Article

Sustainable Tourism Empowered by Social Network Analysis to Gain a Competitive Edge at a Historic Site

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Abstract: Social media has had a strong presence in many people's lives over the last decade. In addition, social media platforms have allowed people to share opinions, provide advice on numerous factors, including where to visit, as well as to stay connected and maintain friendships. The hospitality and tourism industry, however, can make effective use of these powerful tools for marketing purposes, collaboration and information sharing, and service offerings. Reviewing social media followers' behaviors and interests offers a wealth of information and valuable data for a variety of tourism organizations. This case study focuses on an analysis of the social networks applied to the fortified town of Fredrikstad in Norway. The data used in this research study were collected from the Facebook site of the tourist authority. The results of this research project demonstrate the strengths of applying a social network analysis to a dataset, which can aid in the strategic direction of a tourism destination. The conversations of the greatest interest can successfully be identified as well as the growth of the online network. This paper adds knowledge to the literature through the application of a social network analysis regarding the success of a tourism destination and its future potential.

Keywords: social network analysis; historic site; competitiveness; tourism economics; graph theory; sustainable tourism; case study

1. Introduction

The theory of social networks identifies the role of social relationships in transferring data, directing personal or media power, and supporting attitudinal or behavioral change [1]. Network studies have become highly important in recent years and now are even more predominate in the fight against the COVID-19 pandemic. Prior analysis of the social network, by way of comparison, has frequently been applied to health research regarding adolescent risk-taking, obesity, and physical activity [2–6]. Social network theory directly impacts the way researchers think and propose ideas today on the web and on other network structures, such as those recognized in business interactions. There are many fields in which networks have an important role. Computer science and artificial intelligence (AI), the application of neural networks, criminal investigations, geography, and transport networks are examples of such areas [7–9]. In the field of sociology, network research is also rapidly evolving. Researchers study co-authorship and citation networks, systems of cooperation, and other aspects of social networking in informatics [10,11]. The hospitality and tourism industry must adapt to changes frequently and can certainly benefit from social network theory. In this study, we examined social networks and demonstrated how this topic can be applied to the field of tourism. The purpose of this research study is

to apply the thematical foundation by applying the framework of social network analysis to better understand destination tourism and to identify major themes as well as patterns in the social media data from an established tourist destination. Social media data are thus a key component of a tourist product where destinations compete for visitors. This study addresses the following research questions,

RQ1: By analyzing the social network, can popular posts be identified, and can they recognize solutions to promote a destination?

RQ2: How does the social network of a tourist location develop over time?

This paper adds knowledge to the literature through the application of social network analysis regarding the success of a tourism destination in the unique case of the fortified town of Fredrikstad and its future economic potential. The goal of this research study is to demonstrate the importance of monitoring and analyzing web data for the fortified town of Fredrikstad to become an innovative and sustainable tourist destination for years to come. The results of analyzing the data clearly reveal patterns from the social network conversations, developing solutions to better preserve the historic town.

2. Background

This case study will concentrate on the fortified town of Fredrikstad, which is one of Scandinavia's best-preserved fortified towns, consisting of 18th century buildings that are protected by a wall that is surrounded with a water moat. The historic Old Town of Fredrikstad is a special part of the area with several small shops located in historic buildings. Arts, crafts, furniture, food, and knickknacks can be found, as well as a flea market held in the town square every Saturday. The fortified town also contains the Fredrikstad City Museum with its historic exhibition in the town. Festivals and events are frequently held in this part of the city as well. The Old Town houses several galleries, one of which is Gallery Sand that represents world-famous local artists. These talented artists are also frequently seen in their studios both in New York City and in locations around the world, therefore, visitation to their gallery in the Old Town when there is an exhibition is an intriguing and unique experience. In terms of dining options, there are a limited number of cozy restaurants and cafés located throughout the town [12].

In recent years, however, several well-established establishments closed down their operations in the Old Town of Fredrikstad including Fredrikstad International School for adults, the Wine Monopoly, a local pharmacy, and a bookstore. The socializing and mingling of students and consumers visiting shops and eateries brought an inspiring synergy into the atmosphere of the area. The Wine Monopoly that was located in an old-fashioned storefront created a special and unique shopping experience for visitors. The loss of these institutions certainly had an effect on the fortified town's businesses and community. Once a business close it is difficult to find a new one to move in, as one needs a certain amount of foot traffic into a store to make the location desirable. Therefore, there exists a need to collect data and analyze the situation to ensure that businesses can be effectively sustained, along with strategic measures to support the positive vibrancy and energy of this historic town.

According to Visit Fredrikstad and Hvaler [13], "The old town stands on the threshold of a new age, now holding the fort as a symbol of cultural values and living history." It is important to ensure that the fortified town of Fredrikstad remains a sustainable historic city in which local citizens, tourists, and businesses flourish. As articulated through the United Nations World Tourism Organization (UNWTO), the term "visitor" includes both overnight visitors (tourists) and same-day visitors (excursionists) [14].

3. Literature Review

Social network analysis has increasingly evolved with great interest to researchers [15–20] and particularly with respect to destination tourism, sustainable tourism, historic sites, marketing, collaboration, and network properties, as well as regarding information-sharing

including patterns and tools. Social network analysis is a theory that can aid in the analysis of the popularity, competitiveness, and sustainability of a tourist destination [21–25]. However, recent research by Baggio and Valeri on network science has highlighted the shortcomings in a number of studies examining sustainable tourism and network science [26]. Their study clearly shows the importance of the present study developed, as it concerns a historic town that needs to be preserved for future generations. Another study demonstrated the importance of network science to improve the competitiveness of a tourist destination [27], which is also useful for the study of the fortified town of Fredrikstad.

Furthermore, social network analysis is successfully used to analyze network properties such as network size, network width, centrality, and centrality clusters [15,18,19,24,28–30]. As argued by Westveld and Hoff [31], tourism network properties can change over a period of time. Hence, few research studies have encompassed a quantitative analysis of longitudinal datasets while applying social network analysis. Other studies have typically focused on visualizations of bibliometric networks that show changes in tourism research over time [32,33].

Studies pertinent to this study are discussed below. These studies are divided into two categories that are examined in this manuscript: (a) tourist destinations around the world, applying social network analysis, and (b) collaboration, information, and knowledge-sharing of information among stakeholders, applying social network analysis.

3.1. Destination Tourism

According to the UNWTO [14], destination tourism is defined as taking a journey for the main reason of visiting a site. Several studies have been conducted on destination tourism research that has become a prevalent form evident in the literature [17,34–36]. To illustrate, Shih [36] explored the characteristics of social media networks in drive tourism populations in Taiwan, in which the author applied analyses of social networks. This study analyzed information regarding appropriate tourist facilities and services located in the proximity of the traveler. To clarify, drive tourism is characterized by people who have no set plans and will explore new sites as they travel [37]. Furthermore, the authors in [34] conducted a survey in Korea examining multiple attractions through a combination of social network analysis and structural equation modeling. The results of their research indicated that destination photos are a critical predictor affecting the multi-attraction travel actions of a tourist, with a positive outcome on visitor satisfaction. Pietro et al. [35], who investigated the use of social media to select a tourist destination, found that word-of-mouth had a direct effect on the destination. Casanueva et al. [17] similarly examined various ways in which social network analysis is applied in tourism, along with a description of the principal elements. Developing a deeper understanding of visitors' purchasing intentions through the use of online social media platforms will aid tourist authorities to develop better social exchange strategies [38].

Albrecht [21] focused on sustainable tourism research based on past workshops and with the existing literature review that was collected. The World Cultural Heritage initiative was successful in the reduction of foot traffic to try and preserve the area, which was the mission rather than a mission centered on raising awareness for the destination itself [39–42]. Similarly, Bhat and Milne [43] focused on researching the dynamics of interorganizational assistance in destination marketing, whereas Wang and Xiang [25] examined the collaborative marketing efforts in tourism.

3.2. Collaboration, Knowledge, and Information-Sharing

Some research studies have looked at the collaboration effect among stakeholders [19,21,22,44,45]. Marco and Baggio [45], in particular, examined the Italian tourism system agencies and tour operators by applying social network analysis. The researchers found the network to be fragmented and to lack efficiency due to minimal collaboration. Valeri and Baggio [46] conducted a survey applying network analysis, in which they looked

at the knowledge exchange among travel agents and its partners. Antonio et al. [44], in a longitudinal research study in 2012, focused on three main families, along with their role and leadership in this tourist destination. Their findings showed that no single family was able to manage the entire system, while support from the other two families was required. Pulido-Fernandez and Merinero-Rodriguez [19] applied social network analysis to 16 tourism destinations located in Spain to establish whether the condition of the destination is affected by the social dynamics of the visitors. Their findings demonstrated there was a direct link, while Braggio [22] found that the level of collaboration is a central feature for the growth of destination tourism.

Huang et al. [47] studied the motivation and barriers regarding sharing tourism-related data posted online on social media websites among undergraduate and graduate students in the United States. The findings reported that even the younger generations who had predominantly grown up with social media technologies were concerned about online privacy threats and losing control over their information. Lo et al. [48] conducted a study on Hong Kong visitors which revealed that over 89% of visitors take photos; however, only 41% are willing to post them online, with results indicating that those who posted opted to post the photos on social media sites. Furthermore, Tang et al. [49] analyzed user behaviors by applying social network research to a university campus-based social media site on which personal items and resources are exchanged, with findings indicating that user experiences remained highly positive. When applying social network analysis, however, Tang et al. [49] suggested using Facebook or Twitter as platforms for analysis. Rathonyi [50] explored visitor motivation to share information, with survey findings reporting that both the bulk of students using social networking websites daily and students who did not use the same channels for planning a trip preferred to ask fellow students, friends, and relatives for recommendations.

During the Olympics, Leung et al. [51], analyzed tourism trends in Beijing, China, and the findings showed that tourists from abroad were especially interested in popular traditional sights. Similarly, Cortez et al. [52] used automated classifications of the comments made about hotels to support tourists' decision-making when selecting a hotel, with data collected through TripAdvisor. Cheng and Edwards [53] examined social media online postings by Chinese Sina Wibo users with the intention to bring the east and west societies closer. This study attempted to help the readers better understand the Chinese social media landscape. They indicated that their visual approaches offered insight into cultural nuances and behaviors. Moreover, Luo and Zhong [54] applied social network analysis to examine the communication patterns of tourism-associated reviews posted on social-networking sites and discovered that the strength of broadcasted information was more dominant compared to persuasive decision-making. Park et al. [55] applied Twitter data from cruise travelers and the results showed that celebrities and influencers, cruise line companies, and travel agencies steered most discussions on cruise subjects that appeared on Twitter networks. Chung et al. [56] studied tourist patterns among Korean backpackers vacationing in Europe while using the blog NAVER. This blog is considered a leading social media platform in Korea. The findings of this study interestingly indicated that Korean backpackers travel through Europe via Paris and London, followed by two cities in Italy, namely Venice and Florene.

This research particularly shows the important role social media plays at tourist destinations in terms of marketing and service offerings, where the focus on the analysis concerns the number of likes, comments, and shares of information from the website. Most of the literature found indicates that there is great interest in social network analysis and that it has been applied in various settings as a tool for marketing firms and research teams. This study seeks to examine the online social network from the perspective of the Fredrikstad/Hvaler tourist authority and visitors.

The practical contributions include managerial implications to better assist tourism organizations and practitioners such as the Visit Fredrikstad/Hvaler tourist authority, the Municipality of Fredrikstad (politicians or city planners), and the Directorate for Cultural

Heritage to best preserve the historic site. This research study will help to provide new ideas, highlight the effects of social media by applying social network analysis, and explore how this analysis potentially could be used to benefit similar destinations. Furthermore, scholars and practitioners will be able to use this research study for strategical planning purposes among other destinations through a theoretical lens.

4. Methodology

The framework used for this research study is the social network analysis applied to online social media data pertaining to the fortified town of Fredrikstad in order to evaluate patterns using networks and graph theory. The study is based on social network analysis, as validated by previous studies [17,22,34,45]. No social network studies have been found pertaining to the historic site in Fredrikstad or in related areas in Norway. Social network analysis is a valid method to apply to study online data and to help boost attraction by highlighting what interest's visitors. Social network analysis serves as a vital instrument to analyze visitor attitudes because attitudes typically influence expenditures in addition to recommendations that users make to other users [34].

It is essential to determine the current situation and form a baseline in order to determine what needs to be improved within the fortified town of Fredrikstad. This is necessary to increase visitor spending, extend visitor stay, improve visitor experience, increase the total of return visitors, and ensure the town can raise the number of positive comments and likes on social media. Such an analysis ensures that the fortified town of Fredrikstad will be a vibrant historic city for years to come for visitors. Through applying multiple centrality steps, the social network analysis approach may be used to define the main nodes in the network, as Wasserman and Faust [57] defined, which were applied to this research study.

The social network analysis visualization in this research study consisted of data from a twelve-month period to emphasize the research method's potential. The sample collected was sufficient to detect patterns and highlight recommendations. The data was gathered from the Fredrikstad/Hvaler tourist authority's Facebook site, scraping month by month in a one-time setting, combining the data into a single spreadsheet for analysis using an access token. Descriptions are provided in the results section of this study. Data collection can involve various tools, although one tool does not necessarily work for all data posted online. Tools we recommend to gather data are Data Miner, Apify, Octoparse, and Scrapy Nodexl. The researchers recommend that future researchers test these tools on their dataset as access to APIs and tools often changes. For researchers particularly interested in text mining, Text Miner by IBM is a good choice to identify meanings from what people write, while addressing open ended questions; a good example of this is concerns the research paper on the data collected regarding the movie Frozen by Walt Disney [58]. There are many suitable tools out on the market to assist with gathering and analyzing data.

Gathering thousands of queries can be tedious, overly burdensome, and impractical due to limitations put in place. Hypertext Transfer Protocol Secure (HTTPS) encryption preserves social media users' privacy and protection, but many aspects of personal data can still be retrieved. There are currently restrictions in place due to the Cambridge Analytica incident in which millions of Facebook users' personal information was collected without consent to be used later in political campaigns [59]. There is also a continuing and concerning discussion about the privacy and changing restrictions on the use of personal data.

Facebook, Instagram, and Twitter are examples of social media sites that are among the most effective tools for disseminating and searching for information. These websites not only provide content, but they also connect with followers via social media. Social networking applications generate information that can be relevant for businesses. The material that is disseminated through social media can be difficult to find or can experience difficulty reaching the intended audience in real time. It also makes information extraction more difficult because there are too many redundancies of data when others start posting

the same information. Web scraping is a way of obtaining information from the internet. Weather data, traffic data, pricing comparison, and comments made by followers on websites are all examples that web scraping can help in terms of web automation. Web scraping can convert unstructured data into structured data that can be saved and examined in a database. The main objective of web scraping is to collect data, store it, and analyze it, which allows validated data to be transformed into more useful information [60].

5. Results

In this study, a total number of 997 posts were collected with the permission of the Fredrikstad/Hvaler tourist authority from their Facebook site. A diagram of the data consists of edges and vertices, with an edge referred to as a tie that connects two vertices together. The edges, therefore, serve as building blocks for the network. In this case, there are 1130 unique edges and no duplicate edges. The two major types of edges are undirected or directed. In this case, the edges are shown directionally, which reveals a clear origin and destination where a Facebook user follows another user. Vertices are referred to as nodes, which can represent people, content, and keywords. Figure 1 displays the number of likes based on postings by the Fredrikstad/Hvaler tourism authority. The reciprocated edge ratio is set to zero as well as the vertex pair ratio (see Figure 1).
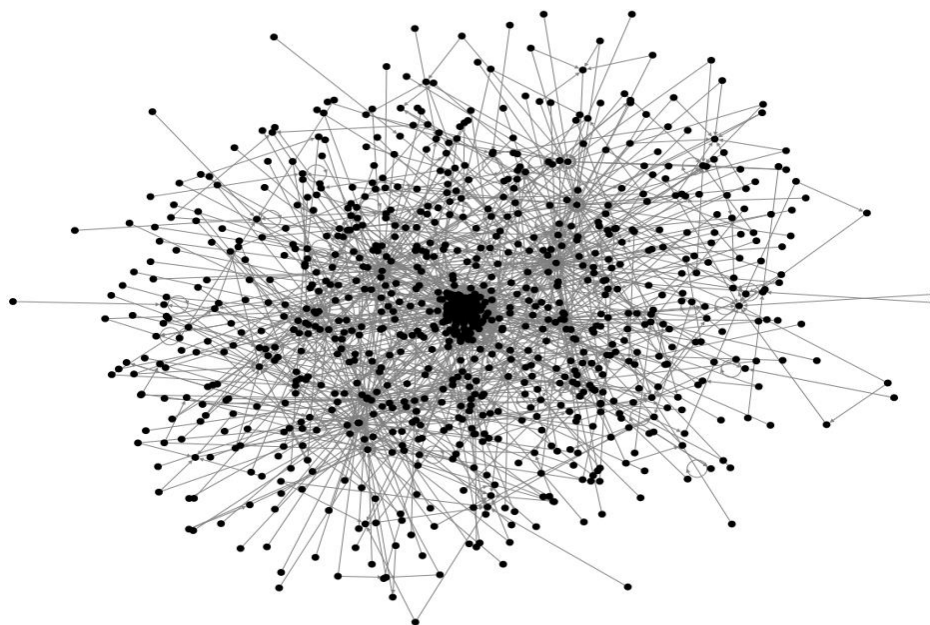
Figure 1. The number of likes based on posts by the tourism authority.

Popular algorithms used in social network analysis include the Fruchterman–Reingold and Harel–Koren algorithms. The end result of the visualization will vary depending on which of these algorithms are used based on the dataset and topology of the network. For the visualizations in this research study, the Harel–Koren algorithm was used, consisting of a fast-multiscale layout algorithm that achieves better visualizations. The method consists of a two-phased process, which makes the graph recursively coarser to arrive at its multilevel representation. The graph is initially embedded in a high-dimensional space and then projected onto a 2D plane using an analysis of the main components. In practice, an analysis of a social network is multilayered. From the breakdown of the model, five main themes trigger the followers of the Fredrikstad/Hvaler tourist authority (see Figure 2).

Figure 2. Layout of the top five categories displayed.
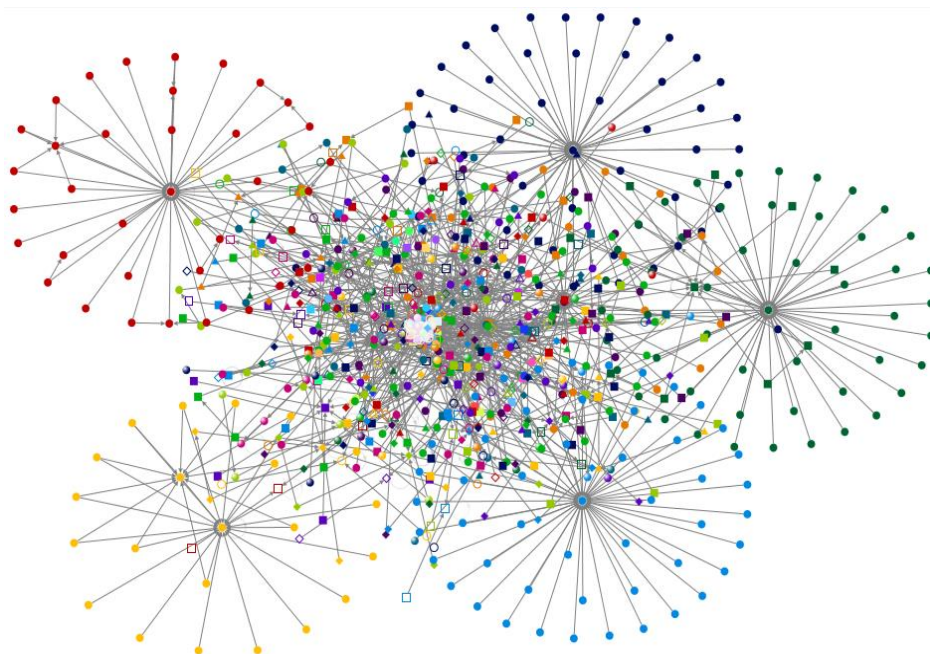
Sharing dining experience: A post was made by the Fredrikstad/Hvaler tourist authority regarding the local fish restaurant, Slippen, which received an award for being the best restaurant in town. Many people commented that they liked and had been to the restaurant, as they shared their experience. From the data, it is clearly evident that if social media is used correctly, it can effectively promote a business and increase the number of customers. The Fredrikstad/Hvaler tourist authority can therefore be of great help to local establishments to help promote the wider business community and city.

People are attracted to games and contests: A raffle was announced by the Fredrikstad/Hvaler tourist authority and those followers who replied with "Quack, Quack" entered the lucky draw of a special issue of Donald Duck from Disney. A raffle can be an effective tactic to attract followers and stimulate current followers to post comments in the future.

Transportation and parking: Posts were made regarding the city offering free ferries across the waterways to better connect the city. The conversation quickly turned into parking issues due to the fact that a parking lot right on the outskirt of the fortified town had closed down, which created a frenzy of opinions. From this scenario, it is evident that a topic, although posted with positive intentions, can take a drastic turn on social media and be viewed as negative; therefore, it is important to redirect the conversations within this scenario.

Oseberg Viking ship: A post was made about the arrival of a replica Oseberg Viking ship with its guests at the opening of the Gaulating pub, offering 20 different tap beer lines as well as 150 different beers located inside the old fortress town. Oseberg is one of the Viking ships discovered that was built more than 1000 years ago, which generated a great deal of excitement.

Public transportation: A post was made about the "flex bus" that picks up residents outside their doorstep and drives them to town. This is a service the bus company offers in rural areas or in areas where buses do not run frequently.

Illustrated in the next level, there were four categories of popular conversation.

Restaurant/theater: Another discussion of interest involved the local Båthuset pub scene alongside the riverfront where artists and comedians perform. A summer show with local comedians was coming up, which brought great interest to the conversation. Båthuset pub is also a popular place for those interested in the post to leisurely gather.

Shopping ferry: A ferry sails between Fredrikstad, Norway, and Strømstad, Sweden, named Sagasund. This ferry is very popular among locals as most goods are priced 30% less in Sweden. People frequently make daytrips to go shopping. Followers liked the post regarding the ferry going daily to Sweden during summer months and this is helping to promote Fredrikstad through increased visitation and spending in the town by ferry users. After the year of COVID-19, this route is most likely closing, which is a loss to this industry.

Announcement to cabin owners: An announcement was made to vacation homeowners in the Hvaler municipality to make them aware of the fact that there is no need to shovel snow off their cabin rooftops because of the unseasonably beautiful weather. Many vacation owners have childhood memories from this area and because there is such a long winter in Norway, many people look forward to spring arriving and therefore left comments online as well as liked the post.

Photos: A post was made of photos taken by a photographer who was hired to take professional photos, which made the place look very idyllic. The photos generated many likes, again helping to promote the city. The photos were discussed in multiple separate conversations. In this particular case, the photos that attracted the most attention were addressed. The most common feedback was "beautiful."

Every conversation was further been separated and displayed to reveal what is important for these social media followers. Here, one can clearly see the effect each conversation. The data set further shows 253 self-loops (i.e., a person commenting on their own post). In the graph window, the self-loops are illustrated visually by circular edges that start from a vertex and return to the same vertex (see Figure 3).
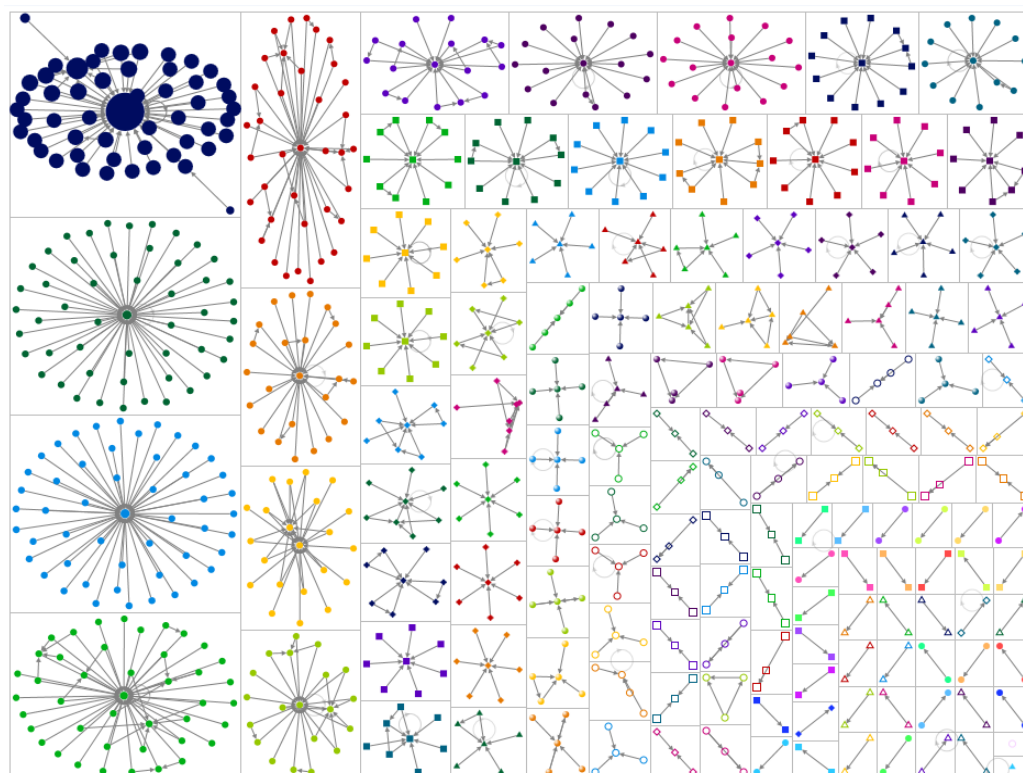
Figure 3. Visualizations of the types of networks that emerged from the social network analysis.

Some posts were less successful at generating comments or likes. When announcements regarding free guided tours in the fortified town were mentioned, no discussions were generated either before or after the free tours, which might be an indication that those following the Fredrikstad/Hvaler tourism authority on Facebook are mainly local visitors. All other written comments that took place on the tourist authority's website were in Norwegian. A better place to reach tourists from out of town or foreign nations would

perhaps be on TripAdvisor where the visitor can post their experience. However, regardless of the platform used by the tourist authority, they can learn a great deal of information from the conversations and posts that take place to better plan for future tourist seasons to ensure a steady number of visitor arrivals at their destination.

To simplify a dense and convoluted graph, one can visualize the online conversations using a grouping motif that makes it easier to associate with because many similar conversations can be ongoing. A motif is a set of vertices connected in a particular way, such as the fan motif shown in Figure 4, consisting of a head vertex that is connected to two or more vertices, each of which is connected only to the head vertex. Motifs are collapsed into simple, compact representations when the graph is displayed, making it easier to discover what people are chatting about online. Several discussions emerged that revealed an ongoing exchange regarding the free shuttle bus, information to cabin owners in the area, the public pool, and the restaurant Slippen (see Figure 4).
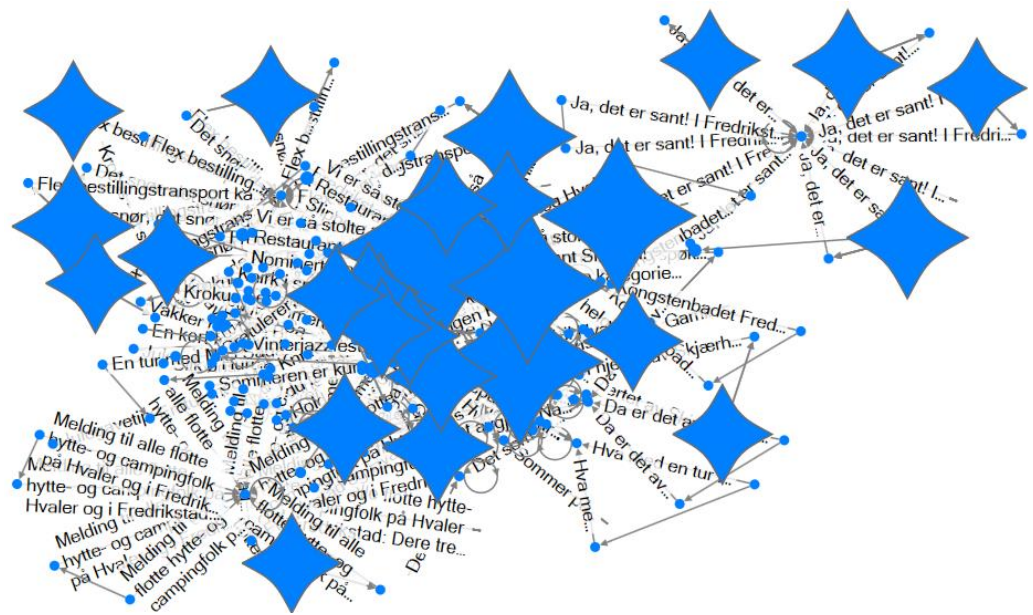

Figure 4. Visualization of the online conversations using a grouping motif.

Visualizing data is one of the more effective ways to see patterns and to communicate a message. From this dataset, 254 connected components appeared as clusters of vertices (shown in diamonds), tied to each other, although separate from other vertices in the graph. Furthermore, there are 121 isolated vertices that are not connected to any other vertices in this graph. In this network, the largest component includes 53 vertices and 62 edges. The geodesic distance is the length of the shortest path between two Facebook members and in this case, the maximum geodesic distance was set to 4.0, which is the largest geodesic distance between two vertices that were reported to be farthest away from each other. The average geodesic distance was 1.787445, with this value demonstrating how close these Facebook followers are to one another. If this value is high, members of the network do not directly know each other. In many instances, Facebook members are connected through a friend of a friend, therefore not through the shortest path.

The graph density value ranged between 0 and 1, indicating how connected the vertices were in the network. In this case, the value was low at 0.00089, which means the graph is less dense, with most of the followers not being friends and not connected to one another. Modularity gauges the force of the division of a network into clusters. Networks with high modularity, which is the case here (maximum 1), have dense connections that link the nodes within communities but have sparse connections or edges between nodes in other groups (see Table 1).

Table 1. Graph metrics.

Graph Metrics	Values
Connected components	254
Single vertex connected components	121
Max. vertices in a connected component	53
Max. edges in a connected component	62
Max. geodesic distance (diameter)	4
Average geodesic distance	1.787445
Graph density	0.000883172
Modularity	0.869925

Facebook networks are typically egocentric networks, with the word "ego" referring to the tourism authority being connected to everyone in the network. In this instance, the ties between the friends (1.5-degree network) have been included. Facebook permits a view of a 1.5-degree network but not a 2.0-degree network. The indegree computes the total number of edges that point toward the vertex of importance. Discussion around the Slippen restaurant, Quack contest, and the Oseberg Viking ship all showed 51 indegrees. This represents the number of ties it received, while the betweenness centrality demonstrates the shortest paths within a network. The conversation around the Slippen restaurant had the highest betweenness centrality. If the value were 0, the conversation would still continue without the person in the center and the shortest communication path would not be changed. In addition, the more central a node is, the more important and the higher the betweenness centrality becomes. It is imperative to note that betweenness centrality-studying in terms of a Facebook network is important when identifying central nodes of the network, which serve an integral role for marketing purposes and information-sharing. The outdegree gauges the number of edges that the vertex of interest points toward, which in this case is one, because it is an ego network. Closeness centrality is a measure of the average shortest path between the vertexes. A low score implies a central position in the network. In this instance, the Slippen restaurant had a score of 0.019, meaning that it takes less time to spread news though this network compared to the others. An advantage of betweenness centrality is that unlike closeness centrality, it is not necessary to have a fully connected graph or component to compute it.

The eigenvector centrality metric reflects the numerous associations a vertex has as well as the extent of the connection to its vertices. The conversation around the Slippen restaurant showed the highest eigenvector, meaning the post about it was the most important one out of the themes, with the most influential people within this group of Facebook users joining in. Page rank is an eigenvector centrality variant designed to rank web content using hyperlinks between pages as a significant metric. Page rank can, however, be used for any form of the network. The top three posts with reference to the restaurant Slippen generated a page ranking of 20,578, while the Disney contest ranked at 23,727 and the arrival of the Oseberg Viking ship at 23,727. The key difference between page rank and eigenvector centrality is that page rank accounts for the orientation of the links. A score is assigned to each node in a network based on the number of incoming links (its "indegree" = 51). Ties established on the relative score of its originating node are also weighted. The consequence is that nodes with many incoming connections are dominant and some of that power is shared by the nodes they are linked to. Similar to eigenvector centrality, PageRank can help to uncover significant or prominent nodes whose scope stretches beyond their direct connections (see Table 2).

Table 2. Degrees.

	Posting	In-Degree	Out-Degree	Betweenness Centrality	Closeness Centrality	Eigenvector Centrality
1.	Slippen restaurant	51	1	2586.000	0.019	0.119
2.	Disney contest	51	1	2450.000	0.020	0.003
3.	Oseberg Viking ship	51	1	2450.000	0.020	0.003
4.	Ferry/Parking	43	1	1652.000	0.024	0.002
5.	Flex bus	37	1	1205.000	0.028	0.000
6.	Cabin owners	24	1	493.000	0.043	0.000
7.	Båthuset theater	22	1	343.000	0.048	0.000
8.	Sagasund ferry	20	1	294.000	0.053	0.000
9.	Photos	9	1	56.000	0.125	0.000

Note. The analysis of the betweenness of centrality on Facebook is particularly vital for areas related to identifying central nodes of the network, where betweenness of centrality is a numerical property for applications used for marketing purposes or for broadcasting news.

The clustering coefficient displays the interconnections of the Facebook followers. A cluster is a group of nodes that are more connected to each other than to other nodes. A cluster can be a bottleneck for information or can be involved in a diffusion process. A cluster can aid in ensuring things remain outside or inside the network. A network with high clustering has a high proportion of closed triads to all triads. Table 3 displays the number of likes, comments, and shares the followers made in this time period. Statistics such as these can help the municipality to enhance its communication process and determine how it can best position itself to aid local establishments.

Table 3. Communication.

	Posting	Page Rank	Clustering Coefficient	Likes	Comments	Shares
1.	Slippen restaurant	20,578	0.004	944	58	425
2.	Disney contest	23,727	0.000	56	160	1
3.	Oseberg Viking ship	23,727	0.000	238	70	27
4.	Ferry/Parking	14,040	0.011	469	42	78
5.	Flex bus	11,614	0.014	96	36	18
6.	Cabin owners	9059	0.012	175	23	17
7.	Båthuset theater	7104	0.026	127	21	14
8.	Sagasund ferry	5897	0.035	235	19	37
9.	Photos	4443	0.000	504	8	53

Note: The clustering coefficient ranges from 0 to 1. When fully connected, the clustering coefficient is reported to be 1, while values closer to 0 indicate that there is hardly any connections among the followers.

The number of likes per post varies widely. The Slippen restaurant generated the most likes and shares. The special issues of the Donald Duck magazine from Disney might have generated childhood memories because the post about it had the most comments. It is extremely important that the posts generate both likes and comments, and that followers share the information with their followers.

From the word cloud one, can see that many people wrote kvakk (quack) to take part in the Walt Disney contest. People discussed the beautiful photos (vakkert and flott) from Fredrikstad and Hvaler. The restaurant Slippen was also commented on numerous times. Some mentioned Christmas (jul), as this is the time of year to visit Fredrikstad with the lighting of the Christmas tree in the Old Town where the outdoor event is held. One can also notice the other comments in reference to the free ferry (gratis), free shuttle bus (flex), parking difficulties, concerts frequently organized (konserter), and the pleasant people. The word cloud created matches to the "likes" indicated, thereby enabling Facebook to connect visitors with the destination. This provides the tourist authority with a way to potentially reach a wide array of people (see Figure 5).

Figure 5. Word cloud.

6. Discussion

The municipality needs to continue planning the future for the fortified town. There are great possibilities that exist but it will require both commitment and funding to have the fortified town of Fredrikstad develop into a vibrant tourist destination. This paper attempts to fill the gap in the application of social network analysis regarding the success of a tourism destination and its future potential.

RQ1: By analyzing the social network, can popular posts be identified, and can they recognize solutions to promote a destination? The posting in reference to the restaurant Slippen certainly brought a level of pride to the followers on Facebook and it was found to be the number one conversation. The comments were extremely positive and those who had already visited the restaurant provided their recommendations by sharing positive experiences, which resulted in those who had not yet visited the restaurant to comment that they wanted to eat at the Slippen restaurant. There were many people who decided to share their positive experiences at the Slippen restaurant, resulting in the following: page rank, 20,578; positive likes, 944; positive comments, 58; and positive shares, 425. As previously illustrated in Figure 3 at the top-left part of the diagram, this post had the highest eigenvector centrality value, which was also similarly demonstrated in Table 2.

RQ2: How does the social network of a tourist location develop over time? The online network has grown denser over time as the tourism authority has steadily been able to increase its online presence and more people have chosen to follow them over time. The modularity value of 0.87 also indicates that there are dense or deep connections between nodes in the groups but only sparse or thin connections or edges between the nodes in other groups. It is paramount to study the development of community structure in a social network; a cohesive group of nodes that are connected to each other are denser than that of the nodes in other communities. Such networks further provide insight into how the network structure and topology interact. Although it is difficult to assess the community and nature of the group, various approaches have been developed and used with varying degrees of success. Modularity is one such concept that provides information on how the communities within social networks are formed. Modularity is the fraction of the edges that fall within the given network and the approximate fraction is less if the edges are distributed randomly. In addition, most businesses in Fredrikstad have their own Facebook site, thus promoting more exposure to the old part of the town while providing separate marketing streams for the destination.

This study has some limitations, as the number of followers on social media are limited compared to Walt Disney and other major tourist destinations. However, the sample size is still sufficient to derive a complete picture.

7. Conclusions

This case study contributes to the advancements in social network theory in the research area of a tourism destination by identifying how tourist authorities can better

make use of its data. More specifically, this study analyzed online posts on the Fredrik-stad/Hvaler tourist authority´s Facebook page. However, as with most studies, there are some limitations to the research considering the data presented is limited to a one-year period. The results, however, can still provide a clear indication to the tourism authority in terms of steering conversations on Facebook to better engage current followers, as well as to reach new followers on Facebook. Having an even larger audience on social media can help generate positive exposure for the area. It is quite fascinating to study the progression of social media networks from the city's marketing perspective, in addition to the new services the city may offer, as well as from a scientific perspective.

By establishing a theoretical foundation within a social network framework, this research study has been able to quantify the spatial and temporal changes of tourism networks. A follow-up study can examine a larger number of posts and likes to validate the results presented in this study. Another direction for future research would be to perform a sentiment analysis study or to apply various forms of machine learning/AI techniques to examine visitors' travel patterns and perhaps draw a correlation analysis.

Future studies should investigate the traffic patterns of visitors and residents. Cur-rently, sensors are installed around the town of Fredrikstad where one can monitor traffic patterns to better provide guidance to local businesses and new establishments. In addi-tion, one can use the data to enhance city planning and better preserve the town. One example would be to apply machine learning techniques to predict future traffic flows for the purpose of not only examining movements of cars and pedestrians, but also to provide recommendations to local establishments regarding what time of day people are most likely to be passing the establishment. Data can also be pulled from cell-phone operators in the area regarding the number of visitors in close proximity to their establishments as well as the visitors' nationality. This can also be a tool to better understand the traffic and who visits the historic site from where and when. Another possible study that could be carried out would be to survey cruise ship passengers and their spending patterns to examine if there are any benefits offered by these visitors to the town of Fredrikstad; additionally, the same can be done for cruise passengers' preferences to make the city more welcoming and attractive. Several cruise ships arrive, and passengers disembark in Fredrikstad during the summer months.

Another viable option would be to understand the relationship between the push and pull motivational factors, particularly regarding cruise ships arriving in Fredrikstad, by applying a canonical correlation analysis (CCA) to measure the relationship. This is important for city planning.

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