Chapter 3

Analysis of Transportation Modes by Evaluating SWOT Factors and Pairwise Comparisons: A Case Study

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Additional information is available at the end of the chapter

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Abstract

Cape Breton Island is one of the most beautiful islands in the World. The island itself has a unique geography and is located in Nova Scotia, Canada. This chapter introduces and summarizes the current transportation modes in Cape Breton Island. The transportation modes discussed include air, rail, water, truck, and intermodal modes. A SWOT matrix is applied to identify the strengths, weaknesses, opportunities, and threats related to the different transportation modes in Cape Breton Island. Then, the factors are evaluated and ranked based on pairwise comparisons in analytic hierarchy process (AHP) method, and the best strategies are defined. This research provides a unique and multidisciplinary overview of transportation modes in the region that is necessary for future quantitative investigations. Furthermore, it introduces the steps to analyze transportation modes of other areas and regions.

Keywords: transportation modes, strengths, weaknesses, opportunities, threats (SWOT), Cape Breton Island, transportation strategies, ranking, evaluation, analytic hierarchy process (AHP)

1. Introduction

The costs of transportation are considerable in supply chain management. There are several transportation modes such as air, rail, truck, water, and intermodal modes. An intermodal transportation mode consists of multiple modes of transportation (e.g., water and truck) being used. Analyzing and selecting the right transportation mode is a challenging task because there are several options to choose from [1].

Nova Scotia is a Canadian province located in the east of the country. Halifax is the capital of Nova Scotia and Cape Breton Island is a beautiful island at the eastern tip of Nova Scotia. The population of the region was 101,619 in 2011. **Figure 1** shows the map of Cape Breton Island and the surrounding areas. Cape Breton Island has a unique geography with accessibility to deep water (North Atlantic Ocean) through multiple ports, such as the port of Sydney. Sydney is a community in Cape Breton Island which is located on the east bank of the Sydney River.

1.1. Transportation modes in the region

Department of Transportation, New Brunswick [2], published a report about Atlantic Canada Transportation Strategy 2008–2018. Atlantic Canada includes Newfoundland and Labrador, Nova Scotia, Prince Edward Island, and New Brunswick. Strategic highways, railways, airports, marine ports, and ferry services have been identified in said report. Cape Breton Partnership [3] summarized the supply chain and business opportunities in the Strait Area/Mulgrave region of Nova Scotia. The area is connected to Cape Breton Island through the Canso Causeway. Logistics opportunities and recommended priority opportunities have been identified in the report.

There are some existing investigations into the transportation modes in Cape Breton Island. A majority of them have focused on one mode of transportation (e.g., rail) in the area without providing an overview of multiple modes simultaneously. The port of Sydney master plan has been defined in the Sydney Harbor, Nova Scotia report [4]. Interested readers are encouraged to refer to the executive summary of the report. In Governance Structure Port of Sydney report [5], new governance structure has been discussed. Besides, some recommendations related to the vision, mandate, financial sustainability, and transition plan have been provided. An overview of rail studies in Sydney subdivision has been provided in the Summary report [6]. The authors concluded that the loss of rail services is a serious concern for businesses in the area. Besides, the

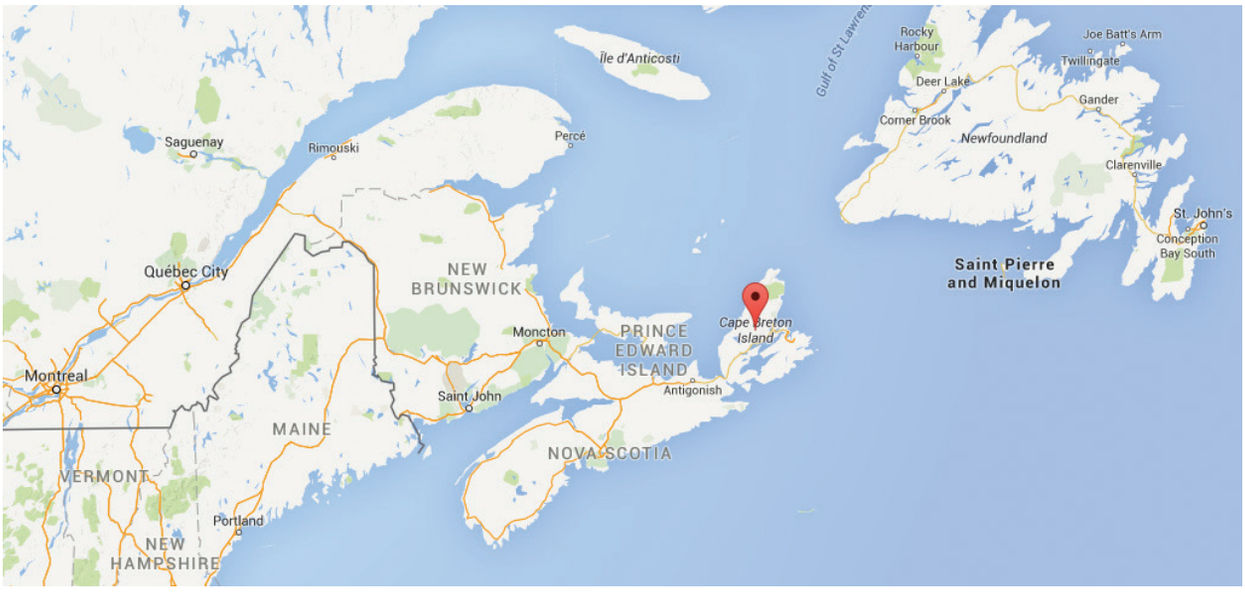

Figure 1. Cape Breton Island (source: Google Maps).

proposed container terminal can result in significant rail traffic and can lead to the reactivation of the railway. MariNova Consulting Ltd. [7] published a report about rail/truck shipping between Cape Breton Island and Mainland Nova Scotia. Rail and trucking rates, transit times (truck versus rail), as well as impacts of transloading and shipping by truck are all important parts of the report.

1.2. SWOT matrix

SWOT (strengths, weaknesses, opportunities, threats) matrix is a well-known technique for conducting a strategic study. It includes determining the objective of the company or project and identifying the internal and external factors for achieving that objective. SWOT is helpful when used to convert weaknesses into strengths, as well as threats into opportunities. SWOT matrix has several applications including strategic decision-making applications [8, 9]. SWOT analysis originated from the work of business policy academics at Harvard Business School and other American business schools in the 1960s [10]. It involves systematic thinking and comprehensive analysis of factors related to both internal and external aspects for any organization, project, or individual [11, 12]. In recent years, SWOT matrix has been utilized in different fields and has provided a good basis for strategy formulation when used properly [13]. However, inadequate development when using SWOT analysis leads to ending-up with long lists of general, even meaningless and over described factors [14]. In addition, the results of SWOT analysis would be strongly dependent on the knowledge and capabilities of the experts involved because it is a subjective approach [14, 15].

Some papers which used SWOT analysis have been classified in **Table 1**. Dadvar et al. [16] evaluated dry ports by SWOT matrix. A dry port is an inland intermodal terminal directly connected by road or rail to a seaport and operating as a center for the transshipment of sea cargo to inland destinations. Gao and Peng [11] developed a model for analyzing and ranking SWOT factors with nonhomogeneous uncertain preference information. They showed the application of the model by a numerical example. Bas [17] applied SWOT-fuzzy based method for the electricity supply chain in Turkey. Diakaki et al. [18] analyzed Vehicle Automation and Communication Systems by SWOT technique. They analyzed the problem from the motorway traffic management viewpoint. Rauch et al. [14] developed strategies for forest fuel supply chains in South East Europe by SWOT matrix. They provided both country and regional level SWOTs.

1.3. Research contributions

To our knowledge, there is no comprehensive report or publication in the literature about transportation modes in Cape Breton Island using SWOT analysis. In this chapter, we provide a unique overview of transportation modes including air, rail, truck, water, and intermodal modes in Cape Breton Island. Then, we find and rank the SWOT factors by two methods. Finally, appropriate strategies are found. This research is the first investigation that applies SWOT to analyze transportation modes in this area. The results of this research will provide bases for future quantitative investigations in the region. In addition, this chapter introduces the steps for analyzing transportation modes of other areas and regions using pairwise comparisons in AHP method.

Authors	Application	# S	# W	# O	# T	Total	Ranking the factors	Finding the strategies
Amin et al. [8]	Supplier selection	3	1	3		7	✓	
Arslan and Er [19]	Liquid chemicals	6	7	7	9	29	✓	✓
Bas [17]	Electricity supply chain	2	6	4	3	15	✓	✓
Dadvar et al. [16]	Dry ports	14	8	14	10	46		
Diakaki et al. [18]	Vehicle Automation Systems	16	10	14	12	52		
Gao and Peng [11]	Numerical example	5	4	3	5	17	✓	
Kurttila et al. [15]	Forest case	4	3	3	3	13	✓	✓
Rauch et al. [14]	Forest supply chain	13	14	10	9	46	✓	✓
Sevkli et al. [20]	Airline industry	10	10	5	5	30	✓	✓
Shahabi et al. [21]	Steel industry	3	5	3	3	14	✓	✓
Shang and Pheng [22]	Construction industry	2	4	4	2	12		
Our research	Transportation modes	14	14	14	13	55	✓	✓

S, strengths; W, weaknesses; O, opportunities; T, threats.

Table 1. Classification of some papers.

The structure of the paper is as follows: Section 2 provides summary of transportation modes in Cape Breton Island. In Section 3, SWOT matrix is introduced. In addition, the factors of the matrix are identified and ranked. Section 4 discusses the transportation strategies obtained from the SWOT matrix. Finally, Section 5 provides the conclusions and future research.

2. Transportation modes

Transportation is defined as the movement of products from one location to another location. It also refers to shipping the products from the beginning of a supply chain to the end customers and or consumers. Since few products are produced and consumed in the same location, transportation proves to play an important role in the supply chain. Moreover, transportation costs are regarded as an important part of the total supply chain cost [1]. The following sections include the summaries of the information we have collected about different modes of transportation in Cape Breton Island.

2.1. Air

There are three commercial airports in Cape Breton Island. They have been illustrated in **Figure 2**. The main airport is JA Douglas McCurdy Airport that lies just 20 min from the Sydney downtown business district. It is also located within easy driving distance to other key areas of Cape Breton Island. This airport provides flight services, which are operated by four airline companies. Air

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Canada operates five flights daily to Halifax and a year round daily flight between Sydney and Toronto, with worldwide connectivity. WestJet also provides a daily flight between Sydney and Halifax year round and another daily flight between Sydney and Toronto from May to October. Air St. Pierre currently offers two flights per week to St. Pierre from July to September and one flight per week during the rest of the year. Unlike other airline companies which just provide passenger services, Air St. Pierre also provides weekly cargo service to St. Pierre and Miquelon. In the past, Provincial Airlines executive air charter service, which travels throughout Atlantic Canada, Ontario, the eastern U.S. and Greenland [23].

The second airport is Margaree Airport, which is owned by the Inverness Municipality. The Inverness County has decided to upgrade this airport as a part of efforts to grow a tourism-based economy [24]. The third airport is Port Hawkesbury Airport that is located in the north of the town of Port Hawkesbury and a few minutes drive from the gateway of Cape Breton Island (Canso Causeway). It has the geographical advantage of being near the famous golf course (Cabot Link), fishing (Margaree River), as well as other interests on Cape Breton Island and the eastern mainland of Nova Scotia. This airport offers a large number of Biz-Jets, recreational flyers, medical and government flights during the year, as well as charter services which operate from Halifax or any other airport on the Atlantic Seaboard [25].

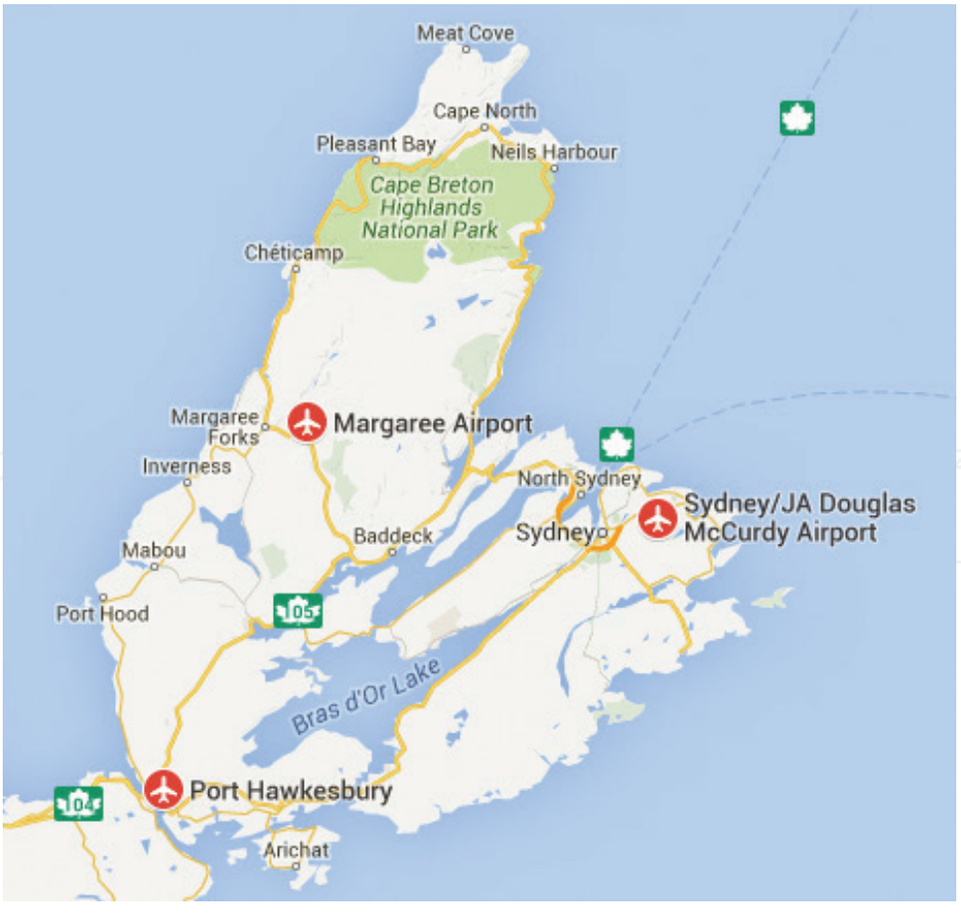

Figure 2. Airports of Cape Breton Island (source: Google Maps).

2.2. Truck

There are three controlled-access 100-series highways converging in the Sydney area, which are Highway 104, Highway 105 (Trans-Canada Highway), and Highway 125. These highways are in total 211 km of 45,456 roadways [5]. In Cape Breton Island, Highway 105 connects the gateway of the island (Canso Causeway) located in Port Hawkesbury to Sydney. Port Hawkesbury has been shown in **Figure 2**.

According to a research by MariNova Consulting Ltd. [7], total annual volumes of truck traffic at two locations in Cape Breton Island were 50,759 units through Hay Cove (St. Peter's) and 221,825 units through South Haven (Baddeck) in 2014. MariNova Consulting Ltd. [7] also pointed out that all rail users indicated that the conversion from rail to truck movements would be a factor of 1:3, which means 500 inbound carloads by rail in 2014 would convert to 1500 truckloads traveling between Port Hawkesbury and Sydney.

Most of the Sydney-area shippers transport the products by rail to Port Hawkesbury and use transloading at the Port Hawkesbury Paper (PHP) facility before completing the journey to Sydney by Truck. The transloading process would also increase shipping costs for the shippers. It would also be necessary for shippers to increase their capital costs and for PHP to improve their storage capacity [7].

For the area of Cape Breton Island, short haul trucking is available for both trailer loads and bulk shipping. In the research of MariNova Consulting Ltd. [7], some of the interviewees said that they are either using RST Industries (Irving Group) or Trimac to move resin from Moncton or Port Hawkesbury to Sydney. Another firm used Atlantic Diversified Trucking System (ADTS) flatbeds to transport products from Port Hawkesbury to Sydney. **Figure 3** illustrates the roads surrounding the Sydney area.

2.3. Rail

The Cape Breton and Central Nova Scotia Railway (CBNS) is the operator of a 245-mile short line railway between Truro and Sydney, with spurs at Stellarton, Point Tupper, and Sydney. This railway was primarily purchased by RailTex company in 1993, then RailAmerica company in 2000, and now it is owned by Genesee & Wyoming Inc. (G & W). The Sydney Subdivision, a portion of the overall Truro to Sydney line, comprises a 98-mile section between St. Peter's Junction (at Point Tupper) and Sydney [7]. A part of the railway across Sydney River has been shown in **Figure 4**.

The railway was active regularly over the past years. According to a study conducted in 2003, there were 520 outbound carloads of cargo per year originating east of St. Peter's. These carloads included transportation of some products such as steel, coal, logs, and scrap. There were 767 carloads of building supplies, scrap, bulk cement, petroleum products, resins, feed, logs, and intermodal cargo inbound at the same time [7].

Recently, traffic on the rail line has decreased. It had decreased to about 500 carloads in total by 2014, which led to the owners applying to the Nova Scotia Public Utilities and Review Board (UARB) to stop the rail service. Based on the estimates from Genesee & Wyoming,

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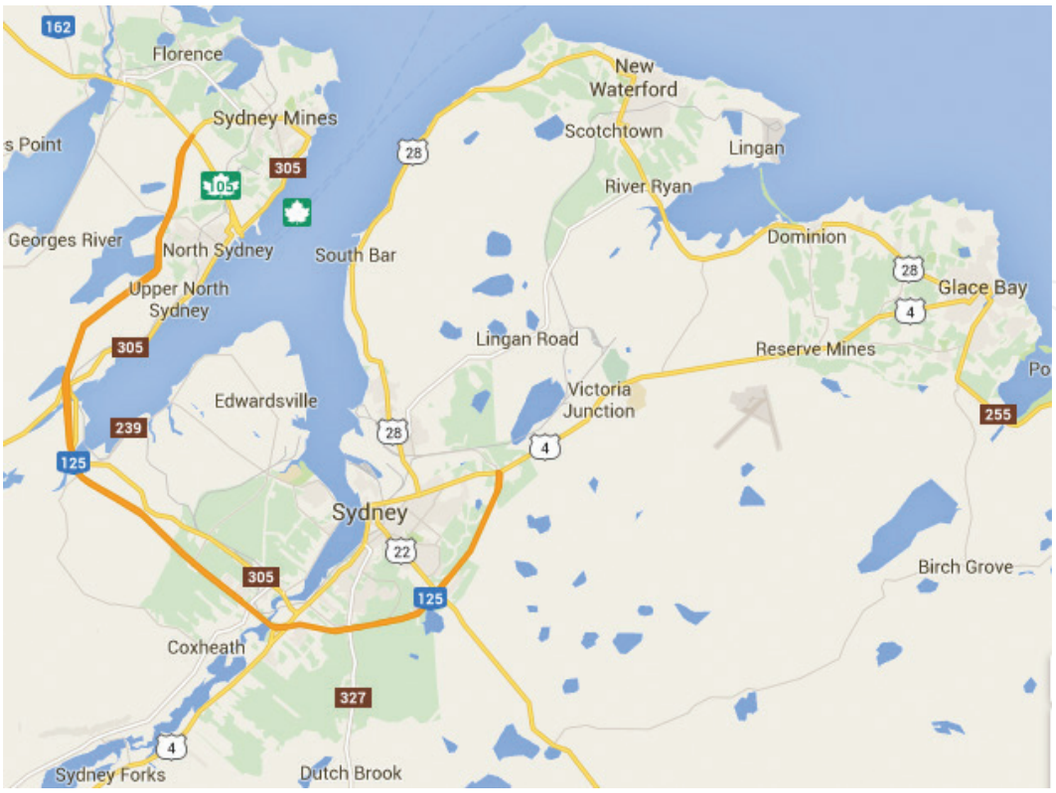

Figure 3. Roads connect Sydney Mines, North Sydney, Sydney, Glace Bay (source: Google Maps).

Figure 4. Railway across Sydney river in Cape Breton Island.

10,000 return carloads per year is the breakeven point for the Sydney Subdivision. For the past 10 years, losses resulting from reduced traffic volume were offset by an annual subsidy from the Province of Nova Scotia [7]. The owner did not resubmit the application for a $3 million yearly government subsidy in 2015, and the railway between Port Hawkesbury and Sydney was to be abandoned based on the authorization of the Nova Scotia regulator in October 2015 [26].

Due to the shut-down of this section of CBNS railway, some manufacturers would encounter challenges related to transportation costs. They would have to try and find new ways to receive raw materials [26]. It is expected that the businesses engaged in the transshipment of building supplies destined for Newfoundland and Labrador, and the businesses involved in feeding grain to the Island, and transportation of round wood (logs) would be affected significantly by the shut-down of the rail line [7].

2.4. Water

The Port of Sydney is situated on the East Coast of Canada. It is noticeable that it is the closest port in North America to the Suez Canal, Middle East, and India, as well as Europe. Its channel and sheltered inner harbor have the potential to handle the world's largest ships and vessels and the Port is placed on direct shipping routes to Europe, the U.S., Asia, and South America. The routes have been illustrated in **Figure 5**. In addition, the Port of Sydney is noted as the "Gateway to the Great Lakes" and is the furthest point that lake freighters or "lakers" can go during the 3 months of the year when the St. Lawrence cannot be voyaged [5].

Some studies show that the development of the port and related supply chains has a very good future and can provide more opportunities for the area. Insufficient investment in transportation infrastructure is the main challenge for the port development plan. It has been announced that Harbor-Port Development Partners (HPDP) have signed an agreement with one of the world's famous port construction companies, China Communications Construction Company Limited (CCCC) for the design, construction, and ownership of a deep-water container terminal in Sydney. The goal is not only to build the terminal, but also to bring business opportunities for all of the area's supply chain components [27]. As for the design and construction of Sydney's container terminal, CCCC plans to take charge of all required infrastructures and related equipment [28].

Marine Atlantic Inc. plays a significant role in water transportation through Cape Breton Island. The company provides ferry services between the island of Newfoundland and the Province of Nova Scotia over two routes; the routes are shown in **Figure 6**. The first route is a year-round, 96 nautical mile daily ferry service between North Sydney, Nova Scotia, and Port aux Basques located in Newfoundland and Labrador. The second one is active from mid-June until late September because of the weather conditions. It is a 280 nautical mile tri-weekly ferry service between North Sydney, Nova Scotia, and Argentia in Newfoundland and Labrador. The company provides service to more than 300,000 people yearly with 6–8 h travel between North Sydney and Port aux Basques, and 14–16 h travel between North Sydney and Argentia. Besides these routes, it also carries more than 100,000 commercial units each year, of which more than 50% of all products are being transported to and from the Newfoundland Island. Recently, there is a competition between the area and Halifax to transport the products needed to Newfoundland and Labrador.

Figure 5. The potential routes for water transportation to Cape Breton Island through Suez Canal (sources: Google Maps, website of Novaporte).

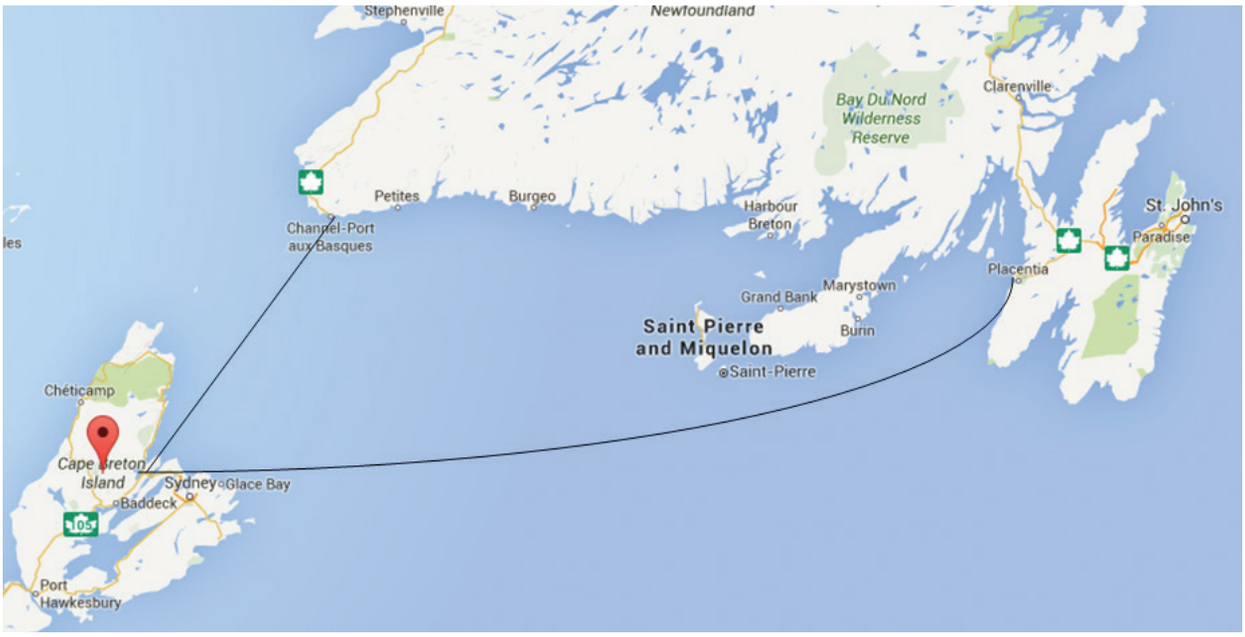

Figure 6. Water transportation from Cape Breton Island to Newfoundland and Labrador (source: Google Maps).

2.5. Intermodal

Truck transportation provides convenience to shippers in Cape Breton Island and has the ability to cooperate with other transportation modes well due to the highways, road conditions, and the flexibility of truck transportation. Especially after discontinue of rail way service, truck services gradually replace the role of rail service in Cape Breton Island. Port Hawkesbury, as the entrance of the Island from the (mainland) rest of Nova Scotia, plays a significant role in the development of the transportation aspect of Cape Breton Island.

Truck and water transportation modes in the Port of Sydney can be combined to promote the intermodal transportation of Cape Breton Island. This port is the gateway for all trucked cargo to and from Newfoundland and Labrador. Due to the condition of the highways, a full range of trucking services can provide an alternative to rail and water transportation modes.

There is a possibility of combining water and rail transportations in this area as well. The Cape Breton and Central Nova Scotia Railway (CBNS) has discussed with HPDP recently about the possibility of providing future rail service on the line from Truro to Sydney, as a part of the deep water port development project in Sydney [28].

3. SWOT matrix

SWOT analysis is one of the most straightforward approaches that can be used in the analysis of a company's strategic position. It includes factors of internal strengths and weaknesses, as well as external opportunities and threats [10, 14].

We propose the following steps to analyze transportation modes of areas and regions:

Step 1: identifying the SWOT factors: brainstorming, SWOT form, interview, and literature review can be applied to identify strengths, weaknesses, opportunities, and threats factors.

Step 2: ranking the factors: multifactor process and pairwise comparisons are utilized to rank the identified factors.

Step 3: calculating the average of the weights for each factor: the results of Step 2 are combined to obtain the average of the weights for each factor.

Step 4: transportation strategies: transportation strategies related to the identified strengths, weaknesses, opportunities, and threats in the region are defined by the experts.

In this section, we apply these steps to analyze the transportation modes in Cape Breton Island.

3.1. Identifying the factors

In this research, we have applied four methods including brainstorming, SWOT form, interview, and literature review to identify the SWOT factors. (i) Brainstorming: we discussed and analyzed the potential SWOT factors in group meetings. Each group included 4 or 5 people. At the beginning of each session, we provided some general information about the transportation modes using PowerPoint slides. We emphasized that this research focuses on business transportation, not public transportation. (ii) SWOT form: **Table 2** shows SWOT form that has been designed based on tables of Rauch [29] and Rauch et al. [14]. In addition to this table, we have provided an example of a SWOT table adopted from Dadvar et al. [16]. The example was helpful to provide ideas for the people. (iii) Interview: we noticed that it is a challenging task for some individuals to fill out the SWOT form. As a result, we conducted some interviews to find SWOT factors. The goal was to explore views and ideas related to this research. (iv) Literature review: some publications about transportation modes in the area have been mentioned in Section 1.1. We reviewed those publications to find the SWOT factors. The identified SWOT factors have been written in **Table 3**. In addition, SWOT factors based on transportation modes have been illustrated in **Figure 7**.

Internal strengths	**Internal weaknesses**
What are the advantages of the transportation modes in the area? What is done well? What do others see as advantages of them?	What are the current disadvantages of the transportation modes in the area? What could be done better? What is actually done poorly?
- Shipping between the area and Newfoundland and Labrador	- Lack of rail services
External opportunities	**External threats**
Which trends are affecting the transportation modes in the area? Which opportunities can arise from these trends?	Are there any relevant future competition scenarios? What are possible barriers and relevant changes? Does a technology shift or a change in legal framework threaten the actual status?
- Port of Sydney development plan	- Competition between the area and Halifax

Table 2. SWOT form.

Strengths	**Weaknesses**
Air	Air
S1: Passenger and cargo services through Sydney airport	W1: Small scale of Sydney Airport
Rail	W2: Limitations in flight destinations
S2: Existence of railways	W3: High cost of passenger and freight transportations
Truck	W4: Infrequent flight schedules
S3: Several roads and highways	Rail
S4: Operations of local companies with economies of scale	W5: Lack of rail services
S5: Shipping of fresh and flash frozen seafood products by refrigerated trucks to USA	W6: High cost of upgrading railways and related infrastructures
Water	Truck
S6: Shipping between the area, and Newfoundland and Labrador	W7: Existence of one connection road to the mainland
S7: Ice free Sydney harbor	W8: All roads and highways are not twin
S8: Existence of cruise	W9: Poor highways maintenance
S9: Geographical location of Port of Sydney	W10: Fresh food deliveries from Halifax to the area is limited in each week
S10: One of the deepest harbors in North America	Water
S11: Fully operational and well developed shipping pier	W11: Lack of governance on port of Sydney and lack of cooperation between municipality and senior governments
S12: Existence of greenfield site which is ready for port of Sydney development	W12: Different ownerships of Sydney harbor bottom
Intermodal	W13: Cruise berth limitations in Port of Sydney
S13: Land availability for projects development	Intermodal
S14: Tourism transportation	W14: Poor public transportation options to the Halifax
Opportunities	**Threats**
Air	Rail
O1: Future development in the Sydney airport	T1: Lack of information sharing about the importance of railways in the community
O2: Future development in Margaree and Port Hawkesbury airports to reach tourism destinations	Truck
O3: Increased flights and better schedules	T2: Poor highway maintenance continues to reduce number of privately-operated tour bus services
Rail	T3: Competition between local transportation companies and other companies
O4: The possibility of buying and maintaining rails by external companies	Water
O5: Future rail services	T4: Competition between the area and Halifax

Strengths	Weaknesses
Truck	Intermodal
O6: Standards improvement of highway construction to lengthen lifespan of road surfaces	T5: Decreasing trend in population of the area
Water	T6: Weather conditions such as storm
O7: Port of Sydney development plan	T7: Increase in the cost of fuel for motor vehicles and marine vessels
O8: Relocating ice breakers to the port of Sydney	T8: Short-term limitations because of stricter emission standards and environmental issues
Intermodal	T9: Poor economic conditions impacting transportation development
O9: Potential transportation businesses related to Donkin coal mine	T10: Limitations of government funding and support for development of transportation modes
O10: Shipment from larger vessels to smaller vessels in port of Sydney	T11: Older demographic in local areas
O11: Technological innovations	T12: Policy of provincial government for infrastructure development in Halifax area and Sydney area
O12: Growth of tourism industry in the region	T13: Limited high-speed internet outside municipal population clusters that limits economic development opportunities
O13: New markets and businesses due to increased transportation modes	
O14: Cost saving and less damages to the roads due to the existence of the rails	

Table 3. SWOT factors.

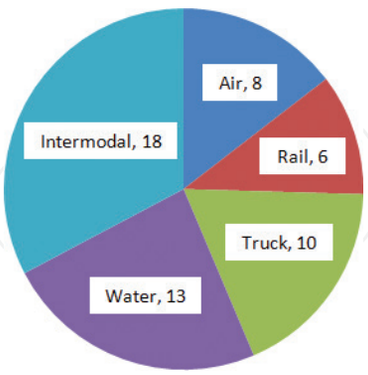

Figure 7. SWOT factors based on transportation modes.

3.2. Ranking the factors

In this section, the five most important factors from each group (strengths, weaknesses, opportunities, and threats) are selected and ranked. Two methods including multifactor process and pairwise comparisons are utilized to rank the SWOT factors. Then, the results are compared.

3.2.1. Multifactor process

In the multifactor decision-making process, 3 experts (E_1, E_2, E_3) assign scores for each SWOT factor. The scale includes 1–9 in which 9 means extremely important. Then, the numbers are combined and the averages and ranks are calculated. The results have been written in **Table 4**. Based on the rankings, "Geographical location of Port of Sydney," "Lack of governance on port of Sydney and lack of cooperation between municipality and senior governments," "Port of Sydney development plan," and "Poor economic conditions impacting transportation development" are the main transportation factors in the area.

3.2.2. Pairwise comparisons

Some studies have shown that pairwise comparisons can provide more reliable results than the multifactor process [30–32]. Pairwise comparisons are utilized in analytic hierarchy process (AHP) [30]. We used a scale that ranges from equally preferred to extremely preferred (1—equally preferred, 2—equally to moderately preferred, 3—moderately preferred, 4—moderately to strongly preferred, 5—strongly preferred; 6—strongly to very strongly preferred; 7—very strongly preferred; 8—very to extremely strongly preferred; 9—extremely preferred). **Table 5** shows the results of the comparisons for strengths assigned by Expert 1. For example, the expert determines that S3 is moderately preferred to S2. Thus, she assigns 3.

In pairwise comparisons method, we should check the consistency vector. Interested readers can refer to [31] for more information. Generally, the consistency ratio should be 0.10 or less. Otherwise, the results are not consistent and the expert should fill the tables again [31]. In this case, the results are consistent.

Strengths	**E_1**	**E_2**	**E_3**	**Average**	**Rank**	**Weaknesses**	**E_1**	**E_2**	**E_3**	**Average**	**Rank**
S2	7	3	6	5.33	3	W3	7	7	6	6.66	2
S3	8	5	8	7	2	W5	8	4	7	6.33	3
S6	6	5	5	5.33	3	W6	6	2	6	4.66	5
S9	8	7	7	7.33	1	W9	6	2	7	5	4
S10	7	9	5	7	2	W11	6	7	8	7	1
Opportunities	**E_1**	**E_2**	**E_3**	**Average**	**Rank**	**Threats**	**E_1**	**E_2**	**E_3**	**Average**	**Rank**
O3	6	6	6	6	3	T4	6	5	5	5.33	5
O5	8	2	6	5.33	4	T5	7	3	8	6	3
O6	6	4	8	6	3	T6	9	2	6	5.66	4
O7	8	8	8	8	1	T9	7	8	7	7.33	1
O12	7	8	7	7.33	2	T10	6	7	8	7	2

Table 4. SWOT ranking based on multifactor process.

Strengths	S2	S3	S6	S9	S10
S2	1	1/3	2	1/3	1/2
S3	3	1	2	2	3
S6	0.5	1/2	1	1/3	2
S9	3	1/2	3	1	2
S10	2	1/3	1/2	1/2	1
Column totals	9.5	2.67	8.5	4.16	8.5

Table 5. Pairwise comparisons by E_1 strengths.

The process is repeated and the numbers are obtained based on the opinions of 3 experts (E_1, E_2, and E_3) for other factors. The weights and the ranks have been written in **Table 6**. All consistency ratios are less than 0.10.

3.2.3. Calculating the average of the weights for each factor

There are some differences between the ranks of the factors in **Tables 4** and **6**. Pairwise comparisons method is preferred to multifactor process method when we do not feel confident or comfortable about determining the factor weights independently. In this paper, we calculate the average of the weights of two methods (normalized multi factor process and pairwise comparisons). The results have been written in **Table 7**. Most of the ranks are like **Table 8**. We observe that "Several roads and highways," "Port of Sydney development plan," "Lack of governance on port of Sydney and lack of cooperation between municipality and senior governments,", and "Poor economic conditions impacting transportation development" are the main transportation factors in the region.

Strengths	E_1	E_2	E_3	Average	Rank	Weaknesses	E_1	E_2	E_3	Average	Rank
S2	0.12	0.04	0.19	0.117	5	W3	0.07	0.38	0.12	0.190	2
S3	0.35	0.11	0.43	0.297	1	W5	0.37	0.12	0.26	0.250	1
S6	0.13	0.13	0.15	0.137	4	W6	0.21	0.06	0.26	0.177	3
S9	0.27	0.22	0.12	0.203	3	W9	0.14	0.06	0.19	0.130	4
S10	0.13	0.5	0.12	0.250	2	W11	0.20	0.38	0.17	0.250	1
Opportunities	**E_1**	**E_2**	**E_3**	**Average**	**Rank**	**Threats**	**E_1**	**E_2**	**E_3**	**Average**	**Rank**
O3	0.07	0.16	0.11	0.113	4	T4	0.12	0.14	0.19	0.150	4
O5	0.22	0.05	0.31	0.193	3	T5	0.36	0.08	0.31	0.250	2
O6	0.09	0.11	0.12	0.107	5	T6	0.22	0.07	0.13	0.140	5
O7	0.49	0.34	0.31	0.380	1	T9	0.21	0.41	0.19	0.270	1
O12	0.14	0.34	0.15	0.210	2	T10	0.09	0.28	0.17	0.180	3

Table 6. SWOT ranking based on pairwise comparisons.

Strengths	M	P	Average	Rank	Weaknesses	M	P	Average	Rank
S2	0.167	0.117	0.142	5	W3	0.225	0.190	0.207	3
S3	0.219	0.297	0.258	1	W5	0.213	0.250	0.232	2
S6	0.167	0.137	0.152	4	W6	0.157	0.177	0.167	4
S9	0.229	0.203	0.216	3	W9	0.169	0.130	0.149	5
S10	0.219	0.250	0.234	2	W11	0.236	0.250	0.243	1
Opportunities	**M**	**P**	**Average**	**Rank**	**Threats**	**M**	**P**	**Average**	**Rank**
O3	0.184	0.113	0.149	4	T4	0.170	0.150	0.160	4
O5	0.163	0.193	0.178	3	T5	0.192	0.250	0.221	2
O6	0.184	0.107	0.145	5	T6	0.181	0.140	0.160	4
O7	0.245	0.380	0.312	1	T9	0.234	0.270	0.252	1
O12	0.224	0.210	0.217	2	T10	0.223	0.180	0.202	3

Table 7. SWOT ranking based on combination of normalized multifactor process (M) and pairwise comparisons (P) methods.

Modes	Strategies	Related SWOT factors	Rank
Air	Improve flights schedules and develop air cargo businesses	O3, O12, W3, T5, T6	5
Rail	Increase the activities that lead to have the rail services	S2, S6, O5, W5, W6, T5	4
Water	Focus on port of Sydney development plan	S9, S10, O7, W11, T10	1
Truck	Improve the road conditions and develop new roads	S3, S6, O6, W9, T5, T10	3
Intermodal	Increase the investment in different modes of transportations	S6, O12, T4, T10	2

Table 8. Transportation strategies.

4. Transportation strategies

The three experts were invited to think about the transportation strategies related to the identified strengths, weaknesses, opportunities, and threats in the region. **Table 8** shows the five main transportation strategies that are suggested by them. The work of Andrews [33] made the idea popular that a good strategy means ensuring a fit between the external situation a firm faces and its own internal qualities or characteristics. The proposed strategies have some characteristics connecting them to the SWOT factors. The experts have determined the related SWOT factors. We utilize and combine the weights of the SWOT factors (**Table 7**) to find the overall weight of each strategy and find the ranks in **Table 8**. Based on the information given in **Table 8**, "Focus on port of Sydney development plan" is the most important transportation strategy for the area (Rank 1).

5. Conclusions

In this chapter, we have provided a summary of transportation modes (air, truck, rail, water, and intermodal) in Cape Breton Island. The summary is helpful to provide insight for future applied transportation projects in the area. Furthermore, we have identified SWOT factors including strengths, weaknesses, opportunities, and threats in the region. This chapter is the first investigation that has identified the SWOT factors related to transportation modes in the area. We have selected 20 factors (out of 55) and have ranked them using two methods (multi-factor process, and pairwise comparisons). Then, we have compared and combined the results. Three experts contributed in this process. Based on our analysis, the most important transportation elements in Cape Breton Island are "Several roads and highways," "Port of Sydney development plan," "Lack of governance on port of Sydney and lack of cooperation between municipality and senior governments," and "Poor economic conditions impacting transportation development". Finally, the appropriate transportation strategies have been discussed. This paper provides the steps to analyze transportation characteristics of any area or region.

In this chapter, the SWOT factors have been identified and ranked by the experts. It is valuable to consider uncertainty in this process by using different methods such as fuzzy sets theory and compare the results. In addition, analytic network process (ANP) can be applied in future investigations to rank the factors. ANP is a decision-making technique which structures the problem as a network.

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