Romania (Tech.). Cornell University. Retrieved April 14, 2021, from https://arxiv.org/abs/1312.7432.

Iorio, M., & Corsale, A. (2010). Rural tourism and livelihood strategies in Romania. *Science Direct, 26(1),* 152-162. doi:https://doi.org/10.1016/j.jrurstud.2009.10.006

JewishGen. (2016). *Romania regions counties map* [Map]. JewishGen. https://www.jewishgen.org/databases/romania/RomaniaRegions.htm

Krzesiwo, K., Ziółkowska-Weiss, K., & Żemła, M. (2018). The attractiveness of selected Central European countries for winter sports and mountain hiking. *Turyzm/Tourism*, 28(1), 35-40.

KTA. (n.d.). Report a problem. Retrieved March 10, 2021, from https://www.kta-hike.org/report-a-problem.html#

Light, D. (2000). An unwanted past: Contemporary tourism and the heritage of communism in Romania. *International Journal of Heritage Studies*, 6(2), 145-160.

Light, D. (2007). Dracula tourism in Romania cultural identity and the state. *Annals of Tourism Research,* 34(3), 746-765.

Light, D., & Dumbrăveanu, D. (1999). Romanian tourism in the post-communist period. *Annals of Tourism Research,* 26(4), 898-927.

Lloyd, K. (2006). Catering to the backpacker: The transition of backpacker enclaves in Vietnam. *Tourism Recreation Research*, 31(3), 65-73.

Marcoianu, V. (2019, August 10). Web app: How much does it cost to develop an application? SenDesign. Retrieved February 22, 2021, https://sendesign.ro/web-app-how-much-does-it-cost-to-develop-an-application/?lang=en

Merriam-Webster. (n.d.). Biotope. In Merriam-Webster.com dictionary. Retrieved March 14, 2021, from https://www.merriam-webster.com/dictionary/biotope

Martin, J. (2017, November 1). Hiking is now the most popular adventure activity for travelers. Lonely Planet. Retrieved February 25, 2021, from https://www.lonelyplanet.com/articles/new-research-hiking-most-popular

Mirela, C.S. (2017). Agrotourism and rural tourism the way of sustainable development in rural areas of Sibiu County - Romania. *Oltenia Journal for Studies in Natural Sciences*, 33(2), 179-182.

Mohd Taher, S. H., Jamal, S. A., Sumarjan, N., & Aminudin, N. (2015). Examining the structural relations among hikers' assessment of pull-factors, satisfaction and revisit intentions: The case of mountain tourism in Malaysia. *Journal of Outdoor Recreation and Tourism,* 12, 82-88.

National Institute of Statistics Romania. (2020). Number of tourists accommodated in tourist establishments in Romania in 2019, by destination (in 1,000s) [Graph]. In Statista. Retrieved February 26, 2021, from https://www.statista.com/statistics/1123281/romania-tourists-accommodated-by-destination/

National Park Service, Implementation plan for a socioeconomic monitoring program in the national park system (Natural Resource Report, Tech.). (2019). *National Park Service*. Retrieved February 09, 2021, from https://www.nps.gov/subjects/socialscience/upload/SEM_Pilot_Final_508accessible.pdf

Neuvonen, M., Pouta, E., Puustinen, J., & Sievänen, T. (2010). Visits to national parks: Effects of park characteristics and spatial demand. *Journal for Nature Conservation*, 18(3), 224-229.

Popescu, D. (2015). Economy of Sibiu County. Resources for a future development. *Revista Economică.* 67(5), 139-147.

Report a problem: Island trails. (2019, November 05). Retrieved March 10, 2021, from https://www.islandtrails.ca/contact/problem/

Rodriguez, C. (2020, February 6). The 20 best European destinations to visit in 2020 revealed. Forbes. Retrieved February 20, 2021, from https://www.forbes.com/sites/ceciliarodriguez/2020/02/06/the-20-best-european-destinations-to-visit-in-2020-revealed/?sh=111f933a1bc9

Romania Insider. (2019, February 1). Sibiu competes for spot in Top 20 European tourism destinations. *Romania Insider*. Retrieved February 20, 2021, from https://www.romania-insider.com/sibiu-competes-top-european-tourism-destinations

Romania Insider. (2019, November 25). Romanian city to host top European hiking event in 2021. *Romania Insider*. Retrieved February 20, 2021, from https://www.romania-insider.com/sibiu-eurorando-hiking-2021

Scuttari, A. (2016, December 22). Tourism on the move: How to design hiking routes as unique experiences. *Eurac Research*. Retrieved February 25, 2021, from https://beta.eurac.edu/en/blogs/regionalstories/tourism-on-the-move-how-to-design-hiking-routes-as-unique-experiences

SensMax. (2018). Outdoor people counting in parks. Retrieved April 28, 20201, from https://sensmax.eu/solutions/outdoor-people-counting-in-parks/

Sibiu County Tourism Association. (2021). Welcome on the official website of Sibiu County. Retrieved April 14, 2021, from http://www.sibiu-turism.ro/About-us.aspx

Siegrist, D., Clivaz, C., Hunziker, M. & Iten, S. (Eds.) (2006, September 13-17). Exploring the nature of management. proceedings of the third international conference on monitoring and management of visitor flows in recreational and protected areas. University of Applied Sciences Rapperswil, Switzerland.

Signaler UN problème. (n.d.). Retrieved March 10, 2021, from https://sentinelles.sportsdenature.fr/

Speedtest. (2020). Countries with the fastest average fixed broadband internet speeds as of August 2020 (in Mbps) [Graph]. In Statista. Retrieved February 16, 2021, from https://www.statista.com/statistics/896772/countries-fastest-average-fixed-broadband-internet-speeds/

Stanley, D. (2017, June 8). *Sibiu, Romania* [Photograph]. Flickr. https://www.flickr.com/photos/davidstanleytravel/37731086164/in/photostream/

Stemberk, J., Dolejs, J., Maresova, P., & Kuca, K. (2018). Factors affecting the number of visitors in national parks in the Czech Republic, Germany and Austria. ISPRS *International Journal of Geo-Information,* 7(3), 124.

Tahoe-Pyramid Trail. (2020, August 06). Reporting trail problems:. Retrieved March 10, 2021, from https://tahoepyramidtrail.org/report-trail-conditions/

Texas A&M Transportation Institute. (2013). Monitoring trail use: Case study applications at San Antonio Missions National Historical Park and Guadalupe Mountains National Park. Retrieved April 28, 2021 from, https://static.tti.tamu.edu/tti.tamu.edu/documents/401090-1.pdf

The Ecotourism Association of Romania. (2020). The network of hiking and biking trails in the Transylvanian Highlands [Image]. *Discover Eco-Romania*. Retrieved March 17, 2021, from https://www.eco-romania.ro/en/transylvanian-highlands/biking-trails-network-transylvanian-highlands/

Turnock, D. (1999). Sustainable rural tourism in the Romanian Carpathians. *The Geographical Journal,* 165(2), 192-199.

World Bank. (2019). Proportion of Romania covered by forest area from 1990 to 2016 (percentage of land area) [Graph]. In Statista. Retrieved February 22, 2021, from https://www-statista-com.ezpxy-web-p-u01.wpi.edu/statistics/435973/forest-area-as-percentage-of-land-area-romania/

World Tourism Organization. (n.d.a). Global and regional tourism performance [Fact Sheet]. *The World Tourism Organization, United Nations*. Retrieved March 3, 2021, from https://www.unwto.org/global-and-regional-tourism-performance

World Tourism Organization. (n.d.b). Tourism and culture. *The World Tourism Organization, United Nations.* Retrieved March 1, 2021, from https://www.unwto.org/tourism-and-culture

World Tourism Organization. (n.d.c). Zurab Pololikashvili, Secretary-General of the UNWTO. *The World Tourism Organization, United Nations.* Retrieved March 3, 2021, from https://www.unwto.org/management/zurab-pololikashvili

Appendix A: Trail User Romanian Survey Questions

Ieși, omule, în natură !

Știm cât de prețios este timpul, mai ales acum în epoca vitezei, și mai știm că te întrebi: Cu ce alt sondaj sunt bombardat acum ? Ei bine, noi credem că ochii sunt oglinda sufletului, iar ceea ce vrem să aflăm este: unde se regăsește în sufletul tău natura și activitățile în natură?

* Required

Cine ești: Adam sau Eva?

- [ ] Adam
- [ ] Eva
- [ ] Prefer să nu menționez

Știm că nu este politicos, dar câți ani ai? *

- ○ 18-21
- ○ 22-39
- ○ 40-64
- ○ 65+

și cum lucrezi? *

- ☐ Antreprenor
- ☐ Freelancer
- ☐ Angajat cu normă întreagă
- ☐ Angajat cu jumătate de normă
- ☐ Student(ă)
- ☐ Pensionar(ă)
- ☐ Șomer

În ce județ din România sau în ce altă țară locuiești? *

Your answer

Descrie în câteva cuvinte ce înseamnă pentru tine NATURA *

Your answer

Cum a fost ultima ta experiență în natură? *

	1	2	3	4	5	
de Doamne ferește	○	○	○	○	○	Extraordinar!

Care dintre următoarele activități îți stârnesc interesul? *

- [ ] Drumeție colinară
- [ ] Drumeție de lungă distanță
- [ ] Drumeție montană
- [ ] Plimbări în pădure/ parcuri
- [ ] Echitație
- [ ] Ciclism, MTB, e-Bike
- [ ] Canoe, barcă, înot, padelare
- [ ] Zbor cu parașuta, parapanta, avion
- [ ] Observarea naturii (păsări, mamifere, flora)
- [ ] Meditație
- [ ] Spa
- [ ] Experiențe interactive: poteci tematice, treasure hunt, geocaching
- [ ] Evenimente sportive (ex. maratoane)
- [ ] Evenimente natură & cultură & gastronomie
- [ ] Nimic de mai sus
- [ ] Other:

Ți-ar plăcea să te alături unui grup/unei excursii organizate de profesioniști în colaborare cu mama natură? *

- ( ) Da
- ( ) Nu
- ( ) Nu știu
- ( ) Prefer să-mi organizez singur excursiile
- ( ) Other: _____

Pe cine ai vrea să ai alături într-o astfel de experiență în natură? *

- [ ] Singur
- [ ] Partenerul/partenera de viața
- [ ] Părinții
- [ ] Copiii
- [ ] Prietenii
- [ ] Animalul de companie
- [ ] Un ghid local
- [ ] Other:

Obișnuiești să folosești vreo aplicație mobilă înainte sau în timpul ieșirilor în natură (planificare, navigare, starea vremii etc.)? *

- ( ) Mereu
- ( ) De cele mai multe ori
- ( ) Uneori
- ( ) Niciodată
- ( ) Nu dețin un echipament mobil

Ce aplicație folosiți înainte sau în timpul unei ieșiri în natură (selectați ce vi se potrivește) *

- [ ] AllTrails
- [ ] ViewRanger/Outdooractive
- [ ] Komoot
- [ ] Wikiloc
- [ ] Munții noștri
- [ ] Other:

Ce facilități ale acestor aplicații mobile considerați că vă sunt utile? (selectați tot ce vi se potrivește) *

- [ ] Hărți offline
- [ ] Descrieri
- [ ] Informații utilități de pe trasee (izvoare, puncte de prim ajutor etc.)
- [ ] Servicii din proximitate (restaurante, cazare, etc.)
- [ ] Atracții de proximitate
- [ ] Comentarii utilizatori
- [ ] Modul de raportare părere
- [ ] Niciuna
- [ ] Other: _____

Cât timp ai fi dispus să aloci unei ieșiri/călătorii în natură? *

- ○ o zi
- ○ un weekend
- ○ între 3 și 5 zile
- ○ o saptămână sau chiar mai mult

Cu ce mijloc de transport preferi să călătorești în țară? *

- [ ] Mașină personală
- [ ] Autocar
- [ ] Tren
- [ ] Other: _____

De când te simți pregătit și în siguranță să ieși în natură? *

- ◯ Din orice moment, hai afară!
- ◯ Din primăvară
- ◯ Din toamnă
- ◯ Din iarnă
- ◯ Având în vedere situația actuală (COVID -19), nu mă simt încă pregătit
- ◯ Other: _____

Ești interesat de o experiență în natură în Colinele Transilvaniei? De ce? *

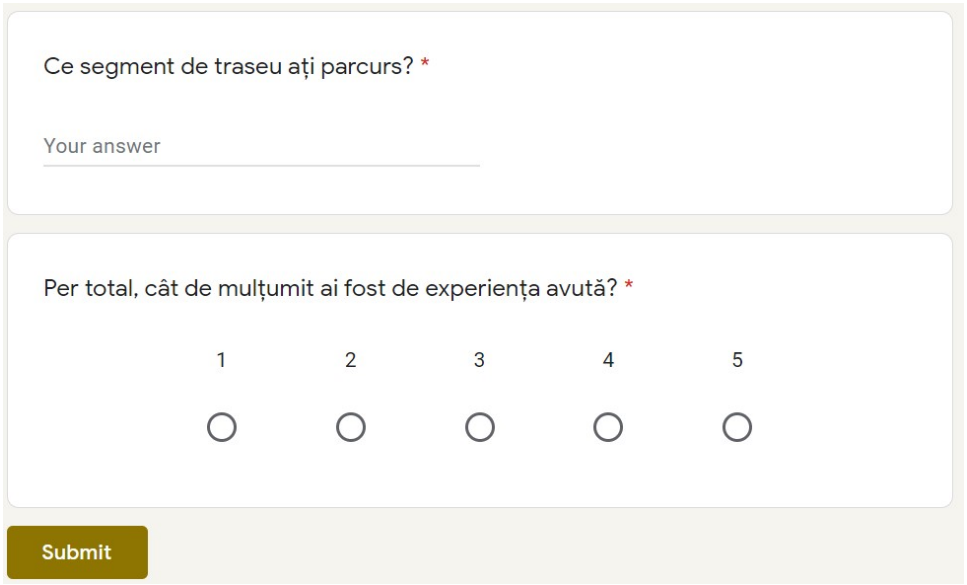
Your answer

Când ați ieșit în natură pe trasee din Colinele Transilvaniei? *

- ☐ 0-6 luni
- ☐ 6 luni - 1 an
- ☐ 1-2 ani
- ☐ 2-5 ani
- ☐ 5+ ani
- ☐ Niciodată

Ce segment de traseu ați parcurs? *

Your answer



English translation for the questions above:

We know how precious time is, especially now in the age of speed, and we also know that you are wondering: What other poll are I bombarded with now? Well, we believe that the eyes are the mirror of the soul, and what we want to know is: where is nature and activities in nature found in your soul?

1. Who are you: Adam or Eve?
    a. Adam
    b. Eve
    c. I prefer not to mention

2. We know it's not polite, but how old are you?
    a. 18-21
    b. 22-39
    c. 40-64
    d. 65+

3. and how do you work?
    a. Entrepreneur
    b. Freelancer
    c. Full-time employee
    d. Part-time employee
    e. Student
    f. Retired
    g. Unemployed

4. In which county in Romania or in which other country do you live?

5. Describe in a few words what NATURE means to you

6. How was your last experience in nature?
   God forbid
   a. 1
   b. 2
   c. 3
   d. 4
   e. 5
   Extraordinary!

7. Which of the following activities arouses your interest?
   a. Hiking hills
   b. Long distance hiking
   c. Hiking mountains
   d. Horse riding
   e. Cycling, MTB, e-Bike
   f. Canoeing, boating, swimming, paddling
   g. Nature observation (birds, mammals, flora)
   h. Parachute flight, paragliding, airplane
   i. Forest walks / parks
   j. Meditation
   k. Spa
   l. Interactive experiences: themed trails, treasure hunt, geocaching
   m. Sports events (eg marathons)
   n. Nature & culture & gastronomy events
   o. Nothing above
   p. Other _____

8. Would you like to join a group / trip organized by professionals in collaboration with Mother Nature?
   a. Yes
   b. No
   c. I do not know
   d. I prefer to organize my own trips
   e. Other _____

9. Who would you like to have with you in such an experience in nature?
    a. Single
    b. Life partner
    c. The parents
    d. The kids
    e. Friends
    f. The pet
    g. A local guide
    h. Other _____

10. Do you usually use a mobile application before or during nature outings (planning, navigation, weather, etc.)?
    a. Always
    b. Most often
    c. Sometimes
    d. Never
    e. I don't have mobile equipment

11. Which app do you use before or during a nature outing (select the one that suits you)
    a. AllTrails
    b. ViewRanger/Outdoor Active
    c. Komoot
    d. Wikiloc
    e. Munții noștri (Our mountains)
    f. Other _____

12. What features of these mobile apps do you find useful? (select everything that suits you)
    a. Offline maps
    b. Descriptions
    c. Route utility information (sources, first aid points, etc.)
    d. Proximity services (restaurants, accommodation, etc.)
    e. User comments
    f. How to report opinion
    g. None
    h. Other

13. How much time would you be willing to spend on an outing / trip in nature?
    a. one day
    b. A weekend
    c. between 3 and 5 days

d. a week or even more

14. What means of transport do you prefer to travel in the country?
    a. Personal car
    b. Coach
    c. Train
    d. Other _____

15. Since when do you feel ready and safe to go out in nature?
    a. From any moment, get out!
    b. Since spring
    c. Since the fall
    d. From winter
    e. Given the current situation (COVID-19), I do not feel ready yet
    f. Other _____

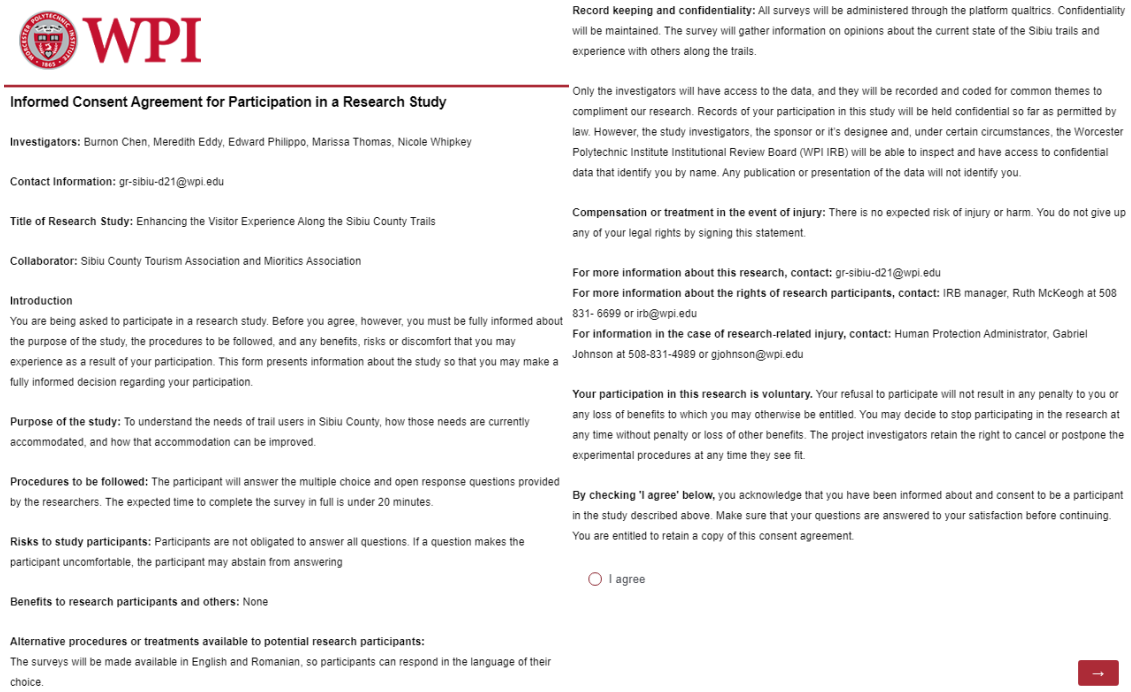
16. Are you interested in an experience in nature in the Sibiu area? Why?

17. When did you go out in nature on routes in Sibiu County?
    a. 0-6 months
    b. 6 months - 1 year
    c. 1-2 years
    d. 2-5 years
    e. 5+ years
    f. Never

18. Overall, how satisfied were you with your experience?
    a. 1
    b. 2
    c. 3
    d. 4
    e. 5

Appendix B: Trail User English Survey Questions

Note: The following screenshots from Qualtrics display every possible question asked in the survey. However, some questions are only shown depending on the participants responses. These conditional questions are explained within the screenshots below.



WPI

Informed Consent Agreement for Participation in a Research Study

Investigators: Burnon Chen, Meredith Eddy, Edward Philippo, Marissa Thomas, Nicole Whipkey

Contact Information: gr-sibiu-d21@wpi.edu

Title of Research Study: Enhancing the Visitor Experience Along the Sibiu County Trails

Collaborator: Sibiu County Tourism Association and Mioritics Association

Introduction
You are being asked to participate in a research study. Before you agree, however, you must be fully informed about the purpose of the study, the procedures to be followed, and any benefits, risks or discomfort that you may experience as a result of your participation. This form presents information about the study so that you may make a fully informed decision regarding your participation.

Purpose of the study: To understand the needs of trail users in Sibiu County, how those needs are currently accommodated, and how that accommodation can be improved.

Procedures to be followed: The participant will answer the multiple choice and open response questions provided by the researchers. The expected time to complete the survey in full is under 20 minutes.

Risks to study participants: Participants are not obligated to answer all questions. If a question makes the participant uncomfortable, the participant may abstain from answering

Benefits to research participants and others: None

Alternative procedures or treatments available to potential research participants:
The surveys will be made available in English and Romanian, so participants can respond in the language of their choice.

Record keeping and confidentiality: All surveys will be administered through the platform qualtrics. Confidentiality will be maintained. The survey will gather information on opinions about the current state of the Sibiu trails and experience with others along the trails.

Only the investigators will have access to the data, and they will be recorded and coded for common themes to compliment our research. Records of your participation in this study will be held confidential so far as permitted by law. However, the study investigators, the sponsor or it's designee and, under certain circumstances, the Worcester Polytechnic Institute Institutional Review Board (WPI IRB) will be able to inspect and have access to confidential data that identify you by name. Any publication or presentation of the data will not identify you.

Compensation or treatment in the event of injury: There is no expected risk of injury or harm. You do not give up any of your legal rights by signing this statement.

For more information about this research, contact: gr-sibiu-d21@wpi.edu
For more information about the rights of research participants, contact: IRB manager, Ruth McKeogh at 508 831- 6699 or irb@wpi.edu
For information in the case of research-related injury, contact: Human Protection Administrator, Gabriel Johnson at 508-831-4989 or gjohnson@wpi.edu

Your participation in this research is voluntary. Your refusal to participate will not result in any penalty to you or any loss of benefits to which you may otherwise be entitled. You may decide to stop participating in the research at any time without penalty or loss of other benefits. The project investigators retain the right to cancel or postpone the experimental procedures at any time they see fit.

By checking 'I agree' below, you acknowledge that you have been informed about and consent to be a participant in the study described above. Make sure that your questions are answered to your satisfaction before continuing. You are entitled to retain a copy of this consent agreement.

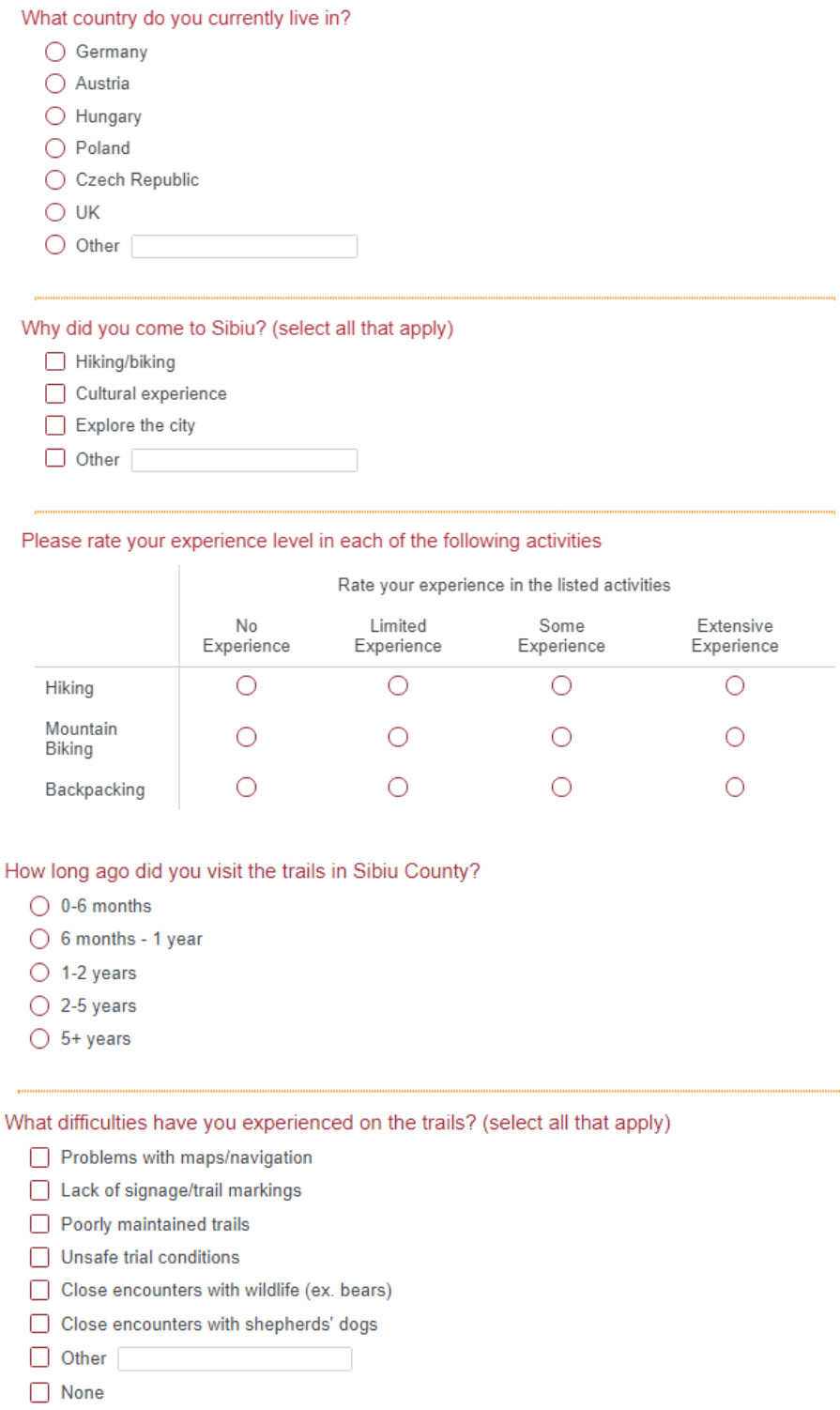
○ I agree

→

Question 1 is the only questions that require an answer as it is necessary to gain consent of the survey participants. All subsequent questions are optional.

If the user answers ‘yes’ to question 6. Question 7 will appear, allowing them to specify their county of residence, and they will skip question 8 automatically.

If the user answers ‘no’ to question 6, they will be redirected to question 8 to identify their country of residence.



What country do you currently live in?

- ○ Germany
- ○ Austria
- ○ Hungary
- ○ Poland
- ○ Czech Republic
- ○ UK
- ○ Other

Why did you come to Sibiu? (select all that apply)

- ☐ Hiking/biking
- ☐ Cultural experience
- ☐ Explore the city
- ☐ Other

Please rate your experience level in each of the following activities

	Rate your experience in the listed activities			
	No Experience	Limited Experience	Some Experience	Extensive Experience
Hiking	○	○	○	○
Mountain Biking	○	○	○	○
Backpacking	○	○	○	○

How long ago did you visit the trails in Sibiu County?

- ○ 0-6 months
- ○ 6 months - 1 year
- ○ 1-2 years
- ○ 2-5 years
- ○ 5+ years

What difficulties have you experienced on the trails? (select all that apply)

- ☐ Problems with maps/navigation
- ☐ Lack of signage/trail markings
- ☐ Poorly maintained trails
- ☐ Unsafe trial conditions
- ☐ Close encounters with wildlife (ex. bears)
- ☐ Close encounters with shepherds' dogs
- ☐ Other
- ☐ None

If the participant selects any of the options in question 11, except 'None,' they will be prompted to answer question 12. If they select 'None,' they will automatically skip ahead to question 13.

Please briefly explain the difficulties you have encountered.

Overall, how satisfied have you been with your trail experiences in Sibiu?

	Extremely dissatisfied	Somewhat dissatisfied	Neither satisfied nor dissatisfied	Somewhat satisfied	Extremely satisfied
Trail user satisfaction	○	○	○	○	○

Do you carry a mobile device (i.e. cell phones) while hiking/biking?

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never
- ○ I do not own a mobile device

If the participant selects 'Always,' 'Most of the time,' or 'Sometimes,' for question 14, they will be prompted to answer questions 15-17. Otherwise, they will automatically skip to question 20.

How often do you have internet access along the Sibiu County trails?

	Never	Rarely	Sometimes	Most of the time	Always
Internet access	○	○	○	○	○

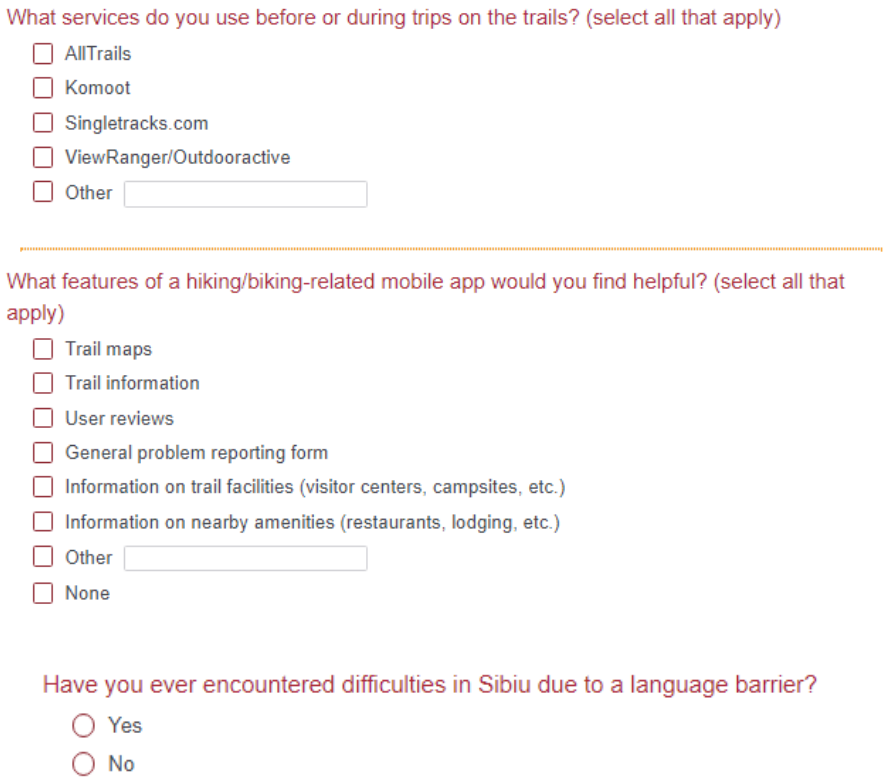
How would you rate the internet speed on the trails?

	Very slow	Slow	Moderate	Fast	Very fast
Internet speed	○	○	○	○	○

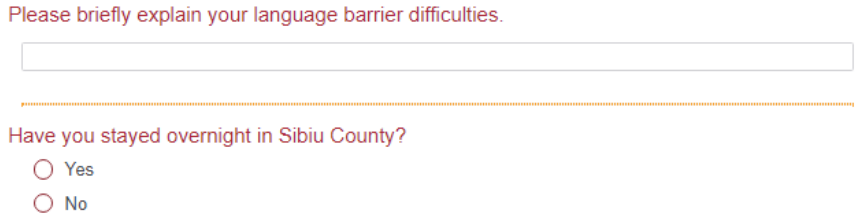
Do you use any mobile applications before or during trips on the trails (planning, navigation, weather, etc.)?

- ○ Always
- ○ Most of the time
- ○ Sometimes
- ○ Never
- ○ I do not own a mobile device.

If the participant selects 'Always,' 'Most of the time,' or 'Sometimes,' for question 17, they will be prompted to answer question 18. Otherwise, they will automatically skip to question 19.



If the participant selects 'Yes' for question 20, they will be prompted to answer question 21. Otherwise, they will skip to question 22.



If the participant answers 'Yes' to question 22, they will be prompted to answer questions 23-26. Otherwise, they will automatically skip to question 27.

How easily could you find lodging?

	Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy
Finding lodging	○	○	○	○	○

Did your lodging have all the accommodations/amenities you needed and expected?

- ○ Yes
- ○ No
- ○ I don't remember

How would you rate the prices of lodging?

	Extremely cheap	Somewhat cheap	Neither cheap nor expensive	Somewhat expensive	Extremely expensive
Price of lodging	○	○	○	○	○

Did anything stand out about your experiences with lodgings?

Have you eaten at a restaurant in Sibiu County?

- ○ Yes
- ○ No

If the participant answers 'Yes' to question 27, they will be prompted to answer questions 28-30. Otherwise, they will automatically skip to question 31.

How easily could you find a place to eat?

	Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy
Finding restaurants	○	○	○	○	○

How would you rate the restaurant prices?

	Extremely cheap	Somewhat cheap	Neither cheap nor expensive	Somewhat expensive	Extremely expensive
Price of restaurants	○	○	○	○	○

Did anything stand out about your experiences with restaurants?

Have you bought anything in Sibiu County?

○ Yes
○ No

If the participant answers 'Yes' to question 31, they will be prompted to answer questions 32-34. Otherwise, the survey will end.

How easy was it to find the products you were looking for?

	Extremely difficult	Somewhat difficult	Neither easy nor difficult	Somewhat easy	Extremely easy
Finding products	○	○	○	○	○

How would you rate the price of products?

	Extremely cheap	Somewhat cheap	Neither cheap nor expensive	Somewhat expensive	Extremely expensive
Price of goods	○	○	○	○	○

Did anything stand out about your experience with merchants?

WPI

We thank you for your time spent taking this survey.
Your response has been recorded.

Appendix C: Core Interview Guide

This is the layout of an interview that would be conducted by two team members. It contains questions to ask all participants (both trail guides and trail managers).

One team member will be the primary person asking questions for a section of questions while the other will work off the answers of the interviewee to ask follow-up questions and let the conversation flow.

Introductions

Hello! We're undergraduate students attending university at Worcester Polytechnic Institute (or WPI), which is in Worcester, Massachusetts in the United States. As third-year students, we are required to complete an Interactive Qualifying Project (IQP). This typically involves studying abroad, so if this was a normal year, we would be in Romania talking to you in person. While this is not the case, we are excited to talk with you and get some insight into trails and trail work in Sibiu County.

Informed Consent

There is one thing to do before we start. Since this interview is technically research involving a human subject, our university's research ethics board requires us to get your informed consent. Before we begin, do you give us consent to record this interview for future transcription and analysis? Anonymity will be maintained and only our team members will have access to the recording.

I will read the rest of the consent information out now.

You are being asked to participate in a research study. Before you agree, however, you must be fully informed about the purpose of the study, the procedures to be followed, and any benefits, risks or discomfort that you may experience as a result of your participation.

We are conducting this interview to understand the needs of trail users in Sibiu County, how those needs are currently accommodated, and how that accommodation can be improved.

The interviewer will ask a series of questions related to the aforementioned purpose, and the interview will take approximately 30 minutes.

Participants are not obligated to answer all questions. If a question makes the participant uncomfortable, they may abstain from answering.

There is no expected risk of injury or harm. You do not give up any of your legal rights by signing this statement.

Only the investigators will have access to the interview recordings, and they will be transcribed and coded for common themes. Records of your participation in this study will be held confidential and any publication or presentation of the data will not identify you.

You may decide to stop participating in the research at any time without penalty or loss of other benefits. The project investigators retain the right to cancel or postpone the experimental procedures at any time they see fit.

If you want more information on the rights of research participants, we have a phone number you can call for the Institutional Review Board manager.

IRB manager, Ruth McKeogh: 508 831- 6699 or irb@wpi.edu

We're happy to clarify anything that was just mentioned. If you're totally satisfied, then please verbally confirm your consent to this interview

Interview Body Questions

1. For trail guide or trail manager interviews, see Appendix D.
2. For business interviews, see Appendix E.

Closing remarks

Thank you for your time and for your help with this project.

3. Is there anything else that you would like to say or anything that we didn't discuss that you would like to add?

Thank you again for your input! Our project wraps up around May 14, so once we finish, we will be sure to send you a copy of our final report.

Appendix D: Trail Guide/Trail Manager Questions

Interviewers should ask these questions as part of a larger interview. They are designed for specific audiences, so no one participant should hear every question.

Opening questions

With that over with, we want to start with some questions about your experiences in Sibiu and what your job is like.

1. How did you end up in the Sibiu area?
2. What do you enjoy most about working on the trails?
3. Have you worked in or visited other regions of Romania or Europe?
    a. How does working in Sibiu compare to working that region? How does the tourist experience in that region compare to the tourist experience in Sibiu? (question dependent on the answer given to question 3)
    b. Are there any things that Sibiu does especially well or poorly in terms of hiking tourism?

Typical day

Now we want to discuss a little more in depth about a typical day on the trails.

4. What are your day-to-day responsibilities?
5. Which trails and attractions are the most popular and what makes them stand out?
6. How many people might you encounter while out on the trails per day?
7. When are the trails busiest in terms of seasons, part of the week, and time of day?

People that use the trails

We have some questions about the people that use the trails.

8. Are they usually domestic tourists, or do they come from other countries?
    a. What languages do they speak?
9. What are some things that trail users typically like about their visits?
10. What are some things that trail users typically dislike about their visits?
11. How long is an average trip (a few hours or several days)?
12. Do people tend to travel in groups or alone?
13. Is it common to hire a trail guide?

Trail conditions

Next, we are going to talk more about the conditions of the trails.

14. What sort of problems do you typically encounter on hiking/biking trails?
    a. Is it necessary to report any of these problems to get them fixed?
15. Are the trail signs and markings effective in showing where the trails lead?
16. Do you have any major concerns with the trails?

Occupation-specific questions

We'd like to ask some questions specifically about your job as a [trail manager/trail guide].

17. Trail Managers
    a. What are the biggest challenges to maintaining the trails?
    b. How do you hear about problems along the trails?
    c. Do you have any way for trail users to report problems they encounter?
    d. Do you have an accurate count of how many people use the trails?
18. Trail Guides
    a. How long have you been giving tours?
    b. How does someone book a tour with you?
    c. Are there ways to communicate problems to trail managers?
    d. How do the trail users interact with the local businesses (if at all)?

Appendix E: Business Interview Questions

Interviewers should ask these questions as part of a larger interview. They are designed for specific audiences, so no one participant should hear every question.

Opening questions

With that over with, we want to start with some questions about your experiences in Sibiu and what your job is like.

1. What is the history of your business?
    a. How did you end up in the Sibiu area?
2. What services do you provide?
    a. What do you enjoy most about your job?
3. What are your day-to-day responsibilities?
4. Have you worked in or visited other regions of Romania or Europe?
    a. How do customers and businesses in Sibiu compare to that region?
    b. Are there any things that Sibiu does especially well or poorly with regards to business?

Customers

We have some questions about your customers.

5. Who are your customers (what nationality, language, and age are they)?
6. What do they come to Sibiu to do/see? (i.e. hiking, sightseeing, exploring the city/culture)
7. What product or service (meals, open garden, etc.) do customers like the most?
8. What are some things that customers typically like or dislike about their visits?
9. Do people tend to travel in groups or alone?
10. How long do guests typically stay in the area?
11. During what times of the year do you get the most business in terms of seasons, part of the week, and time of day?

Business info

We'd like to ask a few questions about how your business operates.

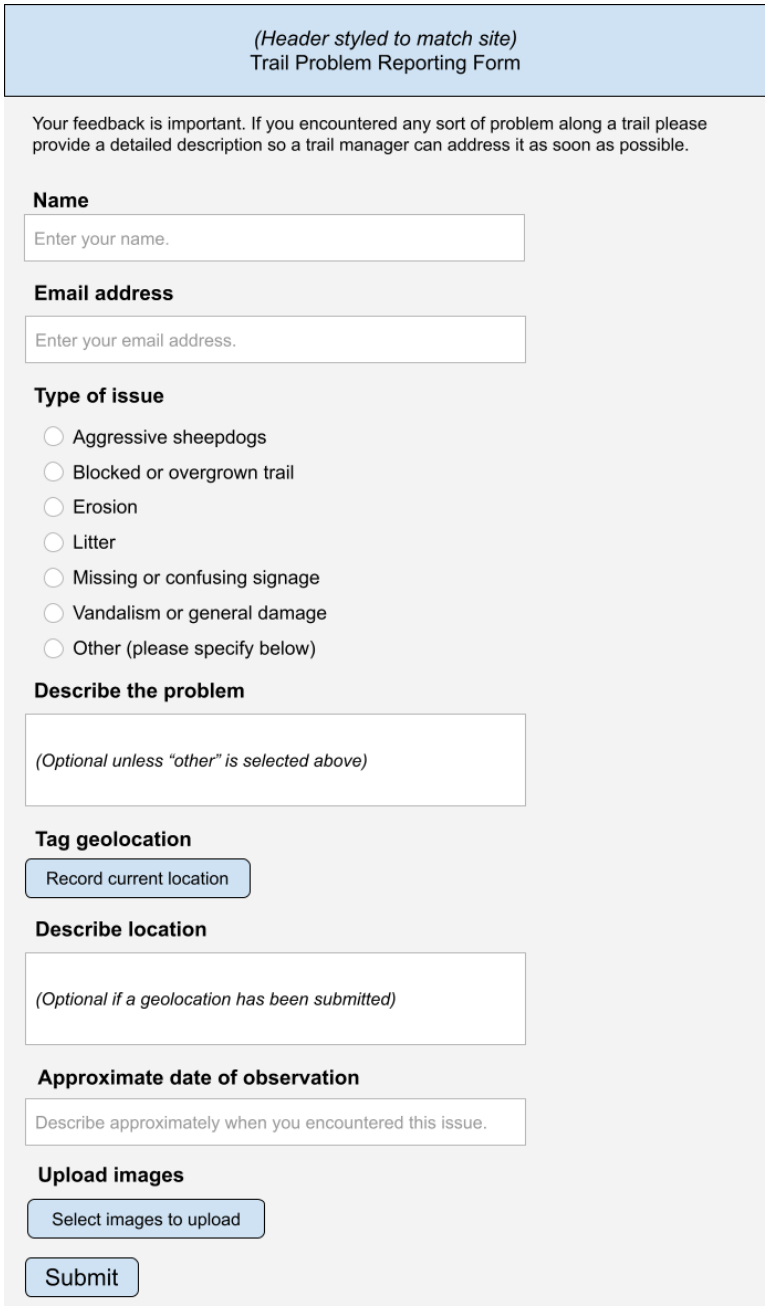
12. How do you advertise your business?
13. What do trail users need from your business (bike rentals, maps, etc.), and how do you cater to them?
    a. Are there other things that trail users might appreciate?
    b. Are there other local businesses that cater to trail users (restaurants, lodging, mechants, etc)?

Appendix F: Reporting System Specifications

This document specifies the features, functionality, and approximate interface of a form to report problems encountered along the trails in Sibiu County, Romania.

Example Interface

The prototype wireframe below provides an overall approximation of the form's visual interface. Italicized text indicates a comment that would not be present in the final version.



Feature Breakdown

This section describes the features and their functionality.

Input Fields

1. Small text entry: submitter's name
    a. Required
2. Small text entry: submitter's email address
    a. Required
3. Radio buttons: select issue from common problems
    a. Required
    b. Options (in alphabetical order):
        i. Aggressive sheepdogs
        ii. Blocked or overgrown trail
        iii. Erosion
        iv. Litter
        v. Missing or confusing signage
        vi. Vandalism or general damage
        vii. Other (please specify below)
4. Large text entry: description of problem
    a. Required if "other" is selected in *Feature 3*
    b. Optional if any other option is selected in *Feature 3*
5. Large text entry: description of location
    a. Optional if coordinates have been recorded using *Feature 6*
    b. Otherwise, this is required
6. Small text entry: date of observation
    a. Required
    b. Note: this is a text entry box, not a calendar picker

Functional Components

7. Button: detect current location
    a. Requests the location of the user's device
        i. Mobile device support is critical
    b. If successful, records the latitude and longitude
    c. If unsuccessful, informs the user why (if permissions were denied or if their device is unsupported, etc.)
8. Button: multiple file upload
    d. After upload, provides the option "upload another file" up to 10 files
    e. Reasonable file size limit should allow short videos
    f. Should allow common photo and video formats, such as PNG, JPEG, HEIC, MP4
9. Button: submit
    a. Submits the form if all required input fields are satisfied

On Submission

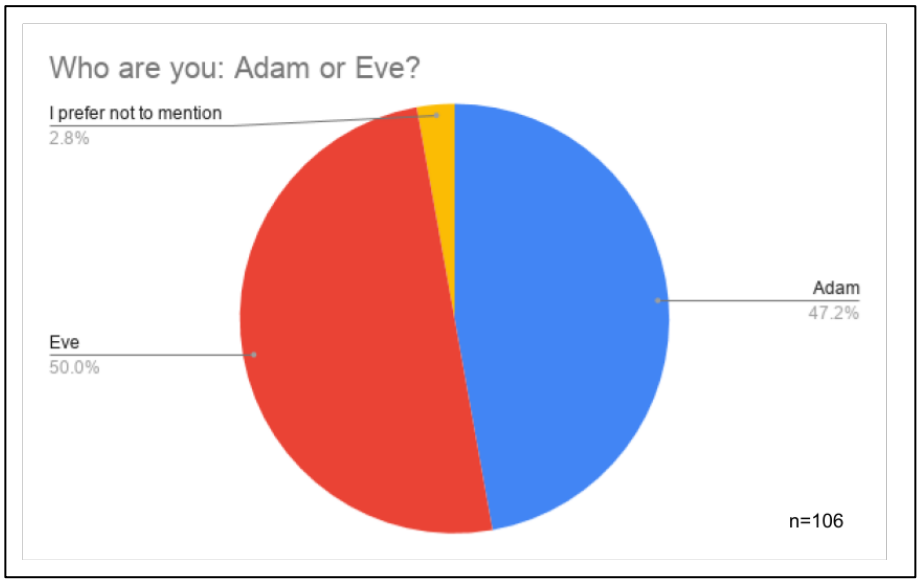
When successfully submitted, the form should:

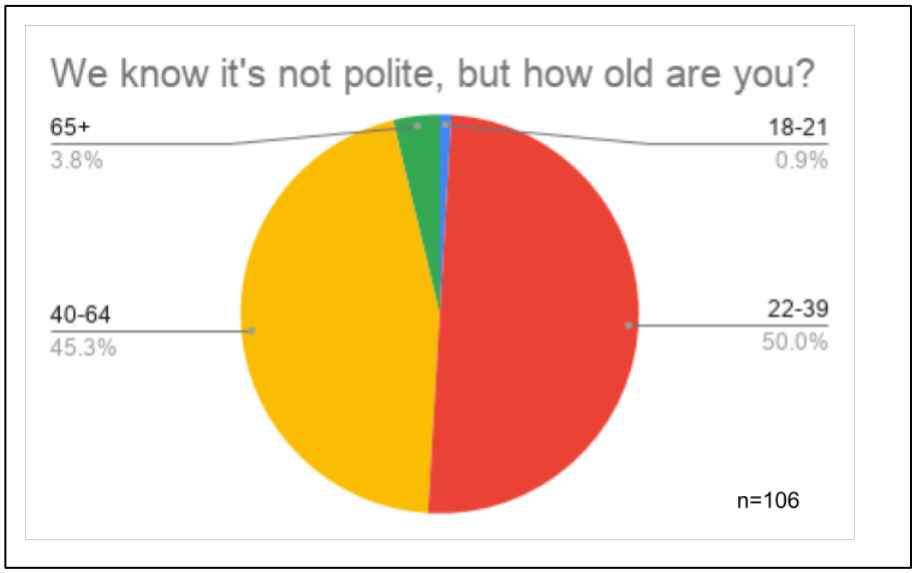
- Store information from all input fields (*Features 1-5*)
- Store information from location button (*Feature 6*)
- Store any submitted files (*Feature 7*)
- Store date and time of submission
- Notify an email address of the new response, including a summary of the submission

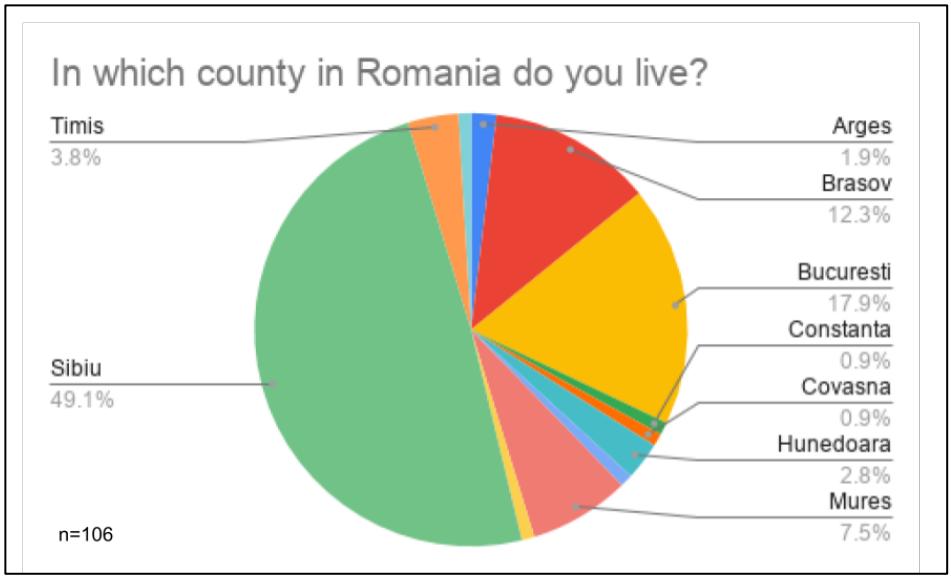
Stored information should be in an accessible database. This specification will not mandate the exact nature of the database, but its contents should be easily viewable in a tabular format by non-technical users.

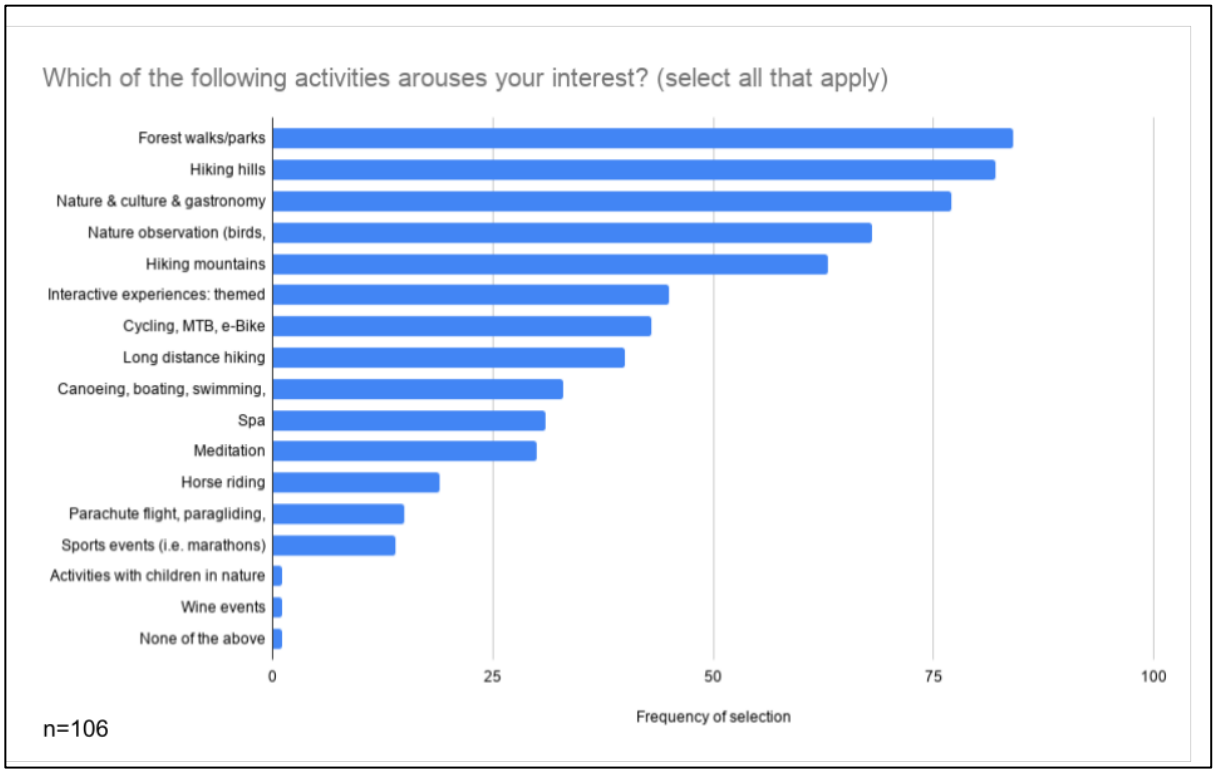
Appendix G: Romanian Survey Results

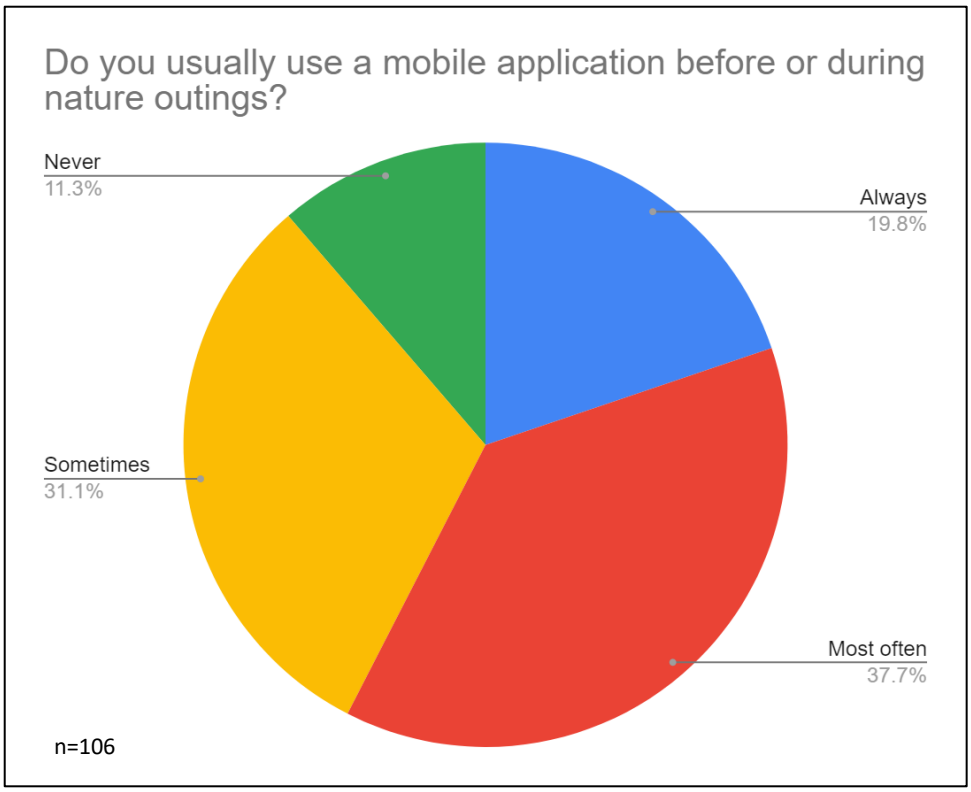
Note: The team only included project-relevant responses. The respondents of the original survey answered in Romanian, but English translations of the results are provided for ease of viewing.

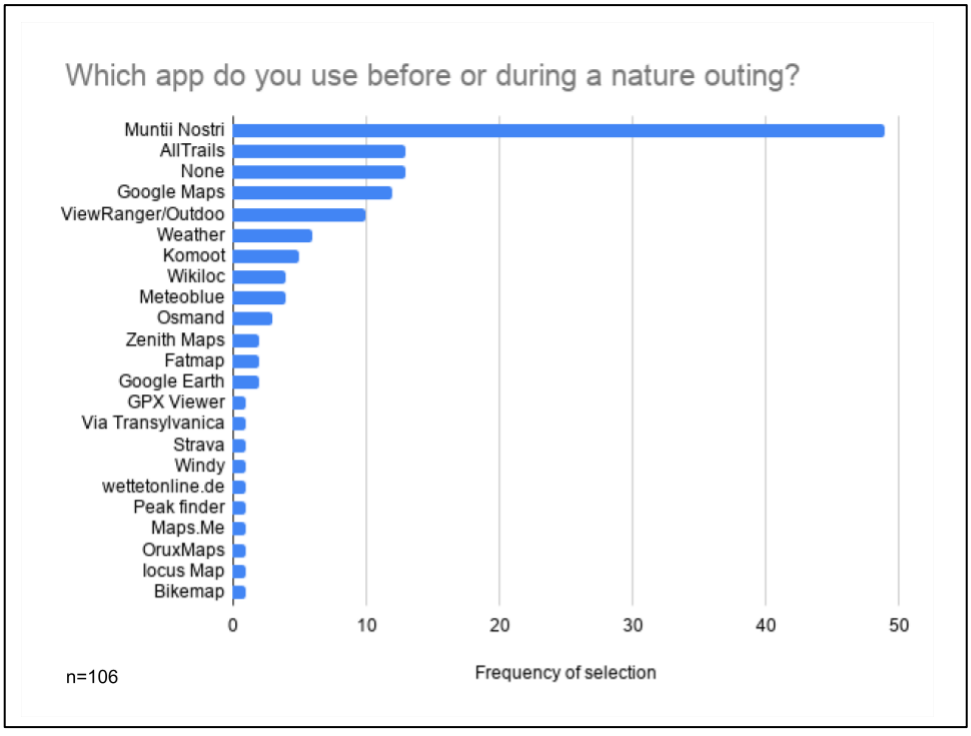


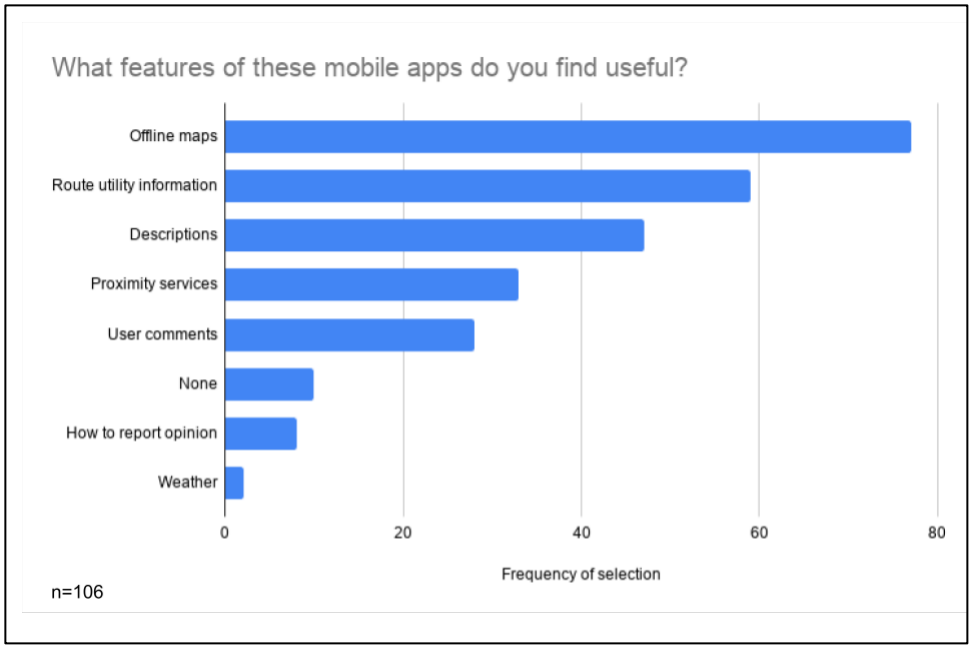


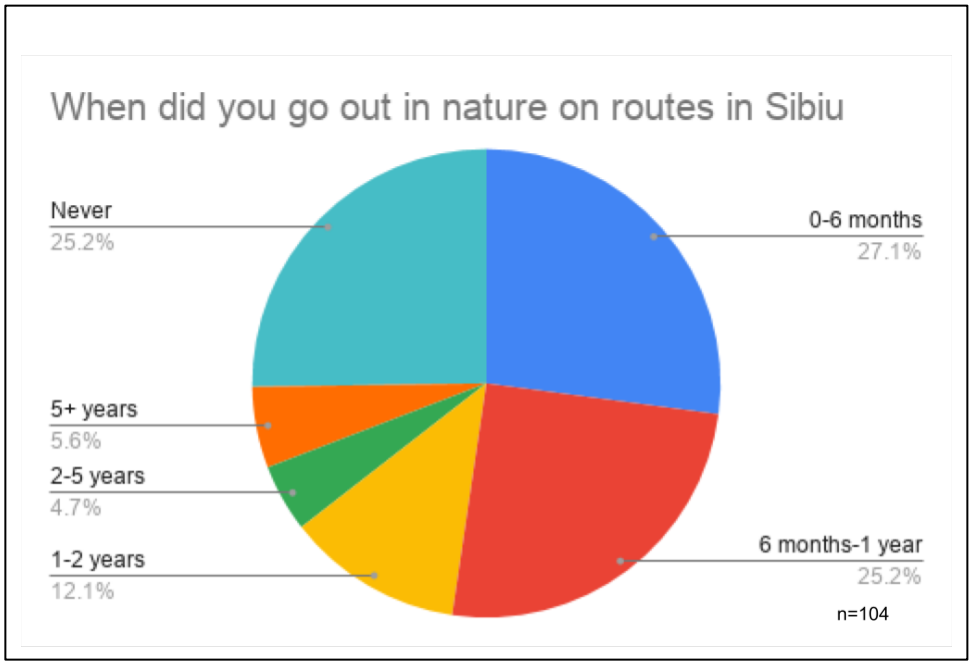

In which county in Romania do you live?
Timis
3.8%
Arges
1.9%
Brasov
12.3%
Bucuresti
17.9%
Constanta
0.9%
Covasna
0.9%
Hunedoara
2.8%
Mures
7.5%
Sibiu
49.1%
n=106


Which of the following activities arouses your interest? (select all that apply)
Forest walks/parks
Hiking hills
Nature & culture & gastronomy
Nature observation (birds,
Hiking mountains
Interactive experiences: themed
Cycling, MTB, e-Bike
Long distance hiking
Canoeing, boating, swimming,
Spa
Meditation
Horse riding
Parachute flight, paragliding,
Sports events (i.e. marathons)
Activities with children in nature
Wine events
None of the above
0
25
50
75
100
Frequency of selection
n=106


Do you usually use a mobile application before or during nature outings?
Never
11.3%
Always
19.8%
Sometimes
31.1%
Most often
37.7%
n=106

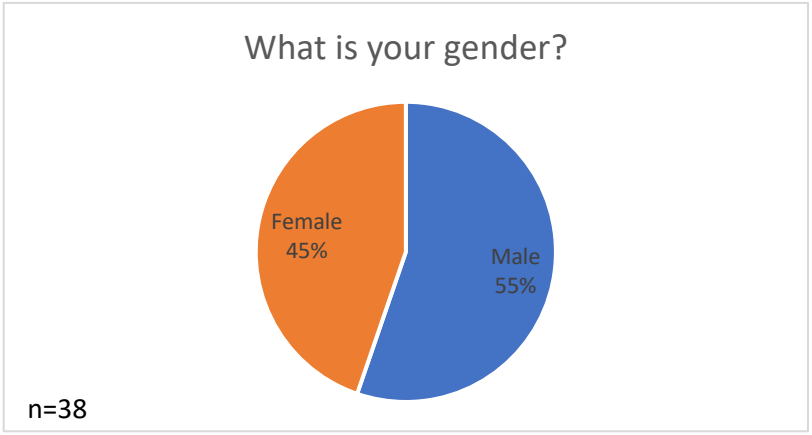

Which app do you use before or during a nature outing?
Muntii Nostri
AllTrails
None
Google Maps
ViewRanger/Outdoo
Weather
Komoot
Wikiloc
Meteoblue
Osmand
Zenith Maps
Fatmap
Google Earth
GPX Viewer
Via Transylvanica
Strava
Windy
wettetonline.de
Peak finder
Maps.Me
OruxMaps
locus Map
Bikemap
0
10
20
30
40
50
Frequency of selection
n=106

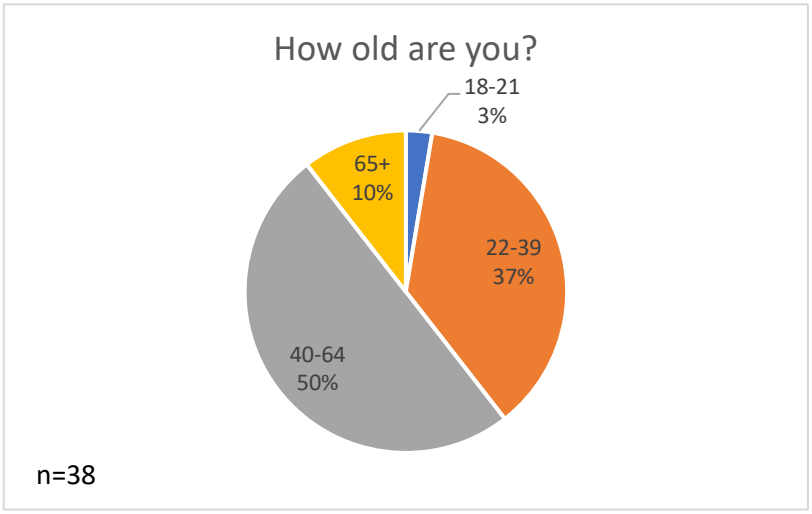

What features of these mobile apps do you find useful?
Offline maps
Route utility information
Descriptions
Proximity services
User comments
None
How to report opinion
Weather
0
20
40
60
80
Frequency of selection
n=106

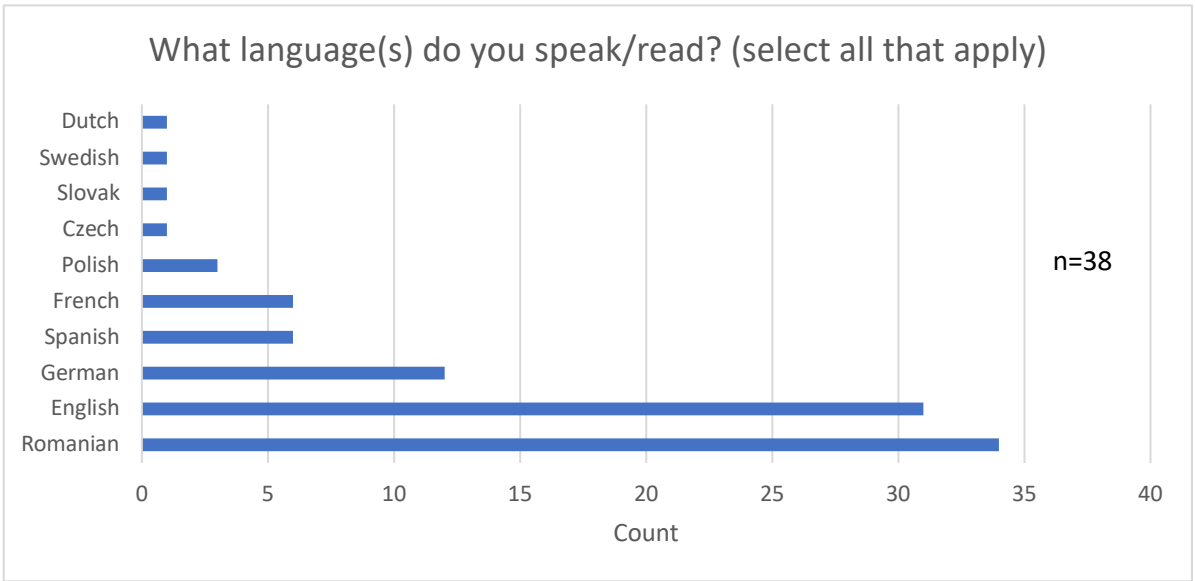

When did you go out in nature on routes in Sibiu
Never
25.2%
0-6 months
27.1%
5+ years
5.6%
2-5 years
4.7%
1-2 years
12.1%
6 months-1 year
25.2%
n=104

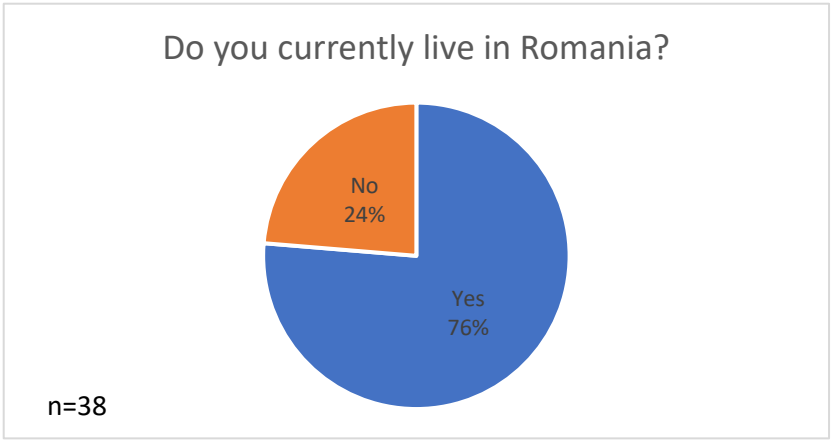

Overall, how satisfied were you with your experience?
60
40
20
0
Number of respondants
1
2
3
4
5
Satisfaction level (1=dissatisfied, 5=extremely satisfied)
n=99

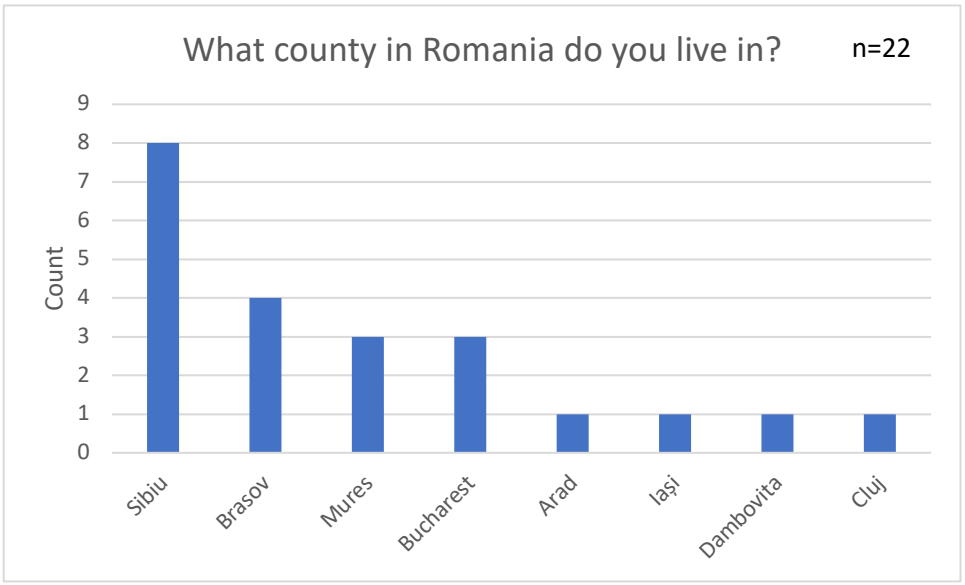
Appendix H: English Survey Results

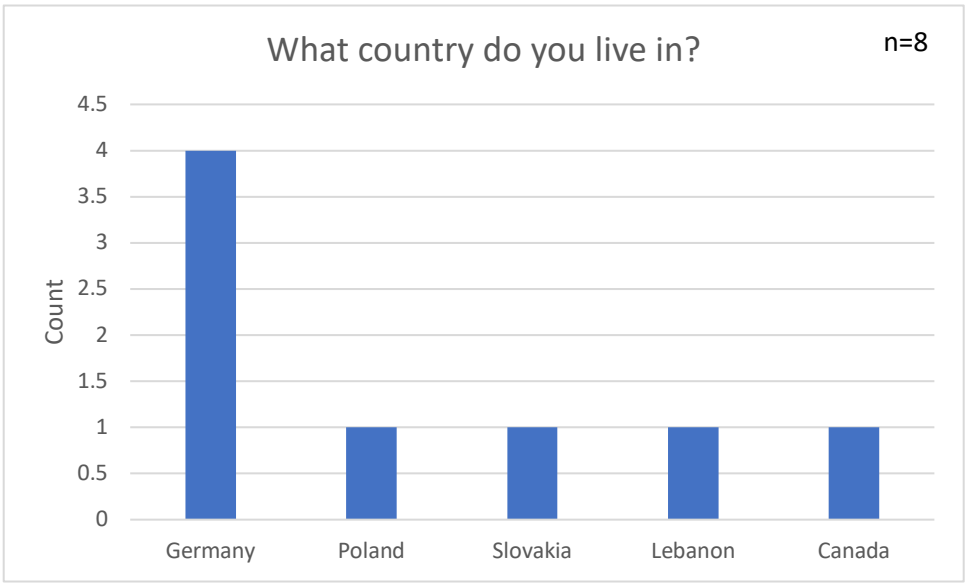


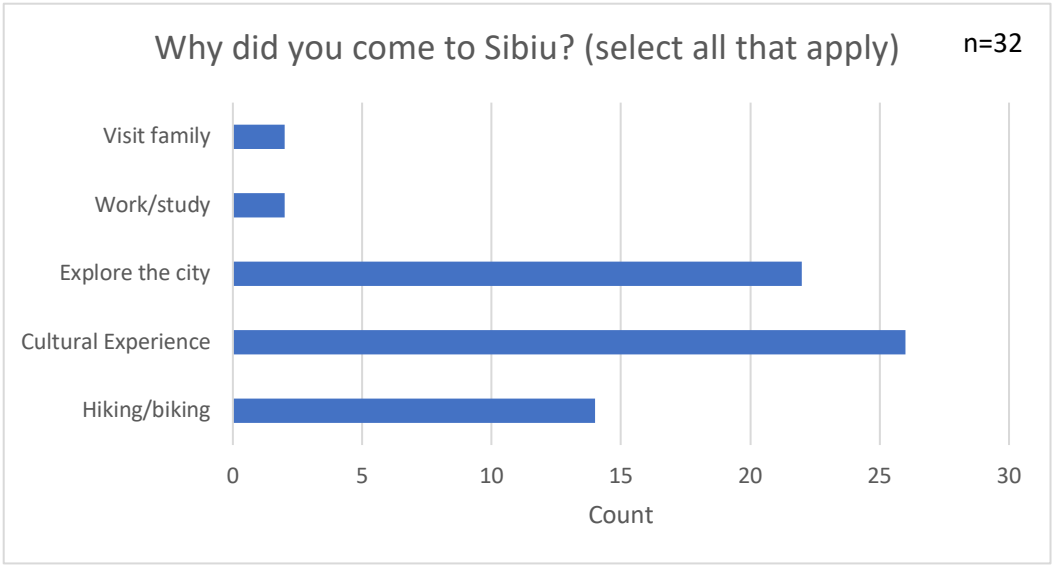


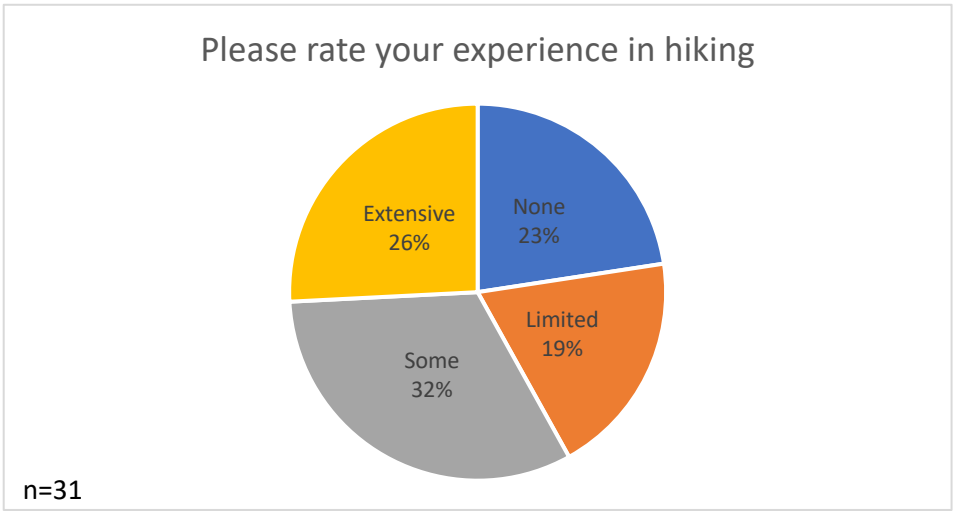


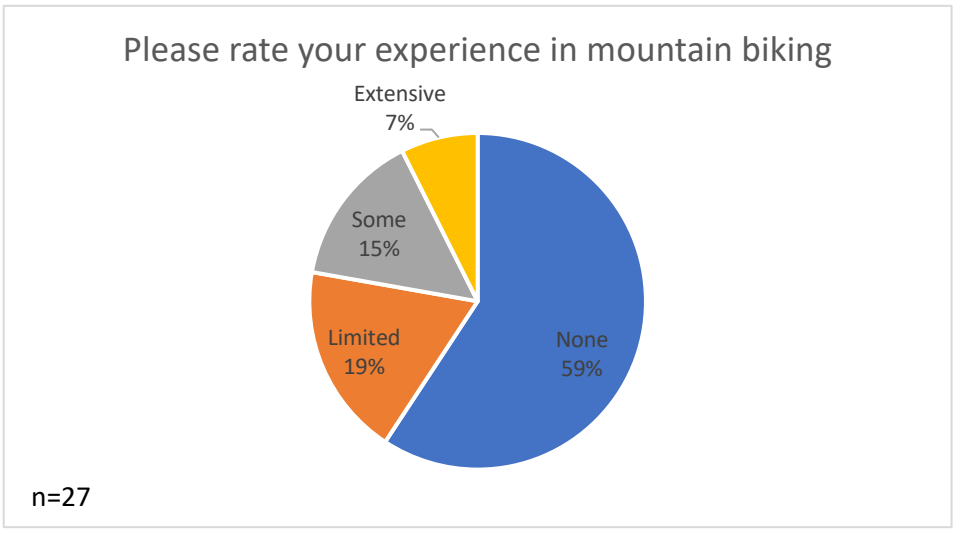

Do you currently live in Romania?
No
24%
Yes
76%
n=38

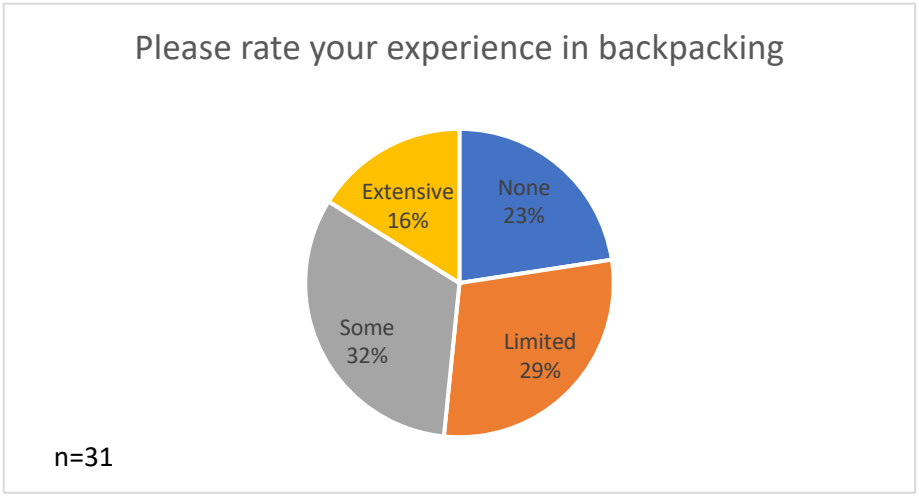

What county in Romania do you live in?
n=22
Count
9
8
7
6
5
4
3
2
1
0
Sibiu
Brasov
Mures
Bucharest
Arad
Iași
Dambovita
Cluj

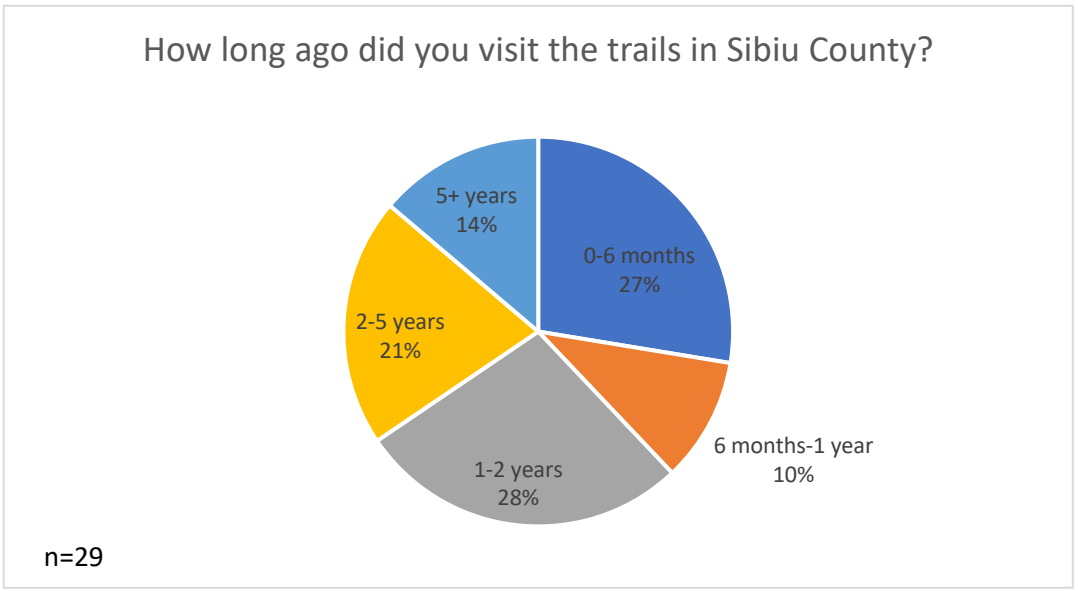

What country do you live in?
n=8
Count
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Germany
Poland
Slovakia
Lebanon
Canada

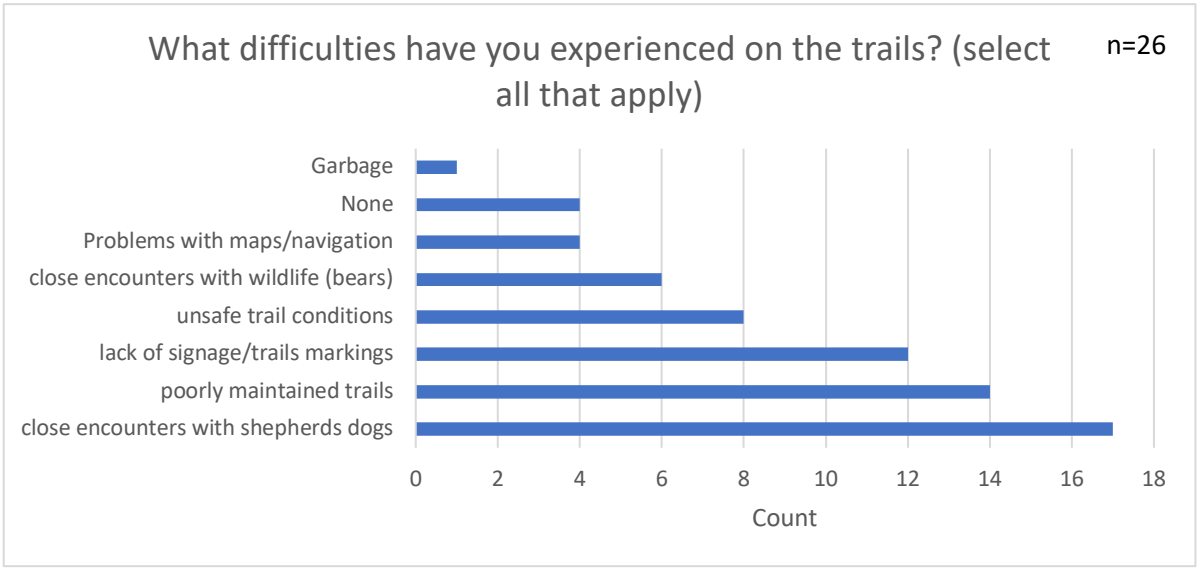

Why did you come to Sibiu? (select all that apply)
n=32
Visit family
Work/study
Explore the city
Cultural Experience
Hiking/biking
0
5
10
15
20
25
30
Count

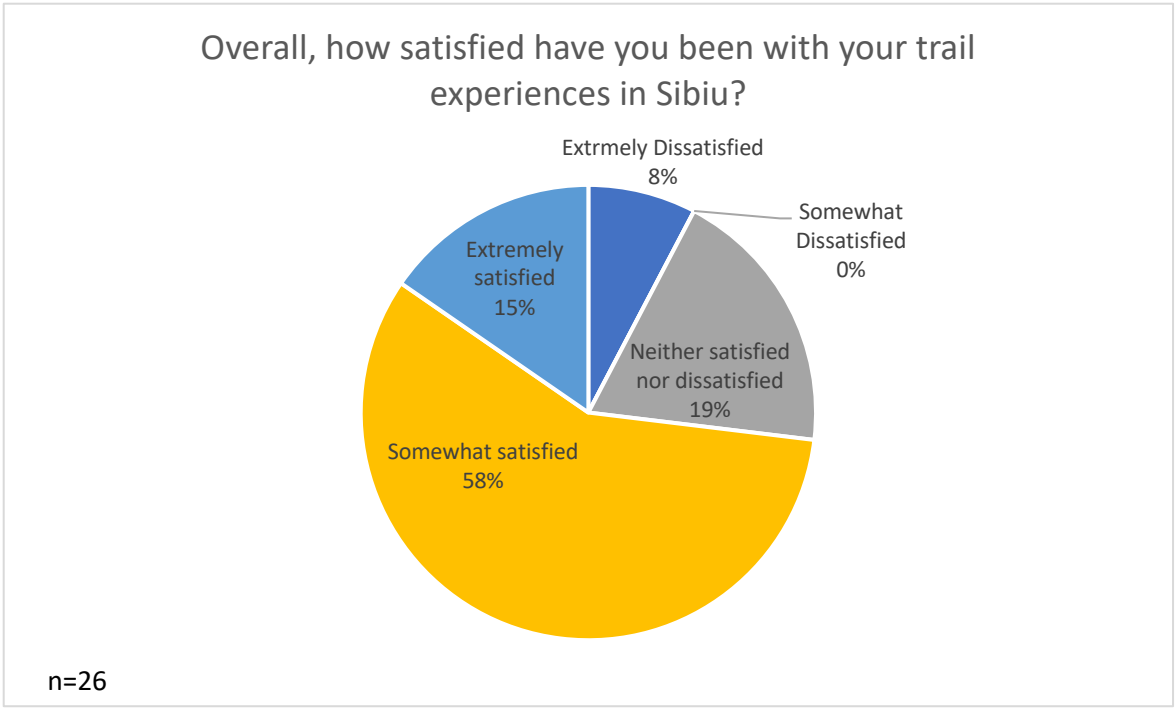

Please rate your experience in hiking
Extensive 26%
None 23%
Limited 19%
Some 32%
n=31

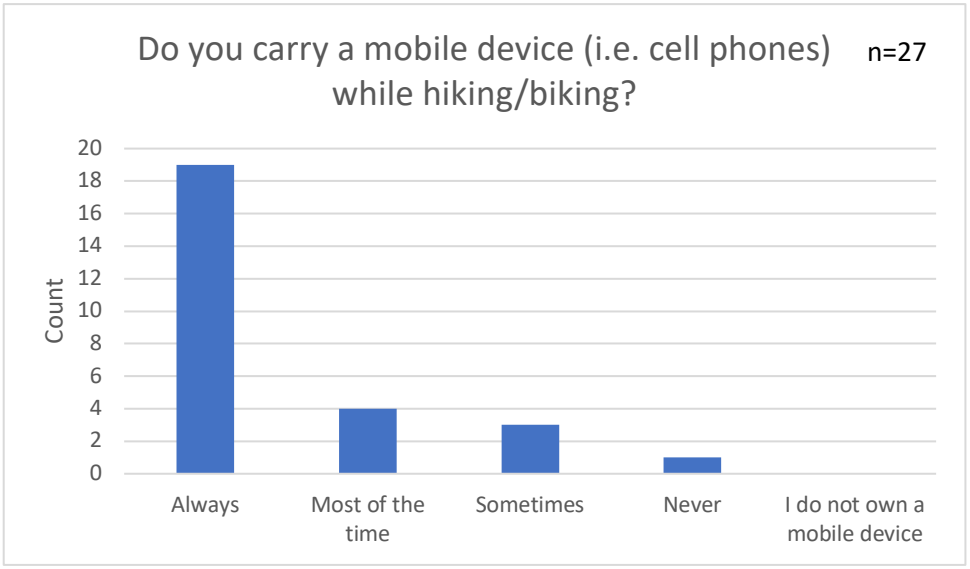

Please rate your experience in mountain biking
Extensive 7%
Some 15%
Limited 19%
None 59%
n=27

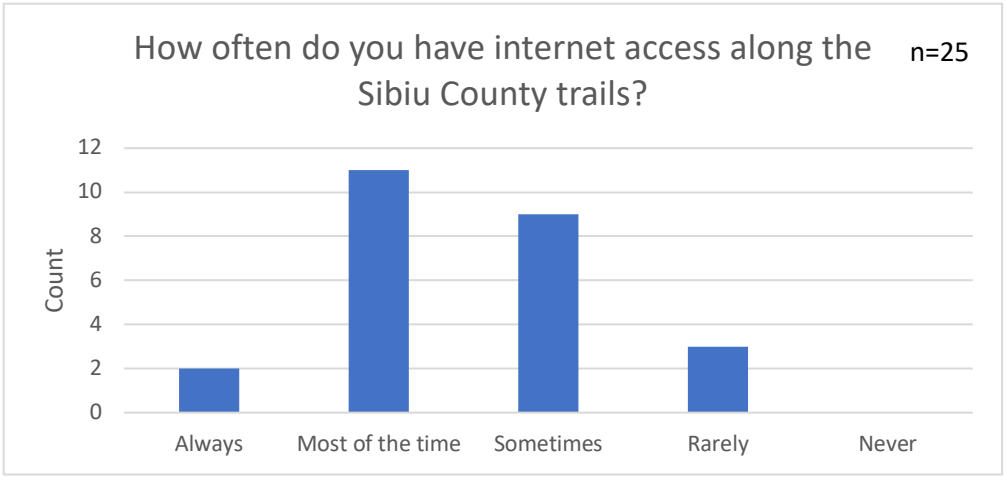

Please rate your experience in backpacking
Extensive 16%
None 23%
Some 32%
Limited 29%
n=31

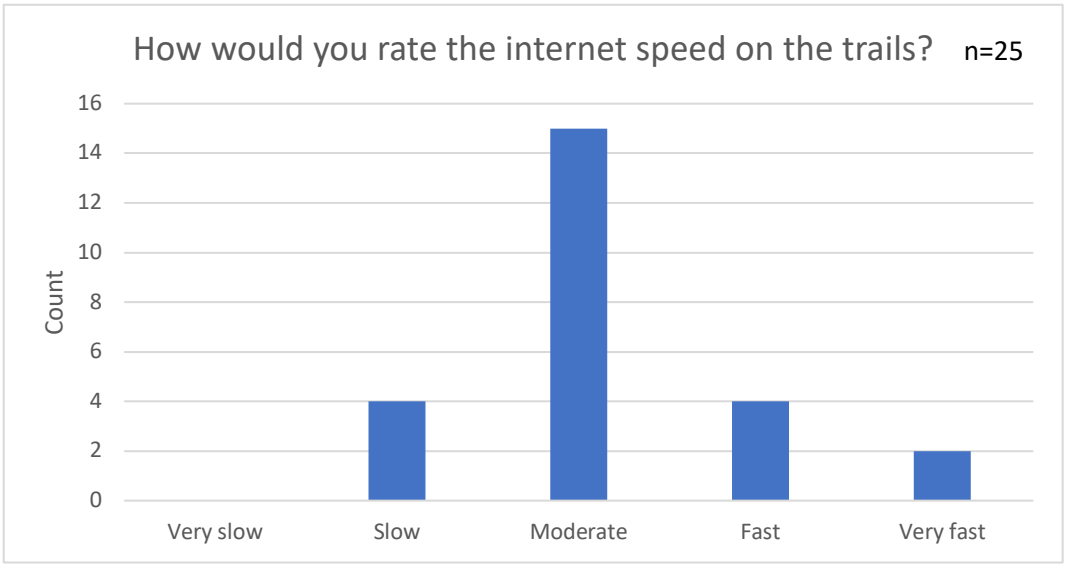

How long ago did you visit the trails in Sibiu County?
5+ years 14%
0-6 months 27%
2-5 years 21%
6 months-1 year 10%
1-2 years 28%
n=29

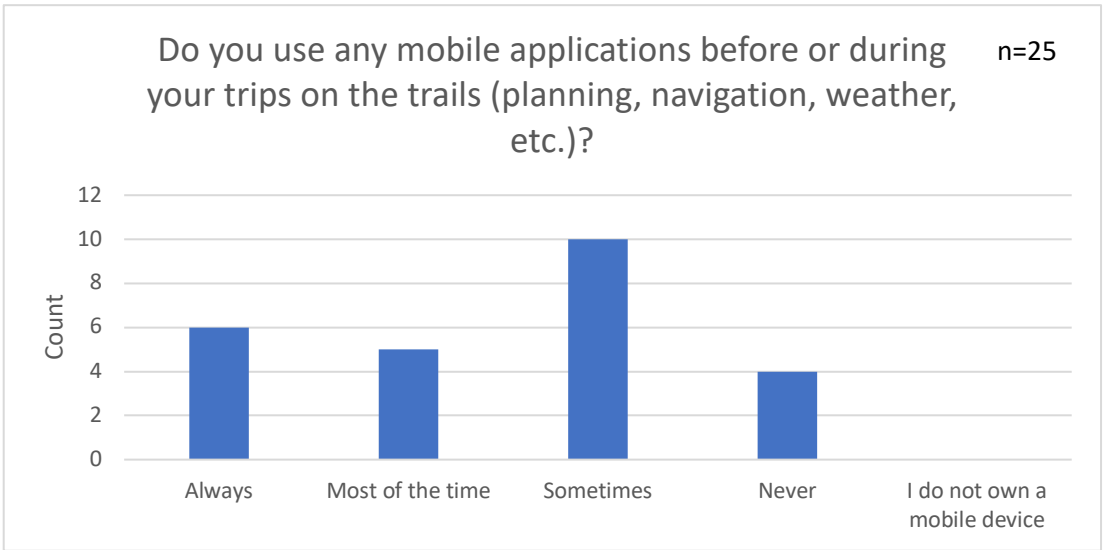

What difficulties have you experienced on the trails? (select all that apply)
n=26
Garbage
None
Problems with maps/navigation
close encounters with wildlife (bears)
unsafe trail conditions
lack of signage/trails markings
poorly maintained trails
close encounters with shepherds dogs
0
2
4
6
8
10
12
14
16
18
Count

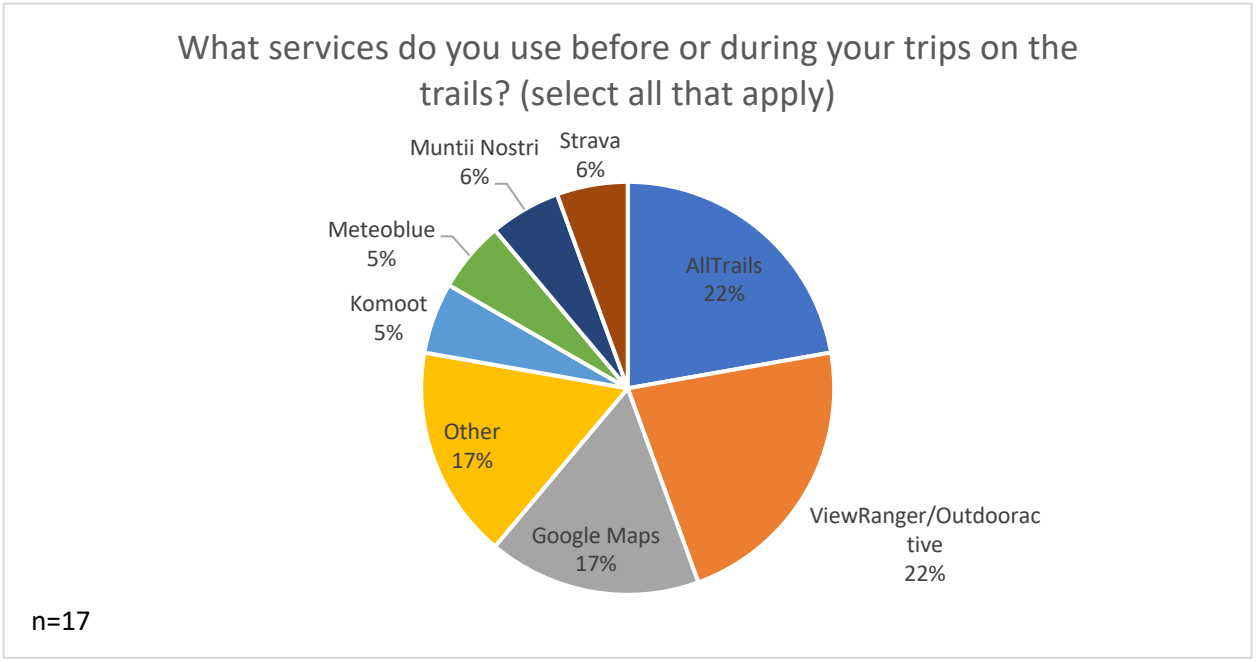

Overall, how satisfied have you been with your trail experiences in Sibiu?
Extrmely Dissatisfied 8%
Somewhat Dissatisfied 0%
Neither satisfied nor dissatisfied 19%
Somewhat satisfied 58%
Extremely satisfied 15%
n=26

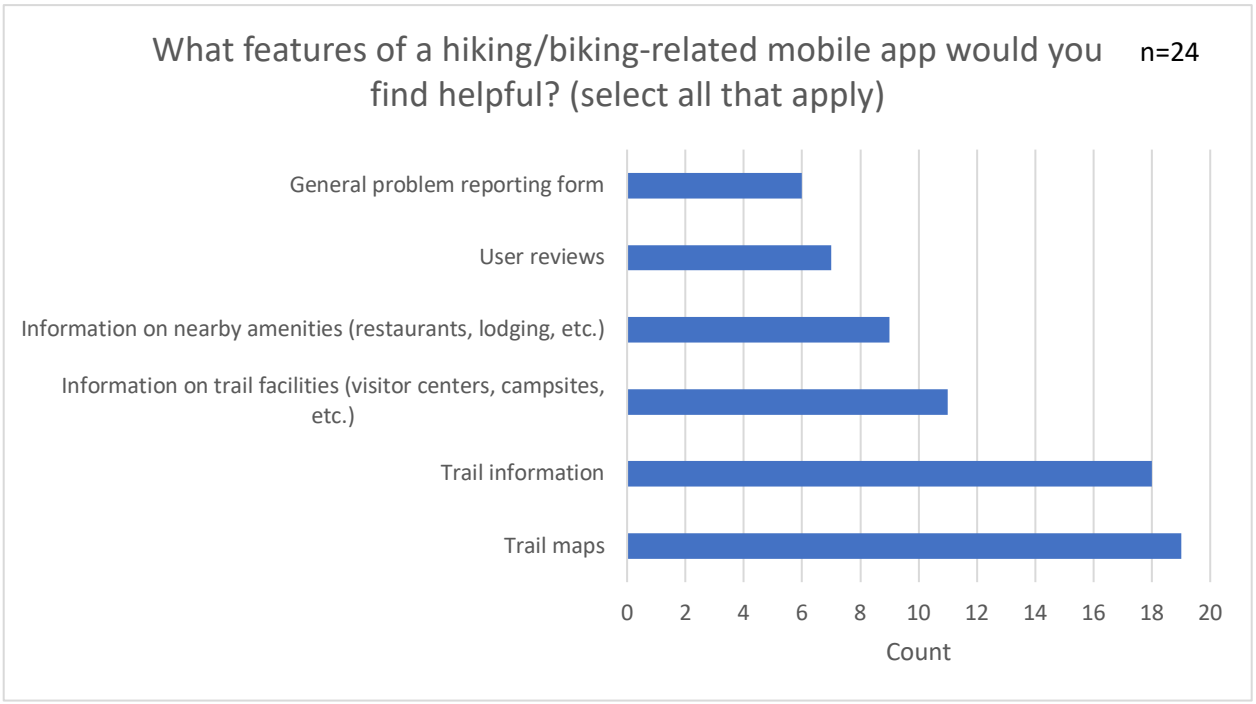

Do you carry a mobile device (i.e. cell phones) while hiking/biking?
n=27
Count
20
18
16
14
12
10
8
6
4
2
0
Always
Most of the time
Sometimes
Never
I do not own a mobile device

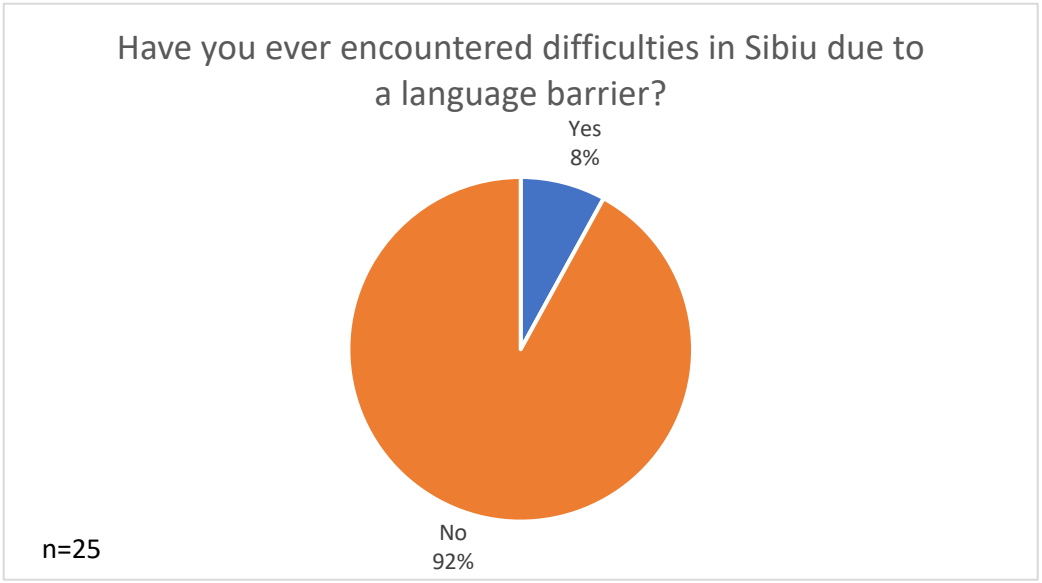

How often do you have internet access along the Sibiu County trails?
n=25
Count
12
10
8
6
4
2
0
Always
Most of the time
Sometimes
Rarely
Never

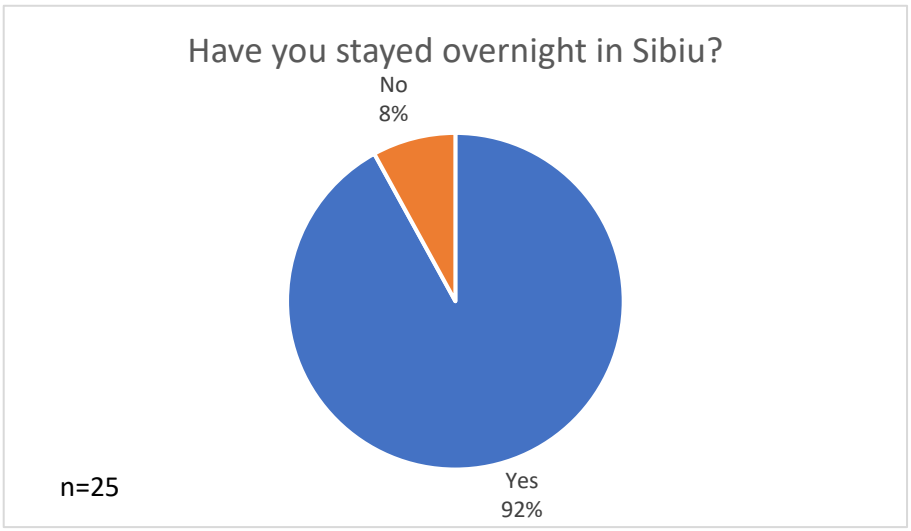

How would you rate the internet speed on the trails?
n=25
Count
16
14
12
10
8
6
4
2
0
Very slow
Slow
Moderate
Fast
Very fast

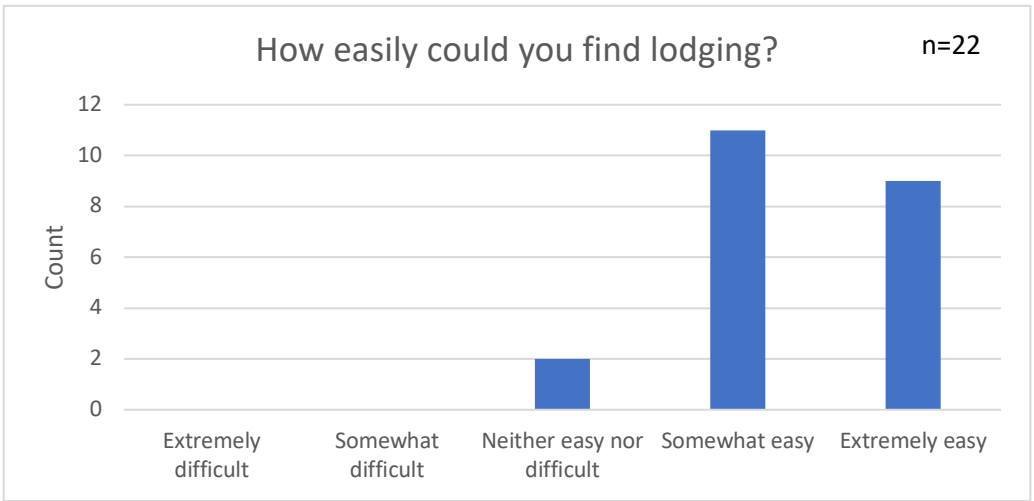

Do you use any mobile applications before or during your trips on the trails (planning, navigation, weather, etc.)?
n=25
Count
12
10
8
6
4
2
0
Always
Most of the time
Sometimes
Never
I do not own a mobile device

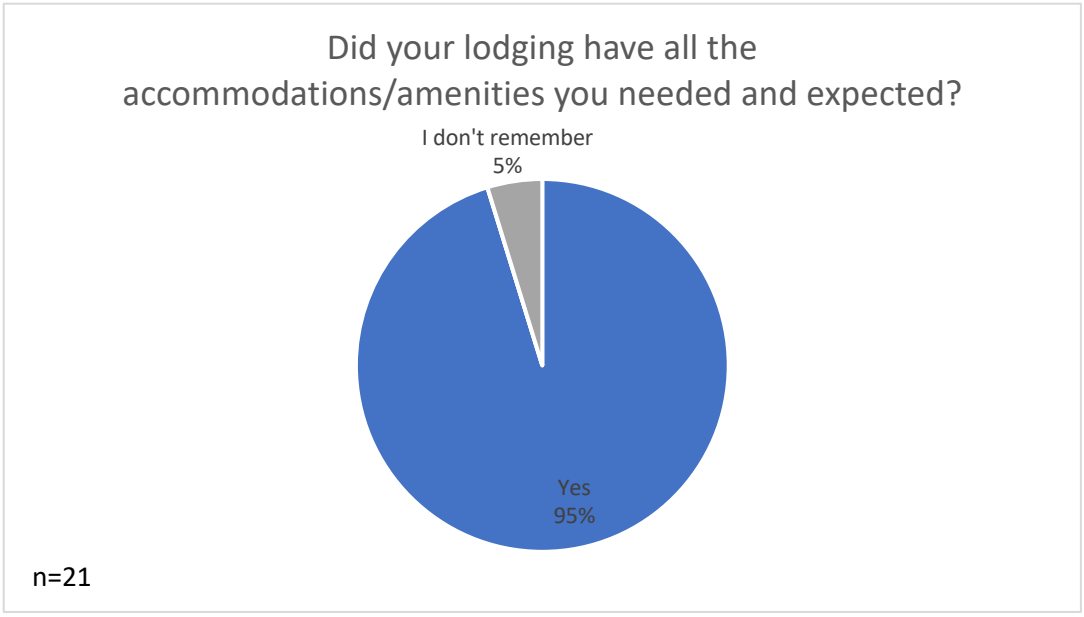

What services do you use before or during your trips on the trails? (select all that apply)
Muntii Nostri 6%
Strava 6%
Meteoblue 5%
Komoot 5%
AllTrails 22%
Other 17%
Google Maps 17%
ViewRanger/Outdooractive 22%
n=17

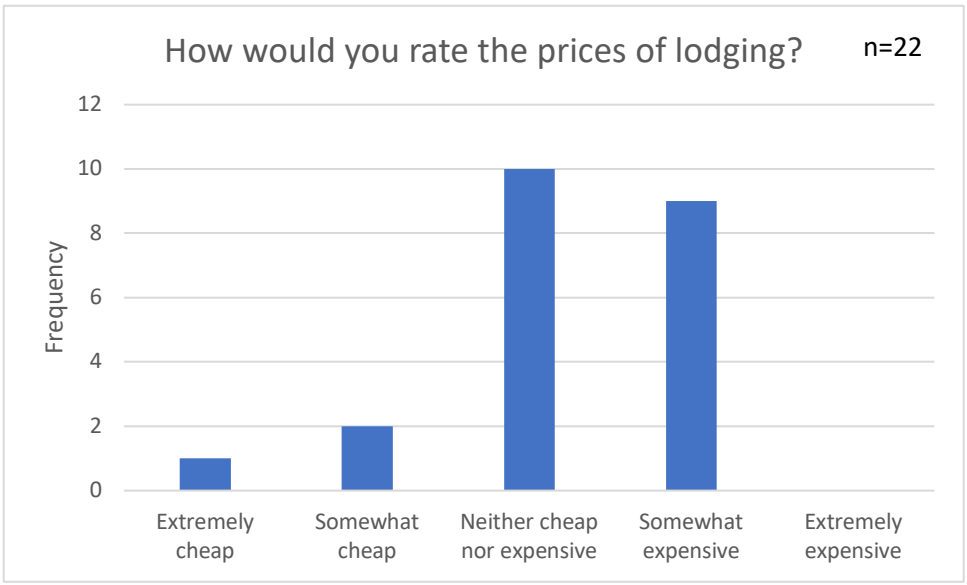

What features of a hiking/biking-related mobile app would you find helpful? (select all that apply)
n=24
General problem reporting form
User reviews
Information on nearby amenities (restaurants, lodging, etc.)
Information on trail facilities (visitor centers, campsites, etc.)
Trail information
Trail maps
0 2 4 6 8 10 12 14 16 18 20
Count


Have you ever encountered difficulties in Sibiu due to a language barrier?
Yes
8%
No
92%
n=25

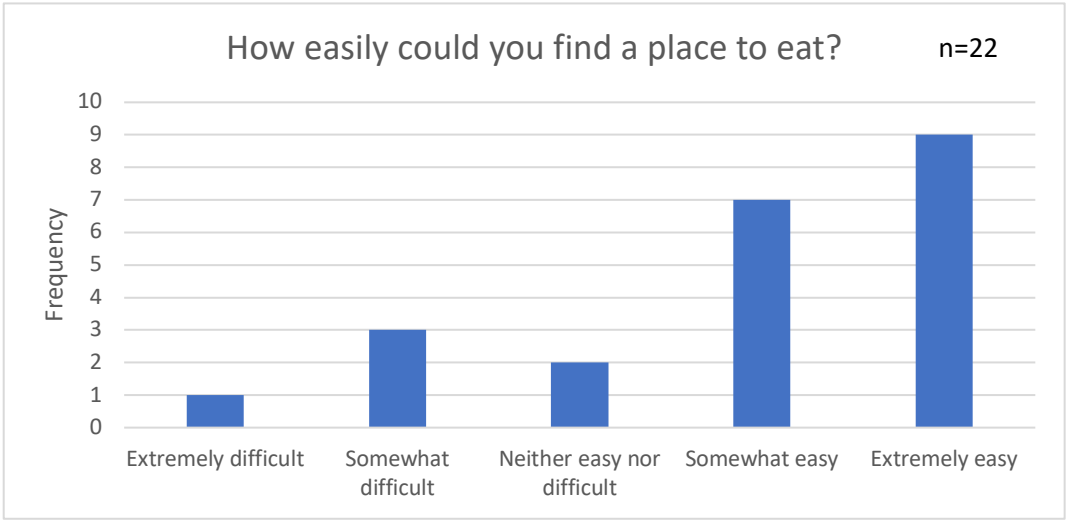

Have you stayed overnight in Sibiu?
No
8%
Yes
92%
n=25

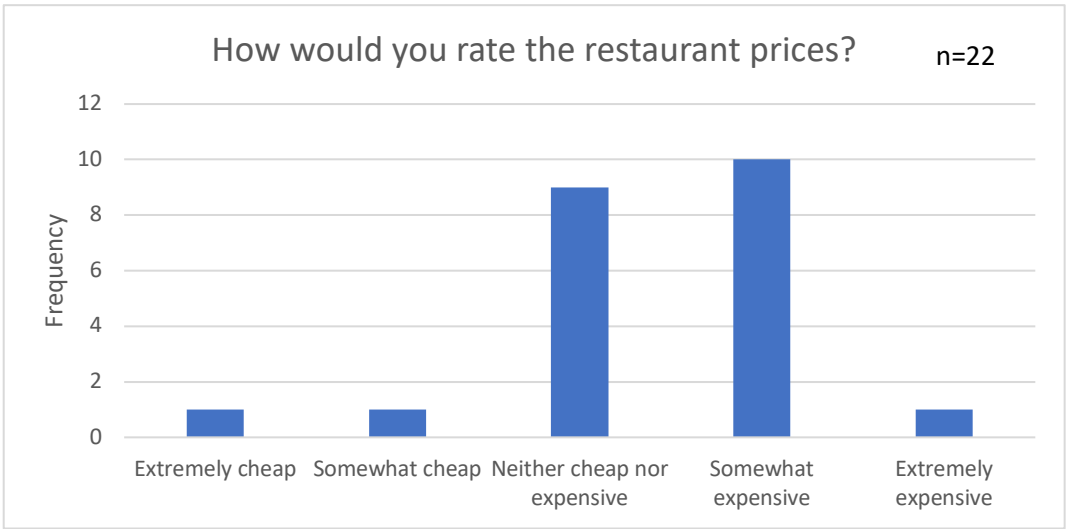

How easily could you find lodging?
n=22
Count
12
10
8
6
4
2
0
Extremely difficult
Somewhat difficult
Neither easy nor difficult
Somewhat easy
Extremely easy

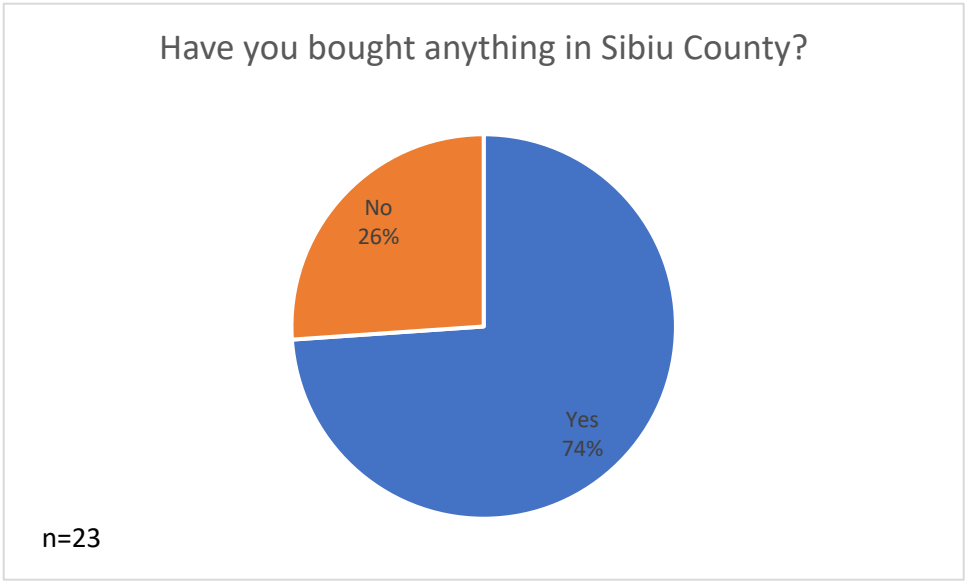

Did your lodging have all the accommodations/amenities you needed and expected?
I don't remember 5%
Yes 95%
n=21


How would you rate the prices of lodging?
n=22
Frequency
12
10
8
6
4
2
0
Extremely cheap
Somewhat cheap
Neither cheap nor expensive
Somewhat expensive
Extremely expensive


Have you eaten at a restaurant in Sibiu County?
No
0%
Yes
100%
n=23


How easily could you find a place to eat?
n=22
Frequency
10
9
8
7
6
5
4
3
2
1
0
Extremely difficult
Somewhat difficult
Neither easy nor difficult
Somewhat easy
Extremely easy


How would you rate the restaurant prices?
n=22
Frequency
12
10
8
6
4
2
0
Extremely cheap
Somewhat cheap
Neither cheap nor expensive
Somewhat expensive
Extremely expensive


Have you bought anything in Sibiu County?
No
26%
Yes
74%
n=23


How easy was it to find the products you were looking for?
n=17
Frequency
0
1
2
3
4
5
6
7
8
Extremely difficult
Somewhat difficult
Neither easy nor difficult
Somewhat easy
Extremely easy


How would you rate the price of products?
n=16
Frequency
0
1
2
3
4
5
6
7
8
9
10
Extremely cheap
Somewhat cheap
Neither cheap nor expensive
Somewhat expensive
Extremely expensive

Appendix I: Ranked Report of Potential Hiking Apps

1. Wikiloc

General features:

- Discover trails by searching with filters such as mileage, elevation gain or browse the map
- GPS tracking that gives the user real-time statistics like speed, distance and elevation profile graphs.
- Take photos and mark waypoints along the route to upload directly to Wikiloc
- Free offline maps that are stored to your iphone and will work without internet connection.
- Share recorded outings with friends and the Wikiloc community
- Upload your own trails

Premium Subscription: 9.99 Euros/year

- Guide yourself along millions of outdoor trails from smartphone with heading indicators, compass, and audio cues. Works offline.
- Search by passing area: find trails starting of passing through your selected areas
- Download trails directly to garmin, apple watch, or Suunto
- Share location with friends and loved ones during an activity
- Check weather forecast
- Ad-free browsing
- Advanced trail search filters
- Organize trail lists to set goals, plan future trips, or share with friend

Wikiloc Org

- Promote your brand and trails to Wikiloc's community
- Have your own personal map of trails
    - Users wanting to follow your trails can use the wikiloc app navigation feature for free
- Trail visitor stats
    - See number of visits and country of origin at all times
    - Know total number of downloads and times your trail have been added to a favorites list
    - Grid displaying most popular routes, number of visits, downloads, favorites, comments
    - Emailed a monthly summary with the main data

Upgrade to Wikiloc ORG

	Basic	Local	Regional
Your map of trails	✔	✔	✔
All Wikiloc users can follow your trails	✔	✔	✔
Stats (Number of Visits, Country, etc.)	✔	✔	✔
No advertising on your trails	✔	✔	✔
ORG badge ORG	✔	✔	✔
Your profile featured on our ORG page.	✔	✔	✔
Wikiloc Premium included	✔	✔	✔
Contribution to: 1% FOR THE PLANET	✔	✔	✔
Your ORG promoted on trail searches surrounding the ones you upload (up to 13,000 impressions/mo).		✔	✔
Your ORG promoted on trail searches in a wider area encompassing the ones you upload (up to 30,000 impressions/mo).			✔
	120 € * 1 year Activate ORG	495 € * 1 year Activate ORG	990 € * 1 year Activate ORG

2. AllTrails

General Features:

- Browse 200,000+ trails with hand-curated trail maps (500 trails come up when you search Sibiu, Romania)
- Access 8 different map layers
- Export files from trails, activities, and maps on AllTrails.com
- Import files to your AllTrails activities and maps lists
- Read and leave reviews
- Create custom lists and favorites lists of trails
- Create custom maps on AllTrails.com
- Use Navigator to keep track of your adventures and log your activities
- Use overlays to get more information on trails
- Be an active member in the AllTrails community

Pro Subscription - $2.50/month

- Download maps to your phone and see your exact GPS location on a fully detailed and interactive map even when you're offline
- Notifications when you've gone off-route
- Lifeline: a real-time tracker that sends status updates to your designated safely contacts with a tap. Automatically sends alerts to your safety contacts with your location if you're overdue for your planned finish time.
- Real-time map overlays including air quality, satellite weather, pollen, light pollution, and user heatmaps
- Create and print custom maps. Choose scale, orientation, gridlines, paper size, and map layers.
- Ad-free
- No clear business contact information, but the customer support email address is support@alltrails.com

3. ViewRanger/OutdoorActive

General Features:

- Shows trip distance, estimated duration, ascent, descent, highest point, lowest point, difficulty level
- Coordinates of starting point given so people can travel there
- Shows many outdoor activities such as hiking biking, running, amusement parks, skiing
- Over 100 hiking and biking results come up when you search Sibiu

Subscription Options:

Features	Basic - Free	Pro - $2.50/month	Pro+ - $5/month
Plan, save, print and navigate routes for over 30 different activities	✓	✓	✓
Rate & comment on routes, huts, lodgings	✓	✓	✓
Download the route's GPX data for use with the outdoor navigation system	✓	✓	✓
Ad free		✓	✓
Access routes and maps even with no internet access		✓	✓
Topographical maps and special activity network: swisstopo, ordnance survey and others		✓	✓
Trail networks for hiking and mountaineering, cycling, mountain biking, winter sports, equestrian activities		✓	✓
Expert-level maps with official details: Alpine Clubs (ÖAV, DAV), KOMPASS, ADFC			✓
Embed routes, lists and other content on websites and blogs			✓
Use the interactive 3D model to get a bird's-eye view of the route			✓

Contact form for business customers: https://corporate.outdooractive.com/en/contact/

4. Komoot

Website language options: Dutch, English, French, Italian, Spanish, Netherlands
General features:

- Ready-built routes as well as free route planning tech
    - Filter by distance, difficulty, public transportation links
- Turn-by-turn navigation and offline maps. Download individual routes or entire maps. One region available for free, and subsequent downloads available with payment.
- Log/save each trip and share photos, stories and recommendations to the community
- Specific routes for road biking, mountain biking, hiking, etc.
- Already has some trail coverage in Romania including a subset specific to Sibiu

Komoot Map Shop:

- Download maps to use offline. All maps are one time payments
- World pack ($29.99) - Unlocks every region worldwide.
- Region bundle ($8.99) - Mid-sized maps best for adventures across multiple regions
- Single region ($3.99) - smallest maps designed for local exploration

Subscription Options:

What you get:	Maps - bought individually	Premium - $4.99/month
Turn-by-turn voice navigation - just listen to instructions or follow them on screen to stay on track	✓	✓
Offline functionality - save individual tours of entire regions offline for reliable navigation even without phone signal	✓	✓
Weekly updates - safe in the knowledge that the map is always up to date	✓	✓
Available on all your devices - phone, garmins, wahoos, smartwatches, practically any GPS computer	✓	✓
Multi-day planner - easily plan adventures that'll take multiple days		✓
Sport-specific maps - choose between different maps specifically designed for mtb, cycling and hiking		✓

Appendix J: Spreadsheet of All Counting Systems Researched

Company and Product	Technology	Counting Ability	Range	Accuracy	Report Cycles	Size	Power Supply	Cost	URL
SensMax; SE Outdoor People Counting System	Active Infrared	Hikers and bikers combined	Up to 9m	95% 2m, >2m -1%/m	Hour, day, week, month, or year	6.7 x 6.7 x 2.5 cm	AA batteries; change every 2 years	241 EUR	https://sensmax.eu/devices/outdoor-people-counting-wireless-sensor-sensmax-se/
SensMax; DE Outdoor People Counting System	Active Infrared	Hikers and bikers combined; tracks direction	Up to 9m	95% 2m, >2m -1%/m	Hour, day, week, month, or year	6.7 x 6.7 x 2.5 cm	AA batteries; change every 1 year	255 EUR	https://sensmax.eu/devices/outdoor-wireless-people-counting-bidirectional-sensor-sensmax-de/
SensMax; TAC-B People Counting Sensor	Radar Sensor	Hikers and bikers separately; tracks direction and duration	Up to 14m	99% / person / m^2; 93% for crowded areas	Shares live and stores data as collected	8.0 x 8.0 x 3.5 cm	Internet and power source connection	590 EUR	https://sensmax.eu/devices/sensmax-tac-b-real-time-people-counting-radar-sensor/
TRAFx; Trail Counter	Passive Infrared	Hikers, bikers, and horseback riders	Up to 6m	95-100% narrow trail, 75-90% wide/crowded	Hourly or daily	7.0 x 11 x 4.0 cm	AA batteries; change every 9-10 years	2215 USD for bundle	https://www.trafx.net/products
TRAFx; Mountain Biker Counter	Geomagnetic Sensor	Bikers only	Up to 2m	Not available	Hourly or daily	14 cm x 10.5 x 5.0 cm	C batteries; change every 8-9 months	2215 USD for bundle	https://www.trafx.net/brochures/TRAFx_Mountain_Bike_Counter.pdf?v=190724
Eco-Counter; MULTI Nature	Combines Passive Infrared and Inductance Loop	Hikers, bikers, horseback riders, and ATVs separately	Up to 6m	Not available	Every 15 min or 1 hour	See Recyled Post and Zelt Greenway	LS batteries; change every 2 years	Quote Request	https://www.eco-counter.com/produits/multi-range/multi-nature-2/
Eco-Counter; PYRO Sensor	Passive Infrared	Hikers, bikers, horseback riders, kayakers, skiiers combined; tracks direction	Up to 15m	Not available	Every 15 min or 1 hour	1.8 x 4.0 x 9.0 cm	LS batteries; change every 10 years	Quote Request	https://www.eco-counter.com/produits/pyro-range/pyro-sensor/
Eco-Counter; PYRO Evo Box-Nature	Passive Infrared	Hikers, bikers, horseback riders, kayakers, skiiers combined; tracks direction	Up to 10m	95%	Every 6 hours	2.6 x 12.6 x 5.35 cm	LS batteries; change every 2 years	Quote Request	https://www.eco-counter.com/produits/pyro-evo-range-en/pyro-boxevo-nature-2/
Eco-Counter; PYRO Recycled Post	Passive Infrared	Hikers, bikers, horseback riders, kayakers, skiiers combined; tracks direction	Up to 15m	Not available	Every 15 min or 1 hour	120 x 15 x 8.0 cm	LS batteries; change every 10 years	Quote Request	https://www.eco-counter.com/produits/pyro-range/recycled-post/
Eco-Counter; ZELT Greenways	Inductance Loop	Bikers only; tracks direction	1100 to 9000mm	Not available	Every 15 min or 1 hour	110-150 cm x 40 cm	Battery powered; change every 2 years	Quote Request	https://www.eco-counter.com/produits/zelt-range/zelt-greenways/
Eco-Counter; SLABs	Pressure Sensor	Hikers only; tracks direction	Up to 10m	Not available	Every 15 min or 1 hour	50 x 50 x 1.6 cm	Battery powered; change every 10 years	Quote Request	https://www.eco-counter.com/produits/slabs/slabs/
Diamond Traffic Products; Trail Counter TT-4430	Active Infared	Hikers and bikers combined	Up to 20m	Not available	User specified	25.5 x 7.5 x 18 cm	D batteries; change every 12-15 months	585 USD	https://diamondtraffic.com/sites/default/files/Trail%20Counter%208.1%20March%202020%20-%20Legal.pdf

Link: https://docs.google.com/spreadsheets/d/1dnvvG-X6ZnjuGrmO_lsr5-6mP7KuOtFSytHqlzoMrZM/edit?usp=sharing

Appendix K: Report of Recommended Counting Systems

Existing Technology

Infrared Beams: Active

Active infrared beams are sold and work in pairs. There is one device that is the transmitter, and one that is the receiver (also called target reflector). Both parts must be set up vertically and directly across from each other in order to work properly. Active beams have a narrower zone/cone of detection than passive beams and work best when set up in narrow trail passages. The active infrared sensor works by sending a series of infrared pulses from the transmitter to the receiver, and when the beam is broken a count is registered. Typically, different models of active infrared beams will allow the owner to predetermine the time the beam is broken for or size of the object breaking the beam required to register a count. This prevents falling sticks, leaves, or larger animals from being falsely added to the count.

Infrared Beams: Passive

Passive infrared beams use only a transmitter and operate by identifying changes of heat in the detection area. Human body temperature (~37°C) is used to register a count since animals tend to have higher internal body temperatures and will not register as a count. Passive beams are mounted on one side of the trail and work best when the sensor is pointed toward a wall, building face, dense vegetation, or similar background.

Radar Sensor

Radar sensors use mmWave technology to identify and count pedestrians. The device is mounted at least 2-2.5 m above ground level and can detect people in a wide area. The radar sensor supports up to five counting lines and zones, so it can be used to track the number of people at multiple entrances at the same time as well as pedestrians' direction of travel and time spent in each zone. Additionally, the owner can set the sensor to record and classify pedestrians moving at different speeds to help distinguish between walkers, joggers, and bikers.

Technology	Applications	Strengths	Weaknesses
Infrared Beams: Active	Short term or permanent; counts hikers and bikers combined	Relatively portable; low profile, unobtrusive appearance	Cannot distinguish hikers and bikers unless combined with a bike counter; difficult to use for lanes; may have a higher error for groups
Infrared Beams: Passive	Short term or permanent; counts hikers and bikers combined	Very portable with easy setup; low profile, unobtrusive appearance	Cannot distinguish hikers and bikers unless combined with a bike counter; difficult to use for lanes; may have a higher error for groups or if the temperature reaches close to body temperature; direct sunlight may cause false counts
Radar Sensors	Short term; counts hikers and bikers separately	Very portable; most accurate; tracks duration of time spent in the zone; supports live data analysis	Less camouflaged appearance; must be connected to the internet and a power bank; less accurate with dense crowds of people

Companies and Products

Eco-Counter

Eco-Counter is based in Lannion, France and has subsidiaries in Montreal, Canada, and Köln, Germany. Eco-Counter specializes in pedestrian and cyclist counters for both urban and rural environments. The solutions they provide are infrared beams, pressure slabs, inductance loops, tubes, patented cameras, real time analysis, and data analysis platforms. With clients in more than 50 countries including France, Chile, Canada, Germany, Australia, the United States, Eco-Counter is focused on international expertise. Their core values are innovation, quality and reliability, sustainability, expertise, peopleology, and international.

- Website: https://www.eco-counter.com
- Contact Form: https://www.eco-counter.com/#
- Phone number: France/World +33 2 96 48 48 81
- Additionally, sample worldwide bike count display data is shown here: https://www.eco-public.com/ParcPublic/?id=4586
    - Note that there is a sensor in Bucharest!

PYRO Sensor

Eco-Counter's PYRO Sensor is a passive infrared counter that is designed for outdoor and natural environments. The PYRO Sensor has the ability to count pedestrians, cyclists, horseback riders, kayakers, and skiers, as well as the direction of travel. It is also able to detect two people walking in a slight stagger, making it most appropriate for trails. The PYRO Sensor

is designed to be installed inside a tree, stone wall, or footbridge and the logger is installed in housing that is buried underground. This makes the system well-hidden and decreases the risk of vandalism. This sensor does not require electricity or internet to operate but does use a cellular connection to transmit count data to the data analysis platform (Eco-Visio). The PYRO Sensor is currently used in the following national parks: Santiago Metropolitan Park (Chile), Yosemite National Park (USA), the National Park of Les Ecrins (France), the National Park of Bieszczady (Poland), the National Park of Alpi Marittime (Italy), the Bohemian Switzerland National Park.

Other characteristics include:

- IP68 waterproof material
- Functions in temperatures from -40°C to +40°C
- 1.8 x 4.0 x 9.0 cm
- Range up to 15 m
- Made of high-density polyethylene and polyvinyl chloride
- Battery life of 10 years
- For more information: https://www.eco-counter.com/produits/pyro-range/pyro-sensor/

PYRO Box Evo-Nature

The PYRO Box Evo-Nature uses passive infrared technology to count hikers, bikers, kayakers, and more as well as track direction. It is designed for a natural environment without electricity. The system relies on new cellular 4G IOT technology (Cat-M1/NB IoT) that is emerging worldwide and may not yet be available in some countries*. This system combines a physical counter with software to analyze trends in the data collected. It is a box that can be temporarily attached outside of a post (the post can also be temporary) or permanently placed inside the post.

*According to https://www.gsma.com/iot/deployment-map/ this technology is available in Romania

Other characteristics include:

- IP68 waterproof material

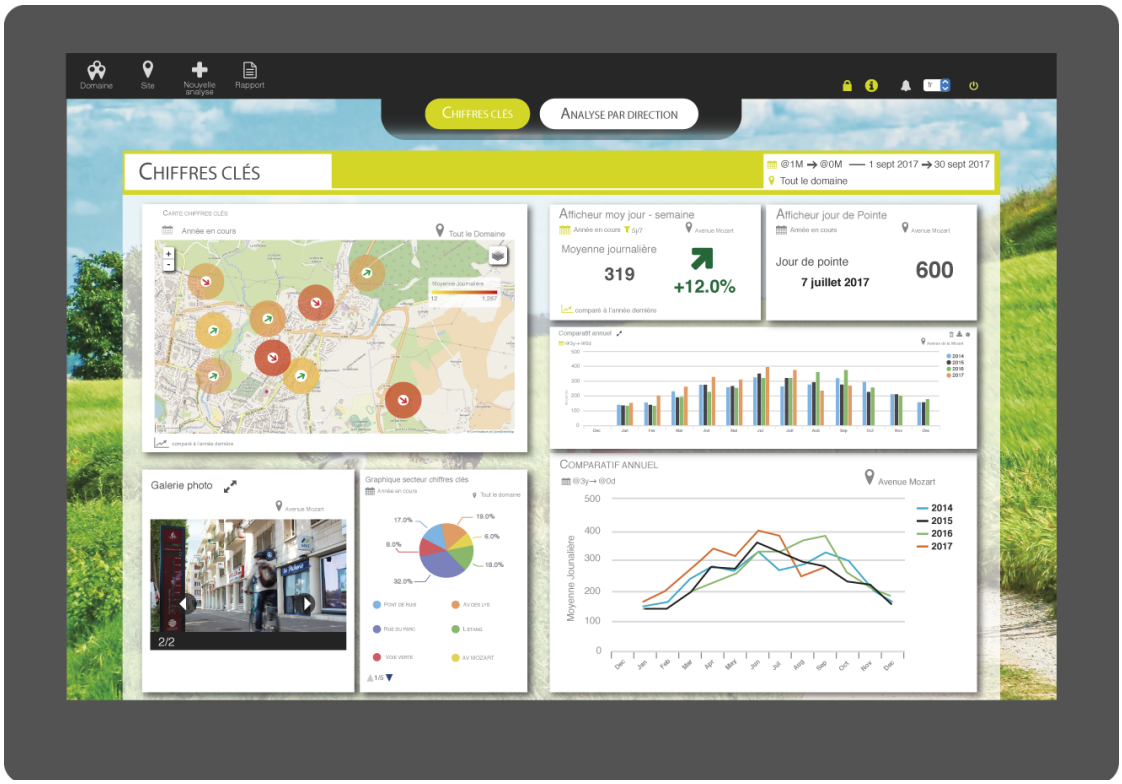
- Functions in temperatures from -25°C to +70°C
- Accuracy of -/+ 5%
- 12.6 x 12.6 x 5.35 cm
- Range up to 10 m
- Weighs 820 kg
- Two-year battery life
- Material is POM-C
- Box is green, but other colors are available upon request
- For more information: https://www.eco-counter.com/produits/pyro-evo-range-en/pyro-boxevo-nature-2/

Eco-Visio

Eco-Visio, the data analysis platform provided by Eco-Counter, is included with every counter. Through Eco-Visio, the user can manage counting sites and data, analyze data, share data between multiple users, and export graphics for external information. This platform is a

website in HTML format that the user can log into with their username and password and is accessible with internet connection on a computer, smart phone, or tablet. The count data is automatically uploaded from the counter to the platform via daily GSM transmission, or the user has the option to upload the count data manually. The data is presented on a personal dashboard with interactive "widgets" (such as graphs, key figures, and maps) to help the user discover trends in count data. Some trends include but are not limited to daily average, seasonality, direction of travel, hourly and weekly usage, heatmaps, and weather data. The dashboard can be uploaded as a PDF, image, Excel spreadsheet, or direct link to be shared with others. No prior data analysis knowledge as needed as a training video is provided.

- For more information: https://www.eco-counter.com/en/produits/eco-visio-range/eco-visio-5/
- You can email sales@eco-counter.com to request a demo.



SensMax

SensMax is a European developer and manufacturer of high-quality counting and monitoring systems for businesses. SensMax was founded in 2010, and since then has continued to progress in technology and innovation. SensMax products can be bought from two distributors in Romania: 4Retail Romania and GO DIGITAL LTD.

- SensMax
  - Website: https://sensmax.eu
  - Email: ag@sensmax.eu
  - Phone Number: +371 2875744

    - Contact Form (under free consultancy): https://sensmax.eu/where-to-buy/
- 4Retail Romania
    - Website: www.4retail.ro
    - Email: info@4retail.ro
    - Phone Number: 031 424 57 37
- GO DIGITAL LTD
    - Website: www.go-digital.ro
    - Email: contact@go-digital.ro
    - Phone Number: 0040 736 409 739

SensMax SE Unidirectional Sensor

The SensMax SE Unidirectional Sensor is an active infrared counting technology that can be used in outdoor, non-electricity areas. The SE Sensor is set up in narrow passages like bridges, nearby trees, or can be installed on wooden or metal posts if narrow passages are not available. The two sensor devices are set up across from each other and perform optimally when placed 1 to 5 meters apart but can be placed up to 9m apart. The sensor has one infrared beam at an angle of 6° that only counts pedestrians in one direction. The SensMax SE Sensor requires AA batteries that need to be changed every two years and has an internal memory of 250 days of count data. The count data is transferred manually to the SensMax SE/DE Data Collector, which is detailed later in the report.

Other characteristics include:

- IP68 waterproof material
- Case is made of black ABS plastic
- Uses double sided mounting tape or screws to install
- Counting accuracy is 95% for pedestrians 2 m away from the sensor, and decreases by 1% for every 1 m further
- For more information: https://sensmax.eu/devices/outdoor-people-counting-wireless-sensor-sensmax-se/

SensMax DE Bidirectional Sensor

The SensMax DE Bidirectional Sensor is the next step above the SE Sensor. The only differences are that the DE Sensor has three infrared beams that can keep track of direction, only has an internal memory of 150 days of hourly data, and the AA batteries need to be changed every year instead of two years.

- For more information: https://sensmax.eu/devices/outdoor-wireless-people-counting-bidirectional-sensor-sensmax-de/

SE/DE Data Collector and EasyReport

To obtain count data from the SE/DE Sensors, the user can use the SensMax SE/DE Data Collector (price is 137 EUR) to manually transfer the data to a computer. The data collector reads the counting statistics from the SE or DE Sensor through infrared technology. The user can point the data collector at the counting device and press the "Read" button to obtain the counting data. The SE/DE Data Collector can store up to 2000 days of counting data and has a rechargeable battery. To view statistics of the data collected, the SE/DE Data Collector can be connected to a PC that has the SensMax EasyReport software installed. With EasyReport, the user can generate graphs and detect trends in the count data. Data analysis time intervals include every 5 minutes, hour, day, week, month, quarter, and year. EasyReport contains over 20 statistical, analytical, administrative, and financial reports.

- For more information on the SE/DE Data Collector: https://sensmax.eu/devices/data-collector-for-outdoor-people-counters-sensmax-sede/
- For more information or a demo request of EasyReport: https://sensmax.eu/software/people-counting-and-customer-survey-system-software/

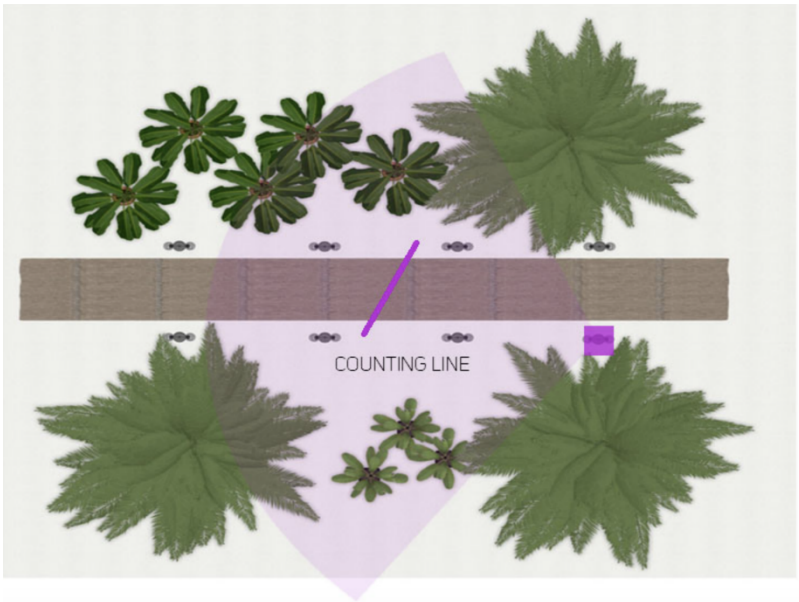
SensMax TAC-B Real Time Bidirectional Sensor

The SensMax TAC-B is a radar sensor that uses mmWave radar technology to count and classify pedestrians in both indoor and outdoor conditions. Outdoors, the sensor works through kinds of weather including rain, fog, and snow. There is a setting to classify each pedestrian by speed, and through this it is possible to distinguish walkers, joggers, and bikers in the overall count. The SensMax TAC-B is able to detect and track the direction of travel as well as time spent in a specified zone (such as how long someone is sitting on a bench for). The sensor can record pedestrians in a 6m range at a 120° viewing angle in high resolution, and up to 14m at a lower resolution. This device is installed at least 2-2.5 meters above ground level on a sidewall or pillar and requires internet connection and a power supply. For temporary installation, a WiFi hot-spot from a mobile phone can be used and the sensor can be connected to the SensMax MiniUPS Powerbank which will last for about seven hours. The sensor operator can view the count data and graphics live (or later) through the SensMax cloud reporting portal. Since the radar requires an internet connection, the count data is transferred automatically. The operator can choose to schedule and receive automated reports through email or receive live real-time text updates via Telegram messenger. To share the counting information with a third party, the SensMax TAC-B supports MQTT protocol for direct data reading from the sensor or API data export from the SensMax cloud platform.

Other characteristics include:

- ABS plastic case or IP65 discreet outdoor case
- Has user-defined counting lines and zones

- Counting accuracy is up to 99% in areas with one person per m^2, and >93% for more crowded areas with three people per m^2
- 8 x 8 x 3.5 cm
- Data transfer through WiFi 2.4 GHz/WPA2-PSK via WiFi Router or WiFi-GSM modem
- Power supply is AC 220V to DC 12V/0.5A
- For more information: https://sensmax.eu/solutions/outdoor-people-counting-in-parks/



Summary of Products

Company and Product Name	Technology	Tracks Direction	Range	Accuracy	Report Cycles	Size	Power and Maintenance	Cost	URL
Eco-Counter; PYRO Sensor	Passive Infrared	Yes	Up to 15m	Not available	Every 15 min or 1 hour	1.8 x 4.0 x 9.0 cm	LS batteries; change every 10 years	Quote Request	https://www.eco-counter.com/produits/pyro-range/pyro-sensor/
Eco-Counter; PYRO Box Evo-Nature	Passive Infrared	Yes	Up to 10m	95%	Every 6 hours	2.6 x 12.6 x 5.35 cm	LS batteries; change every 2 years	Quote Request	https://www.eco-counter.com/produits/pyro-evo-range-en/pyro-boxevo-nature-2/
SensMax; SE Unidirectional Sensor	Active Infrared	No	Up to 9m	95% within 2m, >2m -1% per m	Hour, day, week, month, or year	6.7 x 6.7 x 2.5 cm	AA batteries; change every 2 years	241 EUR	https://sensmax.eu/devices/outdoor-people-counting-wireless-sensor-sensmax-se/
SensMax; DE Bidirectional Sensor	Active Infrared	Yes	Up to 9m	95% within 2m, >2m -1% per m	Hour, day, week, month, or year	6.7 x 6.7 x 2.5 cm	AA batteries; change every 1 year	255 EUR	https://sensmax.eu/devices/outdoor-wireless-people-counting-bidirectional-sensor-sensmax-de/
SensMax; TAC-B Real Time Bidirectional Sensor	Radar Sensor	Yes	Up to 14m	99% per person per m^2; 93% for crowded areas	Shares live and stores data as collected	8.0 x 8.0 x 3.5 cm	Internet and power source connection	590 EUR	https://sensmax.eu/solutions/outdoor-people-counting-in-parks/