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'The Making of Mountains:' The Development of Chair-Lift Technology in the American Skiing Industry

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‘The Making of Mountains’

The Development of Chair-Lift Technology in the American Skiing Industry

By George Eisenhauer '22, Spring 2022

Colby College

Honors Thesis

Science, Technology, and Society Program

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Abstract

Skiing is a sport that is entirely reliant on its setting and the elements that occur around it. This paper takes a science, technology, and society approach to one of the few human controls in the sport, chair lifts. By examining the skiing and chair lift industries, lift technology and their role on a mountain, this paper aims to build a foundational understanding of the overall value of a chair lift in the American skiing scene. With knowledge collected from critical analysis, interviews, maps, and firsthand experiences, the dialogue is rooted in a strong understanding of the role that the development of this technology has on the sport. With new technology and improvement of carriers, skiers are now able to move up mountains at unprecedented speeds while avoiding the elements. By engaging in a case study approach of Big Sky, Jackson Hole, and Snowbird, the paper takes the foundation of knowledge and applies it to ski resorts and their lift networks. The paper finds that a resort's business model, current lift system, location, and culture on the mountain are key factors in determining the development of lifts. Using those cases, a modern case is examined; the Little Cottonwood Canyon is located due east from Salt Lake City and accesses two of the world's premier resorts, Alta and Snowbird. With the ongoing debate about a potential gondola in the Canyon, this paper provides context to both sides of the argument within the framework of the development of chair lift technology.

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Next, I would like to thank my friends for supporting me throughout the research and writing process. I would not have finished this project without your ideas and encouragement. I am glad that so many of you were able to take part in being on the mountain enjoying some turns. It means even more that you would listen to my blabber about the differences in lifts and the importance of their placement on the mountain. I would specially like to thank Oliver Lawrence, Everett Metchick, Marty Whalen, Billy Costello, Bret Miller, Doug Metchick, Joost-Olan Sheehan, and Brandon Miner. The times I have spent with each of you on mountain time will be moments that I will never forget.

Finally, I would like to thank my family; when I first presented the idea of moving to Park City, Utah to be a lift operator you never batted an eye. The experiences that you have given me in my life have given me a non-stop feeling on movement. With that movement I have been lucky to push my own limits and do things that I would have never expected. I hope you take this paper as proof that I am taking the lessons you have taught me and applying them in the best ways possible. Mom, Dad, Frannie, Hattie, Lala, Papa, Gorgeous, and Granddad, thank you for everything. I hope what you read adds some context to all the pictures that I send you.

Preface

“Once you take your first ride up a lift your life will be changed forever” – Warren Miller, skiing
and mountain life filmmaker

The fall of 2020, in what was supposed to be the start of my junior year of college, lead me to that Warren Miller quote. After making the decision to take a semester away from school due to the restrictions in social life and loss of a true in person academic experience, I took a leap of faith with three other friends to live on a ranch in Cora, Wyoming. I recognized that after a semester and summer at home in lockdown that my idea of the true college experience had bene turned upside down and it was up to me to make decisions that prioritized my happiness and interests. Throughout the two and a half months spent getting to the ranch and being there, I developed an appreciation for the value of being in nature.

I am originally from Beverly Shores, Indiana which is at the southern tip of Lake Michigan and an hour away from Chicago. My town is submerged in the Indiana Dunes National Park. The park was given that designation in 2018 after decades of being a National Lakeshore. With the new title came new publicity and new problems; from a rapid increase in visitors that the infrastructure was ill prepared for to new passes required to enter the park, many locals were displeased. I did not appreciate the divide between locals and visitors until I spent time in Cora. Their land and way of life is challenged every day by the city-folk looking to exit concrete jungles for greener pastures. I was a part of that wave during the Covid-19 pandemic. As my time on the ranch ended and my experience there left me wanting more, I looked for new ways to spend my last few weeks away from college out west in the Rockies. After a few phone calls with friends and inspiration from a book, *Tracking the Wild Coomba*, I took a new leap of faith

and committed to working at a ski resort. The only problem was that I had never been on a pair of skis in my life.

After another journey west in a car packed full of my stuff, I made it to Park City, Utah with a pair of demo skis and a job offer at Deer Valley to be a lift operator. Luckily, I was joined by a friend with a deep set of experiences in the mountains and patience that was unmatched. Due to the timing of our arrival and job start date, we decided to take a few days to head north to Jackson Hole, Wyoming to enjoy the start of the ski season. Jackson Hole was the background for much of *Tracking the Wild Coomba* and had a special place in my heart after frequent visits during the fall. It was there that I took my first ski lift up a mountain, and as Warren Miller perfectly describes it in his quote and replicates through his films, my life was quickly changed. While it took a few weeks for me to learn, I developed a deep appreciation for the sport of skiing and its relationship with its surroundings. It is a sport that is entirely dependent on its playing surface and conditions. Working as a 'liftie,' I was afforded a front row seat to the behind-the-scenes of mountain operations. From my first day of training on Deer Valley's Viking lift, I was obsessed with the way they worked and their overall utility within the sport of skiing. From their role in mountain design to the mechanics that kept them running, every day was an opportunity to learn something new for me. As I visited more resorts, I was able to better understand the modernization of lift technology. The differences between Alta's wildcat chair and Snowbird's tram amazed me. After returning east to school, I could not get this technology out of my head. Visiting Maine's Sugarloaf, I would give a bright smile to their lefties jealous of the opportunity they had to wake up every morning and work on a mountain.

As summer rolled around, I planned a trip to get back to the west and adventure around places that I had not stopped by yet. On a trip to Arches National Park, I was told by my dear

friend, and fellow Colby College student, Everett Metchick to read Edward Abbey's *Desert Solitaire*. Everett was one of the three friends that was with me in on the ranch, so his recommendation of a nature-centric reading held serious weight with me. I learned as I worked through the book that Abbey was a park ranger at Arches during the 1960s. The book explores the modernization of the park and the loss of its once wild nature. As I tried to enjoy my time exploring other national parks, I could not get Abbey's ideas of the industrialization and modernization of parks out of my head and realized that so much of my admiration for these 'wild,' places are built around a false notion of environment and nature. Abbey points to early ideas of eco-tourism and how it shifted the way that Arches National Park was managed and designed. No longer did Arches, or other parks that would eventually face the same issues, prioritize the natural environment, but rather the visitors that were set to visit the park. These visitors brought cars, resulting in massive road networks to cater to the car camping and hiking crowds. They also brought trash and a need for modernized sewage systems. Instead of inherently teaching visitors valuable lessons about being outdoors and how to best prepare for time outside, the National Park system adapted to its clientele and quickly lost the battle for preservation to modernization.

As I returned to my memoirs of the previous winter, I realized that the skiing industry plays a similar role to the cars and infrastructure projects that take away from the naturalness of parks but on their mountains instead. The messaging that is seen by ski resorts often lacks conservation and champions consumerism. With an increased number of skiers comes a need for more lodging, dining, and restroom option projects are being done to "transform" mountains (*Big Sky Resort - 2025 Vision*, n.d.; Vincentelli, 2022). At the center of the transformations are the ski lifts that I so quickly fell in love with. How could something with such good intent have intrinsic

drawbacks for its own setting? While Warren Miller's quote highlights how taking a lift changes ones' life, it is equally easy to miss how those same ski lifts also play a role in changing their surrounding environment.

Introduction

Unlike most other sports, skiing is a sport that is almost entirely dependent on its setting. The differences between one ski destination and the next mean entirely different experiences due to differing elevation, amount of snowfall, and latitude. Over the course of the past century, skiing's leaders attempted to mitigate those differences through several technological advancements. This includes the improvement of skiing equipment, access to new terrain, and the focus of this paper, chair lifts. Chair lifts are a captivating technology due to their relevance in the sport and their exposure to anyone moving up a mountain to eventually come back down. The ability to access new terrain and get to higher points in the world with more snow has been made exponentially easier by chair lift technology. Now, it is no longer just about having chairs that can get to higher elevation, instead it is about having the fastest and most efficient chairs (Blevins, n.d.). However, these advancements come at the cost of other aspects of mountain life. For skiing to be such a setting-reliant sport, it does play a role in changing the surrounding landscape. From erosion to man-made avalanches, mountains as a landscape are facing more challenges as the ski model looks to bring more visitors to the top (Diamond & Bigford, 2019; Fava, 2020; Pickering & Buckley, 2010). While chair lifts have been able to reach new heights for skiing, their role on the mountain and in the surrounding areas has become controversial.

What was once a technology that was viewed for its functional abilities has now become polarizing as it is critiqued from several angles (T. Smith, personal communication, March 18, 2022). With the recent growth of mountain towns into resort destinations, many locals view these upgrades as detrimental to habitats (Christensen, 2022). They consider their residencies as not being ready for the expansions needed to support an influx of mountain-goers. This paper will be looking specifically at how chair lift technology is impacted by act-network theory. Through this

theory, the development of chair lift technology can be framed in a way that acknowledges the role of so many actors in outcomes. From the quality of snow to the state of the global economy, skiing and its chair lifts are impacted in so many ways (S. Kircher, personal communication, March 27, 2022; *Why Utah Has The Greatest Snow on Earth*, 2012). In pursuing this argument, is important to first define the term development. This paper defines development as the improvements of chair lift technologies as it relates to time and the level of sophistication within the chair lift field (Hendrickson, 2018). With so many factors at play for decision makers, such as the style of ski business model, the needs of the mountain, and the limitations, it is easy to see why their conclusions are criticized by many. By understanding this struggle between commerce, eco-tourism, conservationism, and modernization readers will be able to build an opinion for themselves for the next time they see an ongoing debate regarding ski lift infrastructure.

By looking at three case studies, each of which is unique, the paper will explore their differences in four different categories. By reflecting on personal experiences, interviews with industry leaders, and examining images and opinions, economic and political differences will be fleshed out. These differing factors include the style of business model, current lift network, the location of the mountain, and the culture of each destinations' skiing. While most ski resorts are privately owned, the variance in model, and resulting lift network, comes from the ownership of land. The larger skiing conglomerates often own the land that is used for skiing and allows for more flexibility in terms of usage. The more popular model is done through the leasing of public lands from the United States Department of the Interior. These public lands, often National Forests or Parks, create an entirely new set of challenges. The current lift network helps determine what kind of terrain the mountain has access to. This also helps decided whether they need a few major lifts or a lot of lifts that vary in size and speed. The location of the mountain

resort determines the snowfall, elevation, and accessibility. This factor is what makes the skiing business so uneven, as the ski resorts in Utah benefit from a reliable snowfall while being near a metropolitan area, Salt Lake City. On the other hand, Sugarloaf faces inconsistencies in snow due to its lower elevation as well as a decrease in visitors due to its placement in rural Maine. The final factor, the culture of each mountain resort, determines the goals of each resort's management team. This was described to me as a resort's "DNA," by Boyne Resorts CEO Steven Kircher (S. Kircher, personal communication, March 27, 2022). Boyne Resorts owns a host of different resorts, from Big Sky in Montana to Boyne Highlands in northern Michigan. As the CEO, he made it clear that the decisions about chairlifts at each mountain is dependent on the clientele and culture of the skiing. Therefore, the lifts that are being used to tight chutes in the northern Rocky Mountains will vary greatly from those that can be found at Boyne Highlands with an elevation of 1300 feet along Lake Michigan. These four factors provide background and insight into how to consider the ski lift networks at each mountain resort that is discussed in this paper.

Within the actor-network theory framework, one that looks to each actor and its role in outcomes, this paper argues that a holistic approach must be used to better analyze the state of skiing and chair lift networks. The central argument of this paper is that the development of chair lift technology is impacted by so many factors and that as a result, impacts are seen in areas that have developed their chair lift networks. This includes industry and environmental concerns that are at odds with one another because everyday citizens look to take advantage of the topographical resources. Frameworks that have been used within the science, technology, and society field will be utilized to create and explore the paper's topic. This includes actor-network theory which looks at how actors play a larger role in the outcomes of their surroundings, and it

is this interconnectedness that creates complexities (Ahmed, 2013; Fallan, 2011). This larger meta-approach, one that has never been done in the chair lift world, is needed to build to an argument that will bring more attention to the issues at hand. A more cohesive environment will be developed concerning the issue because the future of skiing is dependent on these more in-depth conversations.

To demonstrate the findings of this argument, the paper uses a case study approach. By using the historical cases of Big Sky, Montana; Jackson Hole, Wyoming; and Snowbird, Utah, comparisons will be helpful in building an understanding of the uniqueness of each resort's goals and their practices. Each ski resort is unique in its location, its approach to the ski resort model, and its rise to honor amongst the world's top skiing destinations. While each of these resorts have well-known trams, they also house intricate fleets of ski lifts. With thousands of skiable acres at each mountain, these lift systems have been designed to accommodate skiers of all levels. With more than 50 years of skiing at each of these resorts, they have seen millions of visitors and decades of upgrades to match the current state of ski lift technology (P. Landsman, personal communication, February 1, 2022). These cases will provide insight into how chairlifts can change a mountain and how the skiing on that mountain can change a town. Using these historical models, the paper will also examine an ongoing case, the current debate in Salt Lake City, Utah's Little Cottonwood Canyon (*It's Cheaper than a Train, More Expensive than a Bus. Is It the Solution to Canyon Gridlock?*, 2021). In Salt Lake City, discussions are being held about how to best improve the movement of people up and down the canyon that is protected within the Wasatch National Forest system. It also houses two of the world's most famous ski resorts: Alta and Snowbird. The current choices that are being considered by the state government are to either cut into the sides of the Wasatch National Canyon to expand the one lane highway or to

build one of the world's longest gondolas from the mouth of the canyon to the top ("*Gondola Works: Save Little Cottonwood Canyon*," 2021). This is controversial because of the role of the Forest Service in protecting the land while also needing a way to safely move people up and down the Canyon. Major costs will be faced by the citizens of Utah, as each project is more than \$500 million (Christensen, 2022). This contemporary conversation is a perfect place to workshop the knowledge that is gained from the findings of the other case studies.

The paper will first introduce the guiding research questions that were used to develop the goals and eventual findings. Second, actor-network theory will be used to connect the paper's topic to other works done in the field. This will also define how the topic fits into the science, technology, and society domain while using historical works that have looked at similar issues. Next, the actual technology behind chair lifts will be explained to provide readers a background into the mechanisms. By using interviews with chair lift experts and leaders within the skiing industry, the importance of chair lifts to skiing will be explained while also demonstrating just how far the technology has come over the past two decades. Then, the technological background will be employed to explore the research questions using the three historical case studies. Providing an in-depth analysis of each case, the value of chair lifts and their development will be surveyed and compared. By looking at Big Sky, Jackson Hole, and Snowbird, the paper will develop a stronger understanding of the factors that are considered by resort leaders to develop chair lift technology and the process that those decisions undergo to succeed. Next, those findings will allow for a contemporary review of the ongoing case in the Little Cottonwood Canyon. That case will use all the previous knowledge to support the arguments on both sides; those that are for building the gondola and those that support expanding the road and bussing system (Kuprianowicz, 2021; McKellar, 2021). This creates an opportunity for readers to

formulate their own opinions about what they think should happen in Salt Lake City. Finally, the paper will conclude with some limitations that could be improved for the field of study going forward, as well as with some closing thoughts about the meta-analysis of chair lift technology for the skiing industry to consider.

Research Questions

Question 1

How has ski lift technology changed, specifically over the past two decades, and what impacts can be seen in the ski industry as a result?

Question 2

How can understanding the development of ski trams in Big Sky, Snowbird, and Jackson Hole help guide the decision making of future mountain infrastructure projects that are similar, such as the ongoing debate in Little Cottonwood Canyon?

Question 3

How are decisions made about the development of chair lift technology and what factors are in consideration during that deliberation process?

Each of these questions is geared towards creating a better understanding to how ski lift technology has developed so rapidly and created an environment that romanticizes the commodification of a mountain. The first question looks at the advancements in the technology itself. The increased efficiency of ski lifts as components have improved and their capacities have expanded has allowed for more skiers to move up the mountain. The goal of this question is to set the modern standard of the technology in perspectives for readers as they build their own opinions about the potential for resorts to expand their lift networks. The second question sets up the structure of the four case studies. As mentioned in the introduction, the three historical

cases will be used to explain differences that can be found between any mountain and their surrounding areas. This will be used to explain the arguments used on both sides of the contemporary case in Little Cottonwood Canyon. The final question highlights the different factors that are considered when determining the developments for ski resorts. These factors are wide-ranging and crucial for any future investments into mountain infrastructure. The question looks to get into the mind of the skiing industry's decision makers to understand their path to conclusions for the masses to weigh judgment upon. The following literature review section will assist in setting up these questions to be answered within a science, technology, and society framework.

Literature Review

The current literature regarding actor-network theory is the leading used science, technology, and society ideal used for this paper. An example this framework in practice is Kjetil Fallan's "*Architecture in Action: Traveling with Actor-Network Theory in the Land of Architectural Research*," as Fallan looks at the action-network of modern architecture within unique settings around the world. She examines how the actor-network theory works for eco-tourism and its relationship with infrastructure. This argument is useful for me as I am using the space that ski infrastructure is in as the environment that faces numerous negative effects from the development of that technology. The traveling of people up and down mountains is one example of the themes that Fallan is highlighting. Fallan also examines how Actor-Network Theory, an STS centric concept that has been at the forefront of the field, can be used to think about a human's impact on their surrounding geographies. For my project, human incentives, both for one's enjoyment and economic gain, drive decisions about technologies in remote places. These self-interests are a theme that I will continue to return to for both the ski resort

executive and consumer. In ski resort development projects that entail modifications to lifts and other aspects of the mountain, the long-term effects are often overshadowed by short-term economic gains (S. Kircher, personal communication, March 27, 2022).

Another paper that looks at infrastructure and geography, two factors that I study within my own case studies, is Kathryn Furlong's "*Small Technologies, Big Change: Rethinking Infrastructure through STS and Geography*." With the growth of globalization and the ability to get to remote places quickly, Furlong's piece explores how even the slightest advancements in technology can impact geographic regions and how that space is interacted with. She looks specifically at a water system in Canada and the efficiencies needed to produce an effective technology that was able to meet its goals. Due to the massive size of the project and the need to create a system to protect private economic interests, the yield of the water for consumers using the system was an indication of the progress. In a similar way, ski lift investments are measured by the increased revenue that they bring to their mountains (Falk & Tveteraas, 2020). If they are not able to bring more in than the costs that were incurred to improve or create new lifts, then their production is a failure.

The STS literature that is more closely connected to skiing can be brought back to Catherine Pickering. Her study, "*Climate response by the ski industry: The shortcomings of snowmaking for Australian resorts*," along with co-author Ralf C. Buckley, looks at snowmaking infrastructure in Australia. They find that the development of this kind of technology is a direct response to climate change. With the changing of the average global temperature and the need for ski resorts to update their process to continue to be profitable, snowmaking has been viewed as an answer. This solution came up in other parts of my research and has become more closely tied to ski lift developments over the past two decades. However, the economic and

environmental costs of an increase in snowmaking have been detrimental to Australia. The price of water in nearby areas has been driven up and the efficiency of snowmaking is weak, so there is a lot of wasted water throughout the production of snow. Supporting an entire area of the mountain is unreasonable when considering the cost of the guns and the water movement system needed to reinforce the efforts. These costs to the local environment and economies had typically been ignored by large skiing corporations until December of 2021. Aspen Mountain put a melting gondola on display as recognition of the resort's role in increasing carbon emissions as an increased number of visitors have come to ski at one of the resort's four mountains. This was done in association with POW, Protect Our Winters, an environmental organization focused on fighting climate change to preserve our beloved winters (*Melting Art with a Message / Climate Stories / Inside Aspen Snowmass*, n.d.). Pickering's findings here highlighted the need for this paper to identify the relationship between ski lift and snowmaking technologies, as I had not previously been considering the two as coinciding. The marketing campaign from Aspen Mountain also suggested the need to investigate the role of ski resorts and the costs on local ecosystems and economies because of the increase in carbon emissions. Both sources are key for looking at efficiency and climate change under the umbrella of a ski business model.

In another one of Pickering's pieces, "*Indirect impacts of nature based tourism and recreation: the association between infrastructure and the diversity of exotic plants in Kosciuszko National Park, Australia*," with the co-authors Roxana Bear and Wendy Hill, there is a focus on the negative externalities of eco-tourism. The authors found a correlation between eco-tourism and the loss of exotic plants in an Australian National Park. The negative aspects of certain parts of the relationship between eco-tourism and the environment was something that I expected to find, but this literature helped confirm the costs that Edward Abbey and others warn

about, such as a loss of wildlife, erosion, and an increase of pollution due to tourism (Fava, 2020). While spending time in nature is something that is valuable for humans, the massive networks that have been built to support those ventures have also made it possible for those destinations to deteriorate. While many of the effects of eco-tourism that are described are negative, this paper is not built around condemning the ski industry or instinct to spend time outdoors. Rather, the paper hopes to find a common ground so that skiing can continue in an environmentally friendly way so that the exotic plants can survive and mountains can find solutions to preserve their model despite decreasing snowfall (Pickering et al., 2007; Pickering & Buckley, 2010). Using these works, this paper is able to frame the four factors within each case study by utilizing the actor-network theory to analyze how they are impacted.

Methodology

The methodology of this paper is shaped by the case study approach. Within that structure, the paper provides analysis through discursive analysis, interviews, and firsthand experiences. The discursive analysis is reflected in the literature review section, as well as the case studies. This method allows for the author to provide a unique examination of the sources; these sources range from academic journal articles to local newspaper articles weighing in on these important topics. This wide range of sources is reflected using imagery to promote mountain expansion and other messaging that ski resorts are pushing to potential visitors. By being critical of past writings and marketing campaigns, this paper can frame the argument in an STS style. This method also enhances the paper's ability to take lessons learned from the historical cases and apply them to the contemporary case. As a general critique of chair lift technology and its developments, this analysis will be valuable for starting conversations moving forward within the field.

The interviews were used as an opportunity to develop a stronger foundation of the ski industry's relationship with chair lift technology. Interviews were conducted by the author with Steven Kircher, Peter Landsman, James Niehues, and Tim Smith. They each represent different parts of the industry, as Kircher is the CEO of Boyne Resorts, Landsman is a lift operator at Jackson Hole, Niehues is a retired ski map illustrator, and Smith is the President of Waterville Valley Resort in New Hampshire. They were each chosen because of their knowledge and their close relationship to ski lifts. Without these interviews, there would be a lack of background necessary to understand what the dynamic looks like at so many different levels of the skiing hierarchy. The perspective from each interview represents how chair lifts impact everything from how the maps is drawn to how expansion plans are crafted. These interviews were conducted over the phone and on Microsoft Teams and ranged between fifteen minutes to an hour. This allowed for the research to not be limited by geography; instead, the possibilities for who this paper could reach expanded. The relationships were formed via email and through personal connections.

The final method that guides the direction of this paper is first-hand experience on ski mountains. As mentioned in the preface, I acted as a lift operator for a period in the winter of 2020/2021. During that time, I was not only able to interact with the lifts firsthand, but I was also able to visit the three ski resorts used as case studies in this paper. I was also lucky enough to return to each resort during the winter of 2021/2022 to revisit them for the purpose of this paper. Most of photographs in this paper were from my time there this past winter. This opportunity was done in conjunction with my thesis course as a chance to enact science technology, and society ethnographic research methods myself. These personal experiences will provide context from a consumer's viewpoint of each resort. While these opinions are my own, they have been

formulated through the opportunity to ski at several resorts, as well as having conversations with other avid skiers. The skiing community is certainly one with many opinions, so rather than focusing on good versus bad, this paper will use the times spent on a mountain as a viewpoint of what each mountains' operation looks like.

Ski Lift Technology

To understand the role of chair lift technology on the mountain, it is important to create a background of information that explains the technology itself. This next section is focused on placing chair lift technology within a context of a ski resort and the skiing industry in general. Using the interviews that I conducted, I will focus on three main subsections: the chair lift industry, the technology, and the role on a mountain. These three areas will be returned to during the case study portion of the paper, so it is key to have a grasp on this information, especially without if the reader does not have a background in skiing.

Chair Lift & Skiing Industries

The chair lift industry is a competitive market place that is primarily run by two companies: Doppelmayr and Leitner-Poma (*Busier-than-Ever Year for Grand Junction Chairlift Maker Reveals Strength of Nation's Resort Industry*, 2021). These two companies account for more than 90% of the world's chair lift projects. Peter Landsman, a ski lift enthusiast who is the leading expert in the ski lift field and a member of the Jackson Hole Mountain Resort lift operations team, outlined that these two companies have taken control of the industry and that can be reflected in their purchases of other companies. The trend within the industry has shown that as small companies rise and make a name for themselves, one of the two major players will buy them out. This has happened with Garaventa, SkyTrac, and a host of others. This dynamic has allowed for a competitive market that has been driven by innovation. As smaller companies

make a name for themselves taking on different projects, they are recognized by the larger brands that recruit them to be subsidiaries (P. Landsman, personal communication, February 1, 2022). This is key because lifts are also not just used for skiing, as they have been chosen to be key methods of transportation for cities in South America and tourist destinations. Ropeways are also used for mining sites to move through difficult terrain. Therefore, lift companies can innovate in other areas of the field and the larger companies are able to benefit from those advancements when applying that technology to skiing. Regardless of the innovation through other types of chair lift technology, skiing is still the bread and butter of the major lift companies.

The driver of skiing projects is based around the overall state of the skiing industry; this includes the number of visitors to the expected snowfall for the year. From the overall economy to the amount of snow that has fallen, the skiing industry is subject to several forces that are out of its control. An example of these kind of factors would be the year of the Olympics, as consumers are more motivated to ski when they are seeing it done on an international level (P. Landsman, personal communication, February 1, 2022). So, when things trend in the right direction for skiing interests, an effort is put forth by the ski resorts to develop the technology on their respective mountains. This is done through massive projects that take years of planning and preparation. An example of this would be the increase in lift orders for the past year because of the rise in outdoor recreation created by Covid-19 (*Busier-than-Ever Year for Grand Junction Chairlift Maker Reveals Strength of Nation's Resort Industry*, 2021). The downside of this recent boost is the shortages of resources and inflation that has come because of supply chain issues; for a technology that relies heavily on steel, this rise in prices is not ideal. These opposite ends of the

spectrum show how something out of the ski industry's control can completely change its outlook for expansion.

Lift projects have recently been impacted by another phenomenon that is for the most part out of the industry's control, climate change (Patthey et al., 2008). With the rising temperature and loss of consistent snow, snowmaking has become an integral part of a mountain's operation (Pickering & Buckley, 2010). While there are environmental concerns about the costs of snowmaking due to the need for a high concentration of water, this has been a solution to prepare the northern Hemisphere's ski resorts for their most crucial time of the year, New Year's week (T. Smith, personal communication, March 18, 2022). With heavy snow falling later every year, the investment in snowmaking is the only option to have enough of a mountain open to satisfy mountain-goers during this weeklong period. Having enough of a mountain open is also key for safety and the overall efficiency because congestion on a singular trail or chair will leave more skiers hurt or dissatisfied at their wait in a line. Therefore, the skiing industry has responded by not only developing their snowmaking, but also the chairlifts that are used to access those runs (S. Kircher, personal communication, March 27, 2022). Due to the costs and difficulty of snowmaking, only a few trails can receive the treatment. It makes sense for a mountain to invest that money on trails that can be skied by everyone. Therefore, most snowmaking operations focus on the lower half of mountains with terrain that is the most heavily used. To double down on that investment, the ski lifts nearby are made into high-speed chairs that can move more people faster. Therefore, not only is everyone able to ski certain trails, but they are also able to ski it more. This lower level in difficulty and time left waiting to get back to the top keeps consumers happy and mountain operations running smoothly (P. Landsman, personal communication, February 1, 2022).

While the chair lift companies do not have a role in developing snowmaking technologies, they understand that they now coincide with one another. Chair lift projects do not make sense unless they are able to add full value to the resort; that value comes from having enough snow to safely ski on. It makes sense for resorts to bring this expansion together because their costs can be brought down due to the labor and machinery; for both projects to be successfully constructed, they need similar tools (T. Smith, personal communication, March 18, 2022). So, by doing them together, they do not need to pay double to do the amount if they were done separately. This is a lot of money when considering the time and planning to get cranes and excavators up a mountain. As Aspen Mountain showed with their melting gondola exhibit, these resorts understand how they play a role in bringing harm to their surrounding environments (*Melting Art with a Message / Climate Stories / Inside Aspen Snowmass*, n.d.). That example of actor-network theory represents the role of a ski resort within a science, technology, and society framework as the network that the resort inherently creates causes negative outcomes. So, it is up to these resorts to find efficient technologies from companies that are also environmentally friendly. Therefore, these chair lift companies have had to become more sophisticated in their technology to make these upgrades marketable to ski executives, shareholders, and the local communities.

The Technology Behind Ski Lifts

There are three kinds of chair lifts: fixed grips, detachables, and trams. These three categories have subsections with them, such as gondolas within the detachable faction. However, all chair lift technology is similar in its components. While ski lifts have become exponentially more efficient in the past decade or so as technology has improved these components have stayed consistent; this includes towers, rope, carriers, terminals, and motors. The towers are what

make it possible for the chairs to pass over such treacherous terrain while maintaining safety.

While accounting for weight and distance, as well as feasibility, the placement of these towers is spaced put to ensure the safety. These standards are set by the National Ski Areas Association and are known by the chair lift manufactures when they consider how many carriers and towers they will be able to fit on a lift (*Lift Safety*, n.d.). With that variation, there needs to be enough slack in the rope to balance the expected weight while also being a safety net in case the rope is stressed too much. The rope is usually an extremely strong cable, made up of hundreds of smaller steel cables, that is regularly changed out to follow safety standards. These standards are dependent on the number of carriers, length of rope, and weight capacity. The carriers are the chairs, gondolas, or trams that physically hold the people as they move up the mountain. The chairs can hold as little as two people while some trams can hold up to 270 (P. Landsman, personal communication, February 1, 2022). This variance highlights the differing costs for lifts. That two-person chair could cost \$4 million while an average tram that holds 100 people is closer to \$50 million (P. Landsman, personal communication, February 1, 2022). These figures are very scalable and dependent on the size of the other components.

Returning to these components, the terminals sit at the bottom and the top of the chair lift as they house the mechanisms that make the lifts run. This includes the motors, the tension system, and the brakes. Motors over the past fifty years have been electric which highlights the sustainability of chair lifts and their limited cost to the environment (P. Landsman, personal communication, February 1, 2022). The motors have recently been built to replicate wind turbines. While they are more expensive initially, they are more reliable and last longer. As expensive as lift projects can be, their upkeep is just as important. Resorts have entire sections of their staff dedicated to lift operations because of the importance of their role in making the resort

successful. These wind turbine motors spin slower, as they are predicated on a system of gears. This means that they are quieter and therefore provide a more enjoyable experience to a mountain-goer (P. Landsman, personal communication, February 1, 2022). In the competitive world of attracting skiers to one's resort, as well as resorts choosing manufactures for their lifts, those small factors play a large role (T. Smith, personal communication, March 18, 2022).

Historically, lifts have carriers that were permanently fixed to the rope which gave them the title of "fixed grip." This has meant that the speed of the chair lift was consistent from the loading to the unloading point. This created a universally slow chair as the enter and exit portion of the chair could only go so fast. This was done with safety precautions in mind as the carrier making its way around a bull wheel to scoop up skiers would continue that same speed moving up the line. Therefore, these fixed grips have been known to be very slow. They are typically found at the higher points of resorts because of the lack of bottlenecks from skiers since most skiers stays towards the bottom of the mountain (J. Niehues, personal communication, January 28, 2022). Also, many ski lifts have been repurposed instead of retired, especially fixed grips, because they are not reliant on more sophisticated modern technology. Instead, resorts will resell their old lifts to be used for at slower points on other mountains. Fixed grips are still prevalent at almost all resorts because of their reliability, durability, and cheap cost. While few fixed grips are still being made, the repurposing of the technology shows the cost-effective attitude of ski resorts (T. Smith, personal communication, March 18, 2022).

The next iteration of lifts that came along during the turn on the 21st century is called "detachables." These have been built by all the ski lift companies. While the towers and rope are the same, as well as the movement of the carriers, the terminals have strong magnets in them that allow the carrier to detach from the rope. This happens as they slowly move around the bull

wheel to pick up riders at a much more leisurely pace. As the carrier exits the terminal, the carrier connects back onto the rope and can pick up speed as it matches the pace of the cable instead of the slower magnets. These chairs are also referred to “high speed” chairs because of their ability to move up the mountain much faster than the older fixed grips (T. Smith, personal communication, March 18, 2022). This has allowed for modern chairs to have a noticeably increased speed as they move people up the mountain’s skiable acreage because they are not as concerned with the initial or final speeds as skiers load and unload. These lifts are also longer in length because there is less stress being put on the line at the two terminals since the carriers detach; therefore, the spacing for towers can be further apart. These chairs are typically found near the bottom of the mountain and connect to other desirable areas of skiing; this is because of their speed and length (J. Niehues, personal communication, January 28, 2022). It makes sense for a resort to upgrade their central lifts, the ones that most ski runs come back to or are near the lodge, to high speed detachables, because then skiers are not logjammed at the base. Instead, the high-speed chair can connect them to other areas on the mountain that are less busy and fit their skiing level better.

With detachables came the idea of gondolas. A gondola is a kind of carrier that is completely enclosed to the elements (*Home*, n.d.). These boxes must detach from the line so that skiers can easily enter through a small door while they continue to make the turn around the bull wheel, as well as attach their skis to the side of the carrier. This carrier is used for skier comfort and as a marketing tool for resorts to highlight modern lift technologies. A gondola’s capacity ranges anywhere from four to ten people (P. Landsman, personal communication, February 1, 2022). Like the high speed detachables, these lifts are chosen for their high speeds. However, gondolas must be spaced out further from one another due to their weight and the slower

process of loading and unloading. Due to these safety standards, there are high speed detachables that have both chairs and gondolas; these are known as “chondolas” (Landsman, 2015).

Typically having three traditional chairs for every one gondola, these lifts provide the typical lift access while also offering the protection from the elements to a quarter of the lift riders. One of the major drawbacks of gondolas is the need to store them in the offseason, and sometimes every night. This decision is made by each resort but takes up a lot of space on an already crowded mountain. However, the costs for each gondola, sometimes as much as \$100,000, makes it so that protecting the gondolas from the cold and snow is a business decision to protect their investment (P. Landsman, personal communication, February 1, 2022). At larger resorts in more friendly environments, they are more common and are located throughout the mountain. For mid-size resorts, gondolas are a main attraction that is utilized as the center piece of their lift network. With high costs, but increased capacities, they move skiers up the mountain from the base to areas accessible to the rest of the mountain by other lifts. While they have a similar outcome as high speed detachables with traditional carriers, they draw more interest through the draw of being a gondola (Landsman, 2015).

As the technology around carriers, and ski equipment in general, has become more focused on skier comfort and the ability to stay on the mountain all day a new trend has risen in the detachable realm, bubbles. These bubbles were made popular in Europe but have quickly made their way across American ski resorts. Whereas a typical carrier has a bar that comes down in front of a skier for safety concerns, bubble chairs now have a fiberglass covering that can also be brought down after loading. This option protects skiers from the elements, like gondolas, while not taking as long to load or limiting capacity. The Big Sky case study will discuss this further, as over the past two years they have installed two of North America’s fastest chair lifts

with bubble chairs: Swiftcurrent and Ramcharger. They eight and six person carriers even have heated seats. When spending a brisk day on Montana's Lone Peak, having that extra bit of comfort goes a long way when moving back up the mountain. And the resort's executives understand that the investment on these amenities is what helps bring a skier back to their resort (S. Kircher, personal communication, March 27, 2022). And while bubble chairs are not cheap, costing up to \$200,000 per carrier, per Kircher, they are the technology of the future because of their durability and the comfort provided for skiers.

The final kind of chair lift technology that this paper will examine is the tram. The tram is one of the most iconic sites in all of skiing because of its size and movement up a mountain. All three resorts in the case studies have trams that are easily recognizable by all skiers. These permanent structures have differing advantages from fixed grips and detachables. Due to sheer their size, they can carry more people at once. Trams do not need as many towers to support their weight, so they are able to go longer distances without needing more supports. However, they do need much larger bottom and top terminals (*Snowbird History*, n.d.-a; *The Snowbird Tram*, n.d.). These terminals are made of concrete and are serious projects to undergo when placing at the bottom and tops of mountains. Trams work as a fixed grip pulley system with two carriers between the terminals; when one tram goes up, the other goes down. However, despite high speed, trams are not the most efficient tool for movement of skiers. Typically, only individuals with high skiing abilities that interested in making it to the top the mountain without having to ride on other chairs will wait out the lines for a ride in the boxcars. By sacrificing some time out of their day on the mountain, they receive a picturesque ride the bottom to the top free of the elements. Once at the top, nearly everything on the mountain is accessible to ski (Lerman, 1996). However, there is usually not an easy way down so tram lines are aided in scaring plenty of new

skiers away because of their lack of ability. Instead, those same people are encouraged to visit the resorts over the summer to take the tram to the top of the mountain to enjoy the views in warmer weather and help support the summer business (S. Kircher, personal communication, March 27, 2022). The decision to put trams in and the resulting impacts will be looked at more closely in each case study, as their role in each mountains' successes surrounding areas' development is central to this paper's argument.

A Ski Lift's Role on a Mountain

Using the knowledge of the components needed for chair lifts to work and the three different kinds of lifts, this section will now focus on the chair lift's role in creating a successful experience at the resort. That capability goes beyond just moving skiers up the mountain, as it also impacts the overall design of the skiing area. Mountain design varies greatly because of the preexisting challenges that come with each mountain, however consistent themes are seen across the United States that can be connected to lifts and their capabilities. Chair lift networks most important role is providing access to different parts of the mountain at an efficient rate all while keeping the abilities of skiers in mind. Ski mountains are designed to accommodate different levels of skiers, with runs that go from beginner to expert. The topography of most mountains naturally supports that goal; mountains usually get steeper and more strenuous the higher you go. For skiing, that means that the most difficult parts to safely navigate are at the top. Ski resorts use that to their advantage when deciding where to place lifts and which ones to upgrade. Therefore, there will be more people closer to the bottom because everyone should be able to ski those runs (T. Smith, personal communication, March 18, 2022). Even if a skier wants to spend most of their time higher on the mountain, they follow the laws of gravity; what goes up must come down. This includes the start and end of their end. To prevent bottlenecks on lifts for skiers

of all skill levels, the lower lifts that are near the base are used to get skiers to the middle of the mountain (J. Niehues, personal communication, January 28, 2022). There are also some larger higher speed lifts that run up further to inherently divide the skiers that are interested in spending their time on easier terrain versus those seeking more difficult runs. These lifts typically the largest terms of carrying capacity and go the fastest speeds. So, these main lifts are the high speed detachables and gondolas. The carrying capacity is on the higher end, ranging from four to eight as the resort would like to fill every chair to its max to keep these lines from becoming too long and intimidating (T. Smith, personal communication, March 18, 2022). Trams can also be found in this area because of the need for a massive terminal and the ability to divert the most courageous skiers from lines that attract the lower level of skiers.

At the mid to higher level of the mountain is where older and slower lifts are typically found. While this usually means fixed grips, there are also repurposed or slower detachables. Despite being fixed grips, these chairs rarely have lines due to the difficulty of the skiing (T. Smith, personal communication, March 18, 2022). These chairs often run over shorter distances because of the difficult terrain that they traverse, but that terrain also means that is slower for skiers to get back down to the lift. Ski mountains are split between cut out trails and open access runs. The trails avoid all obstacles and ensure a safe riding experience. There is also more consistent snow cover and attention from the grooming team to make sure the snow is in pristine condition every morning. The open access is all natural and requires a much higher level of skiing. Whether it is through trees or over cliffs, these runs attract the snow's best adrenaline junkies (Lerman, 1996). However, much more snow is needed for the mountain's ski patrol to safely open these runs. As exciting as it is for one skiing, it is equally as intimidating for those clipping into their skis for the first time. This divide in talent is reminiscent of the mountain itself

and is one of the reasons why people continue to come back to the sport to find higher elevations and harder lines to skis.

One of the difficulties of running lifts at higher locations on the mountain is the possibility of not being able to run them because of weather. Wind holds and avalanche concerns are the two most common reasons but there are plenty of others (“Cottonwood Canyons Avalanche Info - UDOT Cottonwoods,” n.d.). The role of ski patrol is quintessential in determining consistency of snow. The fear of avalanches and the measures taken to avoid them will be discussed more in the section regarding the Little Cottonwood Canyon. These uncontrollable weather patterns are incentive to focus on the lower lifts because of their reliability to be running more than those up top, as well as the exponential increase of riders. Overall, ski lifts determine the flow of the mountain. While this is also dependent on the size of the mountain, in terms of acreage and elevation, chair lifts can fulfill the vision of ski executives aiming to build an efficient and enjoyable experience for visitors (S. Kircher, personal communication, March 27, 2022).

The role on the mountain does change by the ownership model of resorts, as well. This will be highlighted with specifics in the case studies, but the ability to make decisions regarding the location and size of chair lifts is dependent on private versus public lands. With the prevalence of public lands, held by the federal and state governments, in America, the skiing industry has benefited from the ability to lease these lands (Lovett, 1983). However, this model limits the ability to make decisions quickly. Whereas private ownership of lands calls for safety clearance, ski resorts on public lands must go through many hoops to be achieved; this includes environmental and economic reviews. Therefore, private resorts can have a lift project underway in a year while resorts that lease their lands go through a three-to-five-year process (T. Smith,

personal communication, March 18, 2022). With permits and a presentation for the needs to expand lifts, public lands are often difficult to work on as a ski resort. However, these lands are some of the most pristine and well-kept because of their environmental protection. Therefore, skiing in Grand Teton National Park is made possible by permits from the government to Jackson Hole Mountain Resort because of the leasing model (*The Future of Ski Resorts on Public Lands*, n.d.). Percentages of the resort's income is paid to the National Forest Service, or whoever runs the public lands, as laid out in the lease agreement. This model was copied from many European ski resorts, as towns oversaw the land, but locals ran and operated their own lifts (T. Smith, personal communication, March 18, 2022). They would pay the town back for the usage of the lands with money from the cost of lift passes. By establishing this relationship, the town and its citizens benefited because of their individualized roles in utilizing their lands. The United States has copied this for public land use so that resorts, which are often supported by the town, are able to capitalize on their surroundings and the visitors that it brings to the area. While private resorts are similar in this usage of land, they pay premiums for the land. They also take on responsibility for the care of the entire mountain since the Forest Service is not in place to aid their mission.

It is also important to note that the leased lands are meant to be used. While many people view public lands as being protected, the lands are preserved for their usage over many years. This means that cutting down trees to make way for the building of a new chair lift does not go against the goals of the Forest Service or State Parks. Instead, the ski resorts are helping preserve them by shaping them into an asset that is founded on the ideals of protectionism (T. Smith, personal communication, March 18, 2022). When returning to the ideas about actor-network theory, this relationship suggests that the actors are benefiting from this system while also

engaging in the intended outcomes of use and conservation. The actors, being resort executives and skiers, all reap the benefits of undeveloped forest land that works against climate change (Patthey et al., 2008). While there are costs that are incurred to the surrounding environment, these happen much more slowly and do not impact short term jobs like they do the environment. Therefore, they make decisions that help expand on those desired gains to make sure that skiing is a viable option moving forward. Overall, a chair lifts job on the mountain is to move people, but the work that must be done to ensure they can be safely built and operated is a whole different process that exposes the motivations of several actors.

Case Studies

The following four case studies will be used to examine the research questions that are considered in this paper. Big Sky, Jackson Hole, and Snowbird will represent historical cases where lessons of success and failures have been viewed by local communities over the course of their existences. They also are the classical users of chair lift technology as ski resorts. With the findings from the three historical cases, the ongoing case within the Little Cottonwood Canyon will be examined. Each of these cases have been chosen because of their relevance to skiers and the industry in the North American skiing realm. While they are each located in within eight hours of one another, the differences that they each represent are what makes this proximity that much more useful. The next sections will provide backgrounds on each of the cases while also diving into specifics within the three area that this paper has deemed to be the most important when considering chair lift development: business model, lift network, location, and culture.

Big Sky

Business Model

Big Sky Resort is a privately owned mountain resort in Big Sky, Montana. This is an hour south of Bozeman. It is a part of Boyne Resorts, a company that owns 10 ski resorts, which is one of the major players in the modern skiing industry. With locations across the North America, spanning from Maine to British Colombia, Boyne is one of the premier skiing companies (*Boyne Resorts / Experience the Lifestyle*, n.d.). Boyne Resorts purchased Big Sky Resort in 1976, just three years after the skiing operations started on the mountain. This purchase cemented Boyne's legacy as a power player in the skiing industry while allowing for Big Sky to grow into one of the West's premier skiing locations. While the resort and skiing grew over time, no change was as instrumental as the building of the Lone Peak Tram in 1995. The new ride to the top of Lone Mountain, with a summit of 11,150 feet, added an additional 1,200 acres of skiing (Lerman, 1996). This change brought new visibility to the resort in Montana that was looking to make a name for itself in the world of skiing beyond just the United States. Having a 15-person tram that could reach the summit changed what Big Sky was. It went from being a high-end resort with great views to a destination for the world's most adventurous skiers (Lerman, 1996). The ability to develop a tram to the top of the mountain was due in large part to the private ownership of the mountain. By owning Lone Mountain and the surrounding area, Boyne and Big Sky executives were able to make swift decisions about how to expand. When deciding to build a tram in 1995 or renovate the lift system for the Big Sky 2025 project, Steve Kircher was restricted only by his imagination and the technological capabilities (S. Kircher, personal communication, March 27, 2022). That kind of freedom allows for leaders in the skiing world to develop legacies for themselves and their resorts.

Big Sky is famous for just how big its skiing is. Before the merger of Park City and Canyons in Utah, Big Sky had the most acreage for a resort in America. The size of the mountain is key for this massive operation, but so are the chair lifts. The building of Big Sky into what it is today has taken decades and has included numerous expansion projects. James Niehues, the illustrator of many ski maps, talked about the need for him to redo the Big Sky on multiple occasions to make up for the new skiing area on the mountain (J. Niehues, personal communication, January 28, 2022). This renovation and expansion has not stopped, as the Big Sky 2025 project was a massive undertaking for the resort which has allowed it to gain notoriety in the world of skiing and changing the norm for American skiing (*Big Sky Resort - 2025 Vision*, n.d.). With this project has come new chair lifts and snowmaking capacity. By taking advantage of its natural surroundings and the ownership of the land, Big Sky has been able to develop in ways that other resorts have only considered attempting (S. Kircher, personal communication, March 27, 2022; P. Landsman, personal communication, February 1, 2022). Image One highlights the promotion of this messaging to their customers (*Big Sky Resort - 2025 Vision*, n.d.). The language that is used, such as the title being “The Most Transformational Mountain Upgrades Yet,” or the comparison to European skiing shows how Big Sky aims to build a following that transcends American skiing. Instead, Big Sky’s leadership wants to be one of the top resorts in the world (S. Kircher, personal communication, March 27, 2022). The results of these aspirations will be investigated more closely in the culture section.

Lift Network

The next phase of the Big Sky 2025 project will expand on the replacement of lifts, as well as a focus on the on-mountain experience. A major part of this timeline is the building of a new tram. While the 1995 tram was able to provide access to Lone Peak, the tram has a capacity

of 15 people. Also, it is geared towards skiers, making the trek to the top of Lone Mountain unreasonable for those who do not ski. Due to the capacity and the interest in skiing the snow that it has access to, there is usually a surcharge to ride the tram on top of the ski pass on any given day to limit the number of people seeking to get to the top. The next tram will be much larger and will hold more people comfortably, but it is unclear whether or not there will still be an additional fee to ride (S. Kircher, personal communication, March 27, 2022). The tram will capitalize on its views by running during the summer as well. While Big Sky has done this with the first-generation tram, the new tram will make that ride more customer friendly with seating and extra space.

To better understand the lift network that Big Sky has, acknowledging the size of the mountain and the flow of skiers is key. Chart One lists the current lifts on the mountain, while Image Two shows off the current ski map for the resort (“Big Sky, MT,” 2015; *Mountain Maps / Big Sky Resort*, n.d.). With 29 lifts on the mountain, there is a place to ski for all levels. The width of the skiing area also allows for skiers to be evenly distributed across the resort. Chart One also shows how despite many modern lifts, the mountain still relies heavily on older double, tripe, and quad fixed grip lifts. As mentioned in the mountain design section, these lifts operate at higher points on the mountain or to areas that are not as busy. However, there is still a center base that most of the skiing comes back to. That main area, highlighted in yellow on the center-left of the map, is known as Mountain Village and has become the central focus of lift development. Two of the resort’s newest chairs, Ramcharger and Swiftcurrent, are located there. The 8- and 6-person high speed bubble chairs look to diffuse lines in this area as they disperse skiers out to other parts of the mountain. While the 2025 project includes a new tram, it will also produce a new gondola that will go from the Mountain Village to higher up on the mountain with

a mid-way stopping point for those that would not like to ride any higher. This is shown in Image Three (*Big Sky Resort - 2025 Vision*, n.d.). This addition eases the stress on the lines in this area as well as showing how Big Sky has put a priority on comfort for its skiers. With tough conditions in the Montana mountains, having two larger bubble chairs, a gondola, and a massive new tram, the resort's attitude towards keeping its skiers warm and happy is obvious. At the end of the day, keep skiers happy with a reason to return is the main goal of a successful lift network.

Location

Big Sky is in the south-central part of Montana. It is about an hour south of Bozeman, Montana, and three hours north of Jackson, Wyoming. While Big Sky's location was previously a hindrance to the mountain's success has now turned into a bonus. What was once considered to be a difficult location to reach has becoming easily accessible with the growth of Bozeman and an increase of visitors to Yellowstone National Park; the park's northern entrance is about an hour south of Big Sky (Diaz, 2021). This central location between a growing city and a National Park that sees over 4.5 million visitors a year has allowed for Big Sky to benefit from the development of infrastructure (S. Kircher, personal communication, March 27, 2022). This includes the expansion of the Bozeman Yellowstone International Airport in 2021, allowing for cheaper and more regularly scheduled flights to land at the closet commercial airport to Big Sky. The expansion of the airport was in part a result of the growing interest to visit Big Sky Resort year-round (Sukut, n.d.).

What makes ski resorts that own their own land different than those that lease it is the desire to build quickly. This is especially represented when considering the potential value in the summer, which leasing often restricts from (T. Smith, personal communication, March 18, 2022). Steve Kircher stated that only 3% of Americans ski, so finding a way to attract the other

97% to come to Big Sky is a necessity (S. Kircher, personal communication, March 27, 2022).

As mentioned in the business model section, this has resulted in a year-round developmental focus. The location of Big Sky in the northern part of the Rocky Mountains has allowed it grow at a rate that is supported by the growth of the state (*Montana Reported the 13th Largest Population Growth in the U.S.*, n.d.). Being close to growing city centers like Bozeman, Jackson, and Boise, Idaho, and becoming increasingly more accessible to visit with the expansion of the Bozeman Yellowstone Airport, Big Sky will continue to see the needs for an improved chair-lift network to support the increase in visitors. What keeps these visitors coming back is the conditions that the location allows for. By being in the mountains of Montana, the long and cold winters produce snow that is great for skiing. While the summer is a major attraction for people to come visit Big Sky, there would be no Big Sky Resort without enough snow to keep the skiers coming back for more.

Skiing Culture

The culture of Big Sky is more upscale than a regular ski resort. This is what Steve Kircher and Boyne Resorts were hoping for when developing Big Sky. With its location and business model working in its favor, Big Sky can expand and develop without much interference. It has benefitted from the growth of Montana as a state to live, as well as visit. However, Big Sky still relies heavily on tourists over locals for business (S. Kircher, personal communication, March 27, 2022). This can be seen by the houses that are located around the area. While housing in ski areas is usually very luxurious, the benefit of owning the land is that resorts can develop housing on that very mountain. This makes “ski on, ski off” houses prime for anyone looking for a ski home to visit during the winter months. With that kind of clientele living on the mountain, the town of Big Sky has boomed into an upscale area, too. This, with the combination of some of

the most expensive lift tickets in the country, have pushed away locals that have lived in Big Sky for years (Vincentelli, 2022). While this is not unique to Big Sky, it is very apparent when visiting that the town is realizing the resort's goal of making Big Sky more than just a place to ski. Instead, it has quickly become one of the fanciest and most expensive eco-tourist destinations in the country. This helps explain why lifts have bubbles over them to protect skiers from the elements (Vincentelli, 2022). It also shows why they are advertising against Europe's ski resorts to gain business from the wealthiest of skiers. Overall, Big Sky Resort has found itself a great niche in skiing and is making the advancements, from chair lifts to dining, that help ensure its prosperity moving forward.

Jackson Hole

Business Model

Jackson Hole Mountain Resort is different than Big Sky, as it leases its land from the National Forest Service to be skied. The close relationship with the Forest Service has helped Jackson Hole blossom into one of the world's most well-known skiing destinations. This relationship is cemented on every trail map that is handed out with the National Forest Service signature located on the bottom left, as seen in Image Five (*Jackson Hole Trail Map*, n.d.-b). This area of the country is heavily serviced by the National Park System and Forest Service because of the proximity to two major national parks, Yellowstone and Grand Teton, as well as numerous National Forests. However, Jackson Hole still must face the red tape that comes with leasing land from the government. Yet, this has yielded intriguing results, especially as the resort has expanded its summer operations (*Jackson Hole History*, n.d.-a). One of the major drawbacks of leasing the land is mandatory start and end dates outlined in the lease agreement. This allows for the Forest Service to still enact protections of the land, but it costs the resort over

a month of skiing at the end of the year. While opening date is always near Thanksgiving, the end of the season comes in mid-April when the conditions for spring skiing are just beginning to ripen. For the resort to lease this land, they acknowledge that this is one of the costs that they must accept.

Jackson Hole is independently owned by the Kemmerer family, who resides nearby, which has allowed for the small company feel to withhold despite the massive success of the resort. However, business ventures have created a partnership with Alterra Resorts which allows for skiers to buy a pass, named the Ikon, that is connected to over 50 resorts around the world. Depending on the level of the pass, skiers have up to 7 days of their choice skiing at Jackson Hole. While this is great for skiers that want to visit the resort while not paying insane amounts for the cost of a day pass, the locals view these Ikon visitors as an invasion on their local environment. While Jackson Hole can make a percentage of the money on these passes, the locals are forced to deal with an increase of visitors that are only there for a few days at a time. This concept will be expanded upon in the culture section.

Jackson Hole has also taken advantage of its terrain to become home to some of the world's top skiing events. The most famous being, Corbet's Couloir. The Couloir, which is a geological formation with a very tight chute as seen in Image Four, is one of the most unique runs in the world. It brings in skiers from around the world to take on its difficult entry and nearly vertical slope. Jackson Hole has capitalized by hosting an event named "King and Queens of Corbet's" (*Kings & Queens of Corbet's*, n.d.) The event, in partnership with Red Bull, draws top talent to Jackson, Wyoming to attempt the leap of faith. It is partnerships like this, stemming from the tight-knit leadership group at the top, that allow for Jackson Hole to demonstrate how special of a mountain it is on a global scale. With the combination of all these factors, Jackson

Hole Mountain Resort leadership has taken advantage of its terrain and unique landscape to become a premier skiing destination.

Lift Network

While Jackson Hole may not have as intricate of a lift system as Big Sky, the resort still follows similar principles for its mountain design. Since the resort is not as wide, Jackson Hole is able to provide access to the top of the mountain by having high speed lifts at the base which feed into fixed grips higher on the mountain. The tram, nicknamed “Big Red,” can surpass multiple lift rides for one trip to the peak of the resort (*Jackson Hole Aerial Tram*, n.d.-a). The first iteration of the tram was built in 1964 at the same time the resort itself was built. Therefore, the resort's history is directly connected to the tram's history. On the ride to the top, Big Red goes right over Corbet's Couloir, adding to the run's legend in the skiing world. As seen in Chart Two and Image Five, Jackson Hole has a variety of lifts with differing goals for each (*Jackson Hole Trail Map*, n.d.-b; *Jackson Hole, WY – Lift Blog*, n.d.). With many lifts stemming from the base, most of the resort's lifts are high speed or gondolas. However, there are still examples of older fixed grips being used at higher elevations. The Sublette chair is an example of this, as it is a relatively short lift, but is closed more than the rest of the lifts due to the need for a lot of snow and its exposure to high winds. With the wild weather that being situated next to the Tetons brings, avalanches are a major concern at the resort. What also elevates this fear is the out-of-bounds skiing that the resort promotes (Cocuzzo, 2016).

Skiing out of bounds is considered illegal in many states because of the liability that resorts would face for harm to its skiers in unmarked areas. While this is also related to land ownership and the maximization of space, Jackson Hole has changed its stance on this kind of skiing over the years. While they were previously very opposed, they shifted their view once

they found safety measures that kept them from being liable while also encouraging the protection of the land (Cocuzzo, 2016). There is also a decrease in lift riders when skiers go out of bounds because the runs, they take do not feed back into the resort's main areas. Instead, these skiers must find their own way back onto the property. Overall, the lift network at Jackson is modern and fits the resort's needs. From Big Red to the gondolas that bring skiers to mid-mountain access points, the mountain operations team has done a phenomenal job developing their lift system while preserving the natural beauty of the Tetons (*Jackson Hole History*, n.d.-b).

Location

As mentioned in the previous sections, Jackson Hole Mountain Resort's location is key to its success. Not only does it benefit from the weather conditions that the region experiences, but it is also wedged between two National Parks, Yellowstone and the Grand Tetons. It also can be reached from Boise, Bozeman, and Salt Lake City within four hours. It is also accessible from any spot in Colorado in a day. The National Park System also operates the Jackson Hole Airport, as the valley is a National Monument (*Jackson Hole History*, n.d.-b). The region is reliant on this airport for its tourism coming in from regions outside the Rocky Mountain region. Overall, the central location in the American West and the airports' ability to take in direct flights from around the country has made the once remoteness of the resort into a strength. Instead of natural barriers keeping people out, the landscape and beauty of the Wyoming mountains now keep people there or coming back for more.

The resort is situated in its own zip code separate of Jackson named Teton Village. While the Village is separate of Jackson, the two have a close relationship. Jackson, which is fifteen minutes away from the resort, has grown thanks to the success of the resorts and the influx of visitors to the National Parks, especially during the Covid-19 pandemic (*Surging Tourism*

Strains Jackson Hole, amid Rising COVID-19 Cases, 2020). With this increase of eco-tourists has come push back from the town; this has been noticed most closely with the rise of prices for housing in the region (*Housing in Jackson*, 2021). As prices rise, the work force is being pushed out quickly. With the town and resort sitting in a valley, the new options for housing are an hour away via unpredictable mountain passes, including one that goes over the Tetons into Idaho. This has resulted in even higher prices to compensate for the depleted work force and loss of seasonal workers. Since the resorts opening in 1965, the town has grown at the same pace as the mountain. However, this growth has now resulted in overcrowding and eventual reaching of the areas capacity (Farrell, 2020; *Surging Tourism Strains Jackson Hole, amid Rising COVID-19 Cases*, 2020). It is now up to the resort that helped build Jackson, Wyoming into an internationally known destination to help preserve its unique habitat.

Skiing Culture

The culture on the mountain in Jackson Hole is much different than Big Sky. While Jackson Hole still does bring in the wealthy skiers that are willing to pay a hefty price, Jackson is much more of a ski bum haven. With odd jobs and van life being a reality of life to ski Jackson consistently, the culture reflects it. The town of Jackson and Teton Village are both very upscale, but the terrain brings in a different mindset. This mindset is reflected in the hate directed towards people skiing with an Ikon Pass, or tourists that come during the holidays and three-day weekends. While the resort executives love these visitors and the dollars that they bring with them, the true Jackson Hole enthusiasts despise them and the aura they bring. What many fear in Jackson Hole is a similar process to what has occurred in Aspen, Colorado (*Melting Art with a Message / Climate Stories / Inside Aspen Snowmass*, n.d.). While Aspen has always been known for its fancy and expensive atmosphere, the skiing culture there has taken a hit because of it.

With high prices and a difficult drive from Denver, Aspen has become a mountainous gated community (*Why the Economic Situation in Ski Towns Should Scare the Whole Country*, 2022).

With similar problems in terms of pricing and clientele, Jackson Hole has been given the nickname “Aspen Hole.” While local politicians and residents are doing their best to push those ideals away, the large sums of money are difficult to turn away.

Regardless of this insurgence of wealth into the area, Jackson Hole Mountain Resort still has some of the country’s most difficult terrain. While these transplants, people moving to the area to pursue a Western lifestyle, may want the mountain to shift towards their interest, it will be impossible for the resort to accommodate (Farrell, 2020). With very limited beginner terrain and a lack of real estate to build more skiing on, Jackson Hole’s skiing culture will continue to cater towards the avid ski bums that helped build the legend of the resort. The lifts on the mountain represent this dynamic between ski bum and wealthy visitors. While the high-speed quads and gondolas will always be there to please the mid- to lower-level skier, the tram and fixed grips near the peak will continue to run for the most adventurous people on the mountain. That, combined with the option to ski freely out-of-bounds, also highlights how the resort can preserve its image with the top local skiers and those visiting from around the world (Cocuzzo, 2016). At the end of the day, leasing the land keeps from expansion projects that would be able to change the character of Jackson Hole Mountain Resort.

Snowbird

Business Model

Like Big Sky Resort, Snowbird is a ski resort on private land. Snowbird is owned by Powdr Corporation, a skiing company based out of nearby Park City, Utah (*POWDR*, n.d.). Snowbird is in the Little Cottonwood Canyon and is one of two ski resorts in the Canyon, the

other being Alta. What makes Snowbird's business model interesting is that it is one of the few privately owned parts of the Canyon. The rest of the Canyon makes up a part of the Wasatch National Forest. The forest and surrounding areas are outlined by the Wasatch Mountain range, which is on the western edge of the American Rockies, the range separates Salt Lake City from western Colorado and southwest Wyoming. The canyon represents how protected lands can work and be successful so close to a major city. With the success of Alta as a skiing destination, they also represent how the leading model can be successful next to a major population center (*Conservation and Recreation: What Alta Is Doing to Remain a World-Class Ski Destination*, n.d.). However, Snowbird's advantage is in its ability to stay open later in the year while Alta must close because of its deal with the National Forest Service for the Wasatch National Forest land (Lovett, 1983). Snowbird has benefited from Salt Lake City's rapid growth, especially over the past two decades ("Two Visit Salt Lake Passes, One Ultimate Ski and Après Ski Experience.," 2022).

Like the other two resort case studies, Snowbird is also on the Ikon Pass. This makes sense for them, as all but two of the major Utah ski resorts are on the Alterra Mountain Company led ticketing Ikon. These other two resorts, Park City and Snowbasin, are on the Vail Resorts owned Epic Pass (*Epic Season Pass / Epic Season Pass*, n.d.). For Snowbird and the other nearby resorts, it makes sense to be on the Ikon Pass because there is more value added for local skiers. By joining together in their commitment to Alterra, the Utah resorts are capitalizing on their nearby population (Diamond & Bigford, 2019). In a similar fashion, Vail Resorts and the Epic Pass have a strong hold on the Denver and Colorado market. Also, tourists that come to the area can ski at multiple resorts, adding value to the cost of traveling somewhere else to ski. This is important to consider, as some ski resorts have to fend for themselves to attract skiers, whereas

centralized locations of skiing can work together to bring clients to ski all of them (Mladenović & Virijevic-Jovanovic, 2019). Snowbird's business model represents the value of being a private resort, so that decisions regarding renovations can be made quickly, while also benefitting from the market that it is in.

Lift Network

Snowbird has a very well-developed lift network; their lifts represent the shift towards high-speed quads. When Snowbird was first founded in 1971 it opened with three lifts, including their famous tram. By opening the resort with a tram, a rare feat at the time, Snowbird accelerated itself to the top of the skiing world in terms of its lift technology. As seen in Chart Three, they have continued to be at the forefront with their commitment to renovating and building lifts ("Snowbird, UT," 2015). The resort also benefits from having a front and back side of the mountain, this can be seen in Image Six (*Snowbird Trail Map / OnTheSnow*, n.d.). The back side, referred to as Mineral Basin, alleviates the pressure on the lifts on the front side of the mountain. By drawing skiers to this wide open, bowl style of terrain, the mountain can have a better distribution. While there are only two lifts in Mineral Basin, they are both high speed quads that can move people back up quickly. On the front side of the mountain, the resort has two main lodge centers which allows for less pressure as compared to other ski bases (*Snowbird Trail Map / OnTheSnow*, n.d.). Snowbird's lifts are in places that are like the other resorts, as their staggered length ensures that skiers can get to where they want depending on their abilities. Having a tram is also crucial for this design.

The success of Snowbird's tram made it so that more resorts looked to build a similar type of lift. The history of the resort is closely connected to the tram because of its inception during the creation of the resort. With a new station at the top that has a restaurant and lookout

points, the resort has realized that the tram can be utilized for more than just skiing (*Aerial Tram Cabin Upgrades*, n.d.). With an expanded summer operation at Snowbird, it has followed a similar path as Big Sky in its attempt to attract more than just skiers. In 2022, they announced that the resort would be installing new tram cars to replace the original blue and red cars that had been servicing riders since 1971. Image Seven shows how this change was shared with the public and its relevancy to the resort's brand (*Aerial Tram Cabin Upgrades*, n.d.). With new tram cars comes better sightlines, an increase in riders, and a better overall experience. With the renovations to Big Sky's tram and the new tram cars at Snowbird, the decision to develop trams highlights their visibility from a marketing standpoint as well as their importance within the lift network. It makes sense for resorts to expand their trams and their capabilities because they are a natural draw for skiers making decisions on where to go (J. Niehues, personal communication, January 28, 2022). Snowbird as a mountain also shows the functional use of the tram, as it gets skiers to the highest point, provides access to the front and back sides, and is also valuable for the resort's summer operation. With the tram as the crown jewel of the lift network, Snowbird shows how a modern fleet of chairs can provide value to the all-around skiing experience for the resort in Utah (*Why Utah Has The Greatest Snow on Earth*, 2012).

Location

While the business model for Snowbird does a great job highlighting how important Salt Lake City is to Snowbird's success, it cannot be talked about enough. While many view Denver as America's best ski city because of its location next to the Rocky Mountains, Salt Lake City is much closer to more high-level skiing. With the Wasatch Mountain Range making up the eastern side of the Salt Lake Valley, an entire population center is situated directly next to some of the best skiing on Earth. Seven of the top 10 resorts for skiing access are located in Utah, which

showcases how intertwined skiing is with Utah culture (*Why Utah Has The Greatest Snow on Earth*, 2012). With two Cottonwood Canyons reaching into the edge of the city's limits and a thirty-minute drive to Park City, top skiing can be reached consistently; this is shown in Image Eight ("Ski Utah Reveals ONE Wasatch Lift Connector Locations," 2014). The Big and Little Cottonwood Canyons each access two ski resorts. Big Cottonwood Canyon houses Brighton and Solitude, while Little Cottonwood Canyon is home to Alta and Snowbird. Park City has Deer Valley and Park City Mountain. Park City Mountain recently purchased nearby Canyons Resort; this merger made the new Park City Mountain the largest skiing in America, besting Big Sky (Romero, 2015).

Salt Lake City is one of the few places, beyond remote ski towns, where skiing is extremely accessible; this access brings people to the sport naturally. Also, Salt Lake City recently renovated its airport. With access to destinations around the country, visitors can fly across multiple time zones and find themselves on the snow within a matter of an hour. In regard to the actual ski lift technology, Salt Lake City is also the home to Doppelmayr and Leitner-Poma's North American offices; the state of Utah even gives these companies tax breaks to add value to being in Utah (Release, 2021). This commitment to ski lift and transportation infrastructure suggests Salt Lake City's excitement about becoming America's premier skiing city (Williams, 2022). This commitment will be talked about further when considering the contemporary case going on in the Little Cottonwood Canyon.

Skiing Culture

The culture of the skiing at Snowbird is reflective of its nature next to a major city while also drawing in tourists. This combination makes it for a more laid-back feel. In comparison to the other two resorts, it falls in the middle. Snowbird can have the upscale lodging and dining

while also not sacrificing any of the skiing. With its location in the Wasatch Range, it has impressive terrain that brings in all levels of skiing. The Range has an impressive amount of elevation and terrain, which is what makes skiing there so intriguing (*Why Utah Has The Greatest Snow on Earth*, 2012). By being located near a larger city, the clientele that comes to ski at Snowbird is more diverse than other resorts. This is what takes away from the more serious feeling that occurs at other resorts. Another reason why the skiing is very well known is because of the snow that Snowbird and the Little Cottonwood Canyon receives.

Utah has been given the designation of having the “Greatest Snow on Earth” (*Why Utah Has The Greatest Snow on Earth*, 2012). This is because of its location east of the Sierra Nevada Mountains and lake effect snow from the Great Salt Lake. As the storms brew up over the Sierras, they slowly become drier as they move towards Utah. With the combination of the drying effect and the snow that is created from lake effect, the Little Cottonwood Canyon is situated in a perfect spot to receive maximum amounts of light, dry snow. This is the best for skiing because it is so easy to move through; having a lot of it is nice too. Due to this heavy amount of snow that is in the perfect condition, many skiers move to the area. There is also a culture of back country skiing in the Wasatch (Christensen, 2022). This is a method of skiing that relies on skins for the bottom of the skis and detachable boots. This allows skiers to move up the mountain under their own power with the help of their equipment. While this may be considered as a negative movement for ski lifts, it is helpful in the dispersion of skiers to non-resort areas of the mountains. It also creates a greater interest in the sport that can go beyond just the standard resort skiing. Overall, the growth of back country skiing has brought more excitement to the sport while also creating a culture of more adventurous skiing. This has aided Snowbird as they

draw from this same pool of skiers due to their location in the Wasatch (Kuprianowicz, 2021). Therefore, the skiing culture of Snowbird is representative of some of the best skiing in America.

Little Cottonwood Canyon

With the knowledge gained from the background on ski lifts and the three case studies, this paper now turns to a modern case that encapsulates every topic this paper has covered. The Little Cottonwood Canyon, which houses the Snowbird and Alta skiing areas, has become the focus of the skiing community as it looks for a solution to avalanche concerns. With a narrow two-lane highway being the only access in and out of the Canyon, people have been stuck at the ski resorts for days at a time. When an avalanche slide occurs, the road is extremely hard to clear and can take a while for it to be safe again. These slides are better represented in Image Nine, which showcases the standard paths and their frequency (“Cottonwood Canyons Avalanche Info - UDOT Cottonwoods,” n.d.). While the Canyon receives “the Greatest Snow on Earth,” it receives so much of it that the slide of one avalanche is usually a warning of more to come (*Why Utah Has The Greatest Snow on Earth*, 2012). And even when there is not a threat for avalanches, the highway is extremely narrow and curvy. With any slide or crash of a car, the road becomes backed up for hours. While it can take between fifteen and twenty minutes to get from the bottom to the top in peak conditions, any kind of back up makes it so that traffic will last for hours (Christensen, 2022). When it snows, there is a traction law requiring chains, special tires, or four-wheel drive to go up the road (“Winter Travel in the Cottonwood Canyons,” n.d.). As skiing has become increasingly accessible at the two resorts, both because of the interest of the sport in the area and the boom of multi-resort ski passes, the road has become less reliable. While the public services do their best to keep the road clear, this a battle that is hard to win. Due to all these concerns, there has been a shift from the local community to find an answer that goes

beyond the highway. The answers are being debated at the state level through the Utah Department of Transportation with the governor having a say in the proceedings (McKellar, 2021).

There have been three main suggestions to fix this problem. The first is an expansion of the ongoing ski bus program that Salt Lake City already supports. With buses coming from community lots to the two resorts in the Little Cottonwood Canyon and the two in the Big Cottonwood Canyon, skiers do not have to worry about traction laws or having their car adding to the traffic (*Ski Bus*, n.d.). The growth of this program has been helpful in decreasing the number of cars going up the Canyons every day, however people still choose to drive because of the freedom and flexibility that they have from bringing their car. The buses also cost money to ride, so there is a cost that is inflicted from riding these buses despite trying to support the community-centric approach. This option has been given push back because of the lack of success that it has and its inability to work when avalanches occur (McKellar, 2021). The second potential solution, which is coupled with the increased bus program, would be to expand the road. By adding more lanes, traffic can move more swiftly, and more cars can be on the road at once. However, expanding a ten-mile highway at the bottom of a canyon is not that easy. The road winds through the Wasatch National Forest, so there are also concerns from cutting into the natural landscape on both sides (McKellar, 2021). Doing that would also force the road to be closed for a long period of time due to construction. The cost for the wider road and the bussing operation is estimated at around \$481 million. This proposal has been pushed back against due to the limited success of the bussing and the need to cut into the National Forest.

The other suggestion is the building of a gondola from the mouth of the Little Cottonwood Canyon to the top. A gondola with thirty carriers would cost \$576 million to build

and an additional \$9 million to operate (McKellar, 2021). This gondola would be used to move people up the Canyon; the ride would take between thirty to forty minutes round trip. By taking pressure off the highway system, the gondola would act as an entirely new way of moving through the Canyon. Therefore, people would have the option to move via the gondola or their own cars still. However, this proposal has been highly controversial (Christensen, 2022). What makes this case so interesting is the length of the gondola, the costs that taxpayers would incur, and the location in a National Forest.

First, the overall length and size of the gondola is a major undertaking. This would be one of the longest gondolas in the world and is more reminiscent of ones found in Europe (McKellar, 2021). The gondola would be around eight miles long and would require twenty-two towers to support the thirty carriers that it would hold. It would also need stations at the base and at each of the resorts for people to exit (Christensen, 2022). Operating a gondola of this magnitude would also be very expensive because of the maintenance and labor needed. While it would be useful for moving people and creating jobs, it is an all-around massive undertaking for the state of Utah and the canyon. There is a very minimal advantage from building the gondola because it can only move just over 1000 people per hour (Christensen, 2022). With 14,000 skiers at the resorts on any given day, there would still be a logjam for skiers (Dunphey et al., n.d.). Eventually, they would choose to drive and risk the drawbacks of that option over being stuck atop the Canyon waiting for a 35-minute gondola ride to take them down. The second drawback is the actual cost. While it is only slightly more than the expansion of the road, it would still cost taxpayers from around the state to support this small area. With an almost \$600 million price tag, committing to this plan would be brought up in any future political campaigns (McKellar, 2021). The local politics have crept into this debate for that reason and voters are taking note of their

representatives' actions, especially because only around 3% of Utah citizens actually ski at Snowbird or Alta (Christensen, 2022). For Utah citizens to foot the bill on this massive infrastructure project, it is unfortunate that very few would benefit from the development.

The preservation of the National Forest is the last factor to analyze. The case studies have shown how the process for clearance for these kinds of projects is two to three years (T. Smith, personal communication, March 18, 2022). On top of that, having more than twenty towers with thirty carriers going through a National Forest is almost the opposite of what preservation should be. While this service would be helpful to the ski resorts and the safety of the visitors, the environmental drawbacks are too hard to overlook. The natural beauty would be taken away from because of the large red carriers and the noise that the gondola would take; this was the motivation for protestors when they flew massive red balloons in the Canyon, as seen in Image Ten, in to show how much the gondola would impact the Wasatch (Kuprianowicz, 2021). This externality has been given the most attention due to the visibility of the gondola as a solution. The three case studies show just how influential a major ski lift is to an operation, so having a gondola that is supported by the state of Utah running through a National Forest echo how there are drawbacks to that same notoriety.

The Little Cottonwood Canyon case is a perfect representation of the difficulties that come with the development of ski lift technology. By the state of Utah and its Department of Transportation considering it as an option to solve their problems, it validates how this technology can be useful on multiple fronts (Dunphey et al., n.d.; McKellar, 2021). This helps show why South America has utilized lifts as a dependable form of movement. However, the actual costs highlight the negatives that come with eco-tourism and the infrastructure needed to support it. The realization that I had when reading Edward Abbey's *Desert Solitaire* is now

happening for people around the state of Utah. When natural beauty is a reason to go somewhere, there are many benefits for the surrounding areas. Yet, when that reasoning continues to grow, many pitfalls begin to arise. As of the spring of 2022, there has not been a final decision. Instead, the state has postponed a recommendation and will provide one in the coming months; leaders of this project would like to review more information and come forward with a finalized plan (Dunphey et al., n.d.).

With something as controversial as this gondola, it is impossible to keep everyone happy. What everyone does agree on is that change is necessary. However, the state of Utah must make a decision that shows the respect towards the Wasatch: first as a National Forest, second as a wild land that it cannot have control over. While a gondola will ensure movement of people up the Canyon regardless of avalanche conditions, it will still not be able to change the weather (Christensen, 2022). It is remarkable that something as peculiar as snow could draw so many people, enough so that it creates the need for decisions that are worth more than half a billion dollars. In the same way, people will seek out the new gondola because the past cases have shown this to be true. When thinking about Big Sky developing its tram or Jackson and Snowbird opening their resorts with trams, people will always be drawn to new and large projects, especially in the skiing world. Returning to the science, technology, and society idea of actor-network theory, it is useful to consider how everyone, and everything plays a role in these meta settings (Ahmed, 2013; Fallan, 2011). From the individual skiers that go up the Canyon to the snow that falls, actor network theory shows how they each impact the result. For now, the result of this case will be decided at a governing level, but the people of Utah are making sure that their voices are heard in this process. Utah has been blessed by its geography to have such

ideal conditions, yet they now need to choose a route that will help preserve that geography moving forward.

Discussion

This paper was guided by three research questions. First, it considered what changes have occurred with ski lift technology and how they impacted the skiing industry. The opening of this paper focused on these developments and saw how quickly the skiing industry has adapted to new technology. With faster lifts and more efficient, green technology, skiing has been able to see vast improvements (S. Kircher, personal communication, March 27, 2022). The results have been coupled with a growth in snowmaking technology and a recent development in multi-resort lift passes (Diamond & Bigford, 2019; Pickering & Buckley, 2010). As people travel for skiing more frequently and resorts are grouped together via ownership models, the Ikon and Epic Passes have become a staple for the industry. This grew out of relationships that were connected to the development of ski lifts and the improvements for the on-mountain experience.

The second question looked at three resort cases studies and asked how ski lifts impacted them. It also looked to those findings to provide better insight into the Little Cottonwood Canyon case. This also paired well with the third question which looked at how factors are considered when making decisions about developing ski lift technology. By examining four factors, this paper found the importance of business model, lift network, location, and culture. With the differences between private and public land usage, the business model proved to be a major key when thinking about how to advance chair lift technology (Lovett, 1983; *The Future of Ski Resorts on Public Lands*, n.d.). This coupled with the existing lift network showed how resorts can adapt to the new technology that the first research question highlighted. With trams comes heightened attention, as seen by the Big Sky case. Location is also a major factor and has been a

leading reason for the development of Jackson Hole and Snowbird. Finally, the culture is representative of the people and atmosphere that resorts pursue. The variance across the world for skiing destinations shows that skiers are all looking for different things when they go to ski mountains.

From high end restaurants to tailgating in the parking lots, being in the mountains is always the main goal of skiing regardless of the consumer setting that the resorts aim to create (J. Niehues, personal communication, January 28, 2022). This “making of mountains” is indicative of how wealth can overtake a sport and bring out the uglier sides of an industry. With that in mind, the Little Cottonwood Canyon case was observed. By understanding both sides of the argument, this paper was able to develop a better understanding about why this process is moving so slow despite the need for change. With a large cost and plenty of factors to consider, the Little Cottonwood Canyon dilemma accentuates how ski lifts have become politicized. Leaders within the field are forced to face many things when developing lifts. The system that has been put in place tries to prioritize public lands and their protection, but the business side of the skiing world has been able to find the holes needed for their own growth.

This paper aimed to create a larger discussion around ski lifts and their place in society. Within the actor-network theory, effects that are rarely considered were given light because of their importance in the outcomes of chair lift development. A science, technology, and society framework pushes for a greater conversation about the topic moving forward. For ski lift technology to continue to develop on the trajectory that it is on, it must consider its role in the protection of the settings that it is in. When Aspen Mountain acknowledged their role on harming the environment, first steps towards a solution were shown. However, these steps need to be taken by more than just one resort. There needs to be action from everyone that is involved. If

not, skiing may be a sport of the past sooner than people would like to realize. Within the conversation surrounding skiing and environmental policy, chair lift technology represents a technological tool that had a role in getting skiing to where it is today. At the same time, it has shown that it can be influential in making positive changes, whether that means more people coming to an area or access to new parts of a mountain (*Aerial Tram Cabin Upgrades*, n.d.; Lerman, 1996). And while those results may seem negative, this paper takes them as a sign that skiing can become a vehicle for the protectionist and environmentalism movements.

Conclusion

The findings of this paper demonstrate the complexity of technological advancements in the skiing industry. For a sport to be so reliant on its environment, there is a fine line that is crossed as skiing aims to take control of its environment. While skiing has kept from going beyond that line so far, the failure by the skiing industry to address climate change and the industry's role within it has been shocking (*In the Alps, Ski Resorts Are Desperately Battling Climate Change—and Local Resistance*, 2020). While skiing is a leisurely sport, the consequences of bringing millions of people a year to remote locations creates bottlenecks in the movement of people and energy (*Melting Art with a Message / Climate Stories / Inside Aspen Snowmass*, n.d.). The cases show how skiing can change mountains and their surroundings. While resorts like Big Sky undergo projects to “transform,” there have been very few signs of reformation. While ski lift technology takes little energy to operate and the costs of that specific infrastructure may seem minimal, its development brings in problems that have long term effects. This includes more gas emissions from cars, an increase in human waste, and a need for more of the water supply (Falk & Tveteraas, 2020; *Melting Art with a Message / Climate Stories / Inside Aspen Snowmass*, n.d.). This series of events is like the ones that Edward Abbey

witnessed occur in Arches National Park. This starts with better lifts and an improved mountain experience drawing more people to a resort. From there, more people coming to these locations requires an increase in public and private services. This includes anything from parking spaces to airports. As those services grow, so must the work force. This is all while taking into consideration the limited land area because of the typical location in the mountains. Finally, the cycle starts over again as time moves along and there is a need to improve or expand the lift network to accommodate the increase of visitors to the area. That developmental cycle is what keeps chair lift technology at the forefront of evolution within the skiing industry (P. Landsman, personal communication, February 1, 2022).

Reflecting on the histories of Big Sky, Jackson Hole, and Snowbird, it is clear how the modernization of chair lift technology played a role in perpetuating that cycle as the number of visitors increases. Using their three trams as examples of that modernization, due to the rarity and access that they provide, chair lifts are proven to impact a resort's exposure and popularity (Group, n.d.-a; Lerman, 1996; *The Snowbird Tram*, n.d.). Applying that to the proposal of the gondola in the Little Cottonwood Canyon, the practicality of the project makes sense but could also lead to future drawbacks. While the gondola is a form of public transportation to increase safety in an unpredictable canyon, the efficiency of moving people up the canyon could create problems (McKellar, 2021). This includes the need for more infrastructure on and next to the ski mountain to support the number of visitors. The proposal also incurs massive costs to the local taxpayers despite the limited accessibility of skiing due to cost of entry and time. Regardless, applying the four principles used in this paper to evaluate ski lift networks can be applied to any resort. Business model, lift network, location, and culture encapsulate the motives of decision

makers. Moving forward, the lessons learned those principles in historical cases should be applied to other cases to further develop the findings of this topic.

One of the limitations of this paper was the lack of literature and focus on this topic. As lift technology continues to develop, more research will be done to better understand the drawbacks of larger and faster lifts. At the same time, the knowledge about the growth of ski towns will continue to evolve as both large and small destinations continue to develop. It is important that the field starts to look at these topics because of the fragility of these habitats. Being at such high elevations with variable weather highlights the limited carrying capacity of these locations (Farrell, 2020; Patthey et al., 2008). This will also be prime ground to study the growing wealth inequality in these unique locations as the wealthy seek more remote places to escape to, ultimately forcing people out (Farrell, 2020). Looking at more cases to create more specific findings that can be applied to certain factors will grow the uses of these findings. This paper's goal was to draw more attention to the topic; the analysis will create an interest within the science, technology, and society field to examine more closely.

Moving forward, snowmaking, and the role of other technologies will need to be considered. This paper has shown how snowmaking has quickly become a mainstay in the world of skiing. With the need for snow as resorts lose out on their dependable snowfall, infrastructure projects across the industry will always be tied to man-made snow. Other technologies, such as helicopters and snowcats have also become options for the movement of skiers up the mountain (T. Smith, personal communication, March 18, 2022). These are incredibly more expensive, but do not have the same costs to the Earth as ski lifts with their towers and stations. So, while these other forms of movement are growing in popularity, they do not have the same accessibility as chair lifts. Overall, chair lifts have been able to advance rapidly, and the skiing industry has done

a great job keeping up as resorts look for an upper hand in attracting visitors to their ski runs (Christensen, 2022; Mladenović & Virijevic-Jovanovic, 2019).

Overall, this project has taught me so much about skiing and chair lift technologies. What may look like a simple chair hanging from a rope has become a passion of mine. Reflecting on the lessons that have been learned, from the need for snowmaking to the importance of trams, ski lifts are so much more than most realize. Their role goes beyond just moving people up a mountain; they are directly linked to the growth and success of resorts and surrounding areas. Like Warren Miller said, riding up a chair lift is a magical experience that changes one's life. While he was focusing on where riding that chair brings you, it is important to acknowledge how that chair got there and the processes that it went through for it to become a reality. For chair lift technology moving forward, regulations will continue to be an important hurdle to work through. These hurdles are put in place to preserve the settings that are being enjoyed. The outcome of the Little Cottonwood Canyon case will be important to follow because that will help highlight how important preservation is to people in power (Christensen, 2022; McKellar, 2021). While there is no clear solution to the problem, the answers that are concluded will set a precedent for lifts in the future. From the carriers to the control stations, and everything in-between, chair lifts represent the world of skiing and its relationship with its surroundings. The themes present in this paper highlight the need for more attention to be given to this technology and the resulting impact that it has on the people and areas that chair lifts support.

Images and Charts

Image One

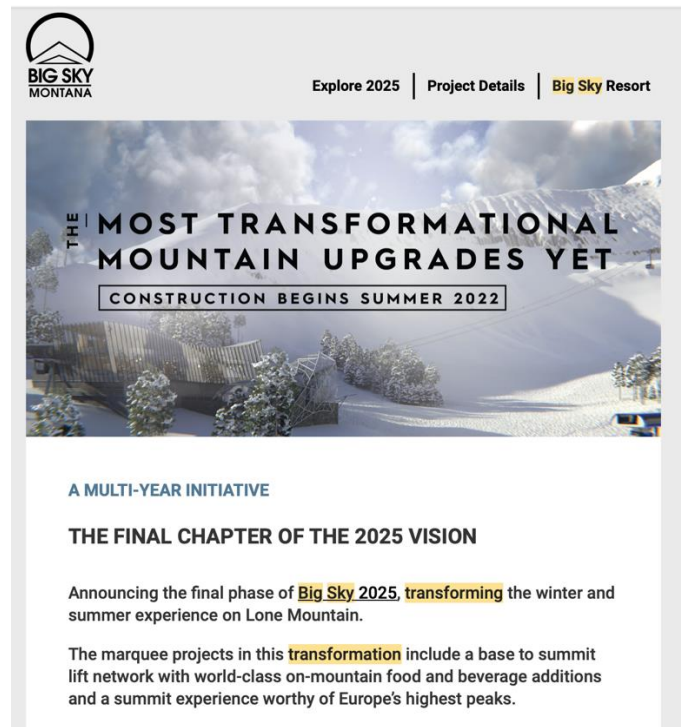


Chart One

Big Sky, MT : Lifts

Status	Lift Name	Type	Manufacturer	Years of Operation	Capacity	Vertical Rise	Length
Operating	Bear Back	Platter	Poma	1993-		300	900
Operating	Cabin	Triple	Doppelmayr CTE	2005-	1200	136	1691
Operating	Cascade	Triple	CTEC	2002-		448	3295
Operating	Challenger	Triple	Doppelmayr	2016-	1232	1640	4380
Operating	Dakota	Triple	Heron-Poma	2007-			
Operating	Derringer	Quad	Doppelmayr CTE	2003-	1500	429	2544
Operating	Explorer	Double	Heron-Poma	1973-	1200	622	3770
Operating	Headwaters	Double	Yan	2005-	375	686	1421
Operating	Highlands	Triple	Doppelmayr	2019-	509	967	3850
Operating	Homer	Platter	Doppelmayr CTE	2005-	129	50	1250
Operating	Iron Horse	Quad	Garaventa CTEC	1994-	1800	921	3215
Operating	Jayhawk	Triple	Doppelmayr	2019-	486	207	2554
Operating	Lewis & Clark	High Speed Quad	Doppelmayr CTE	2005-	1600	715	4145
Operating	Little Thunder	Double	Riblet	2006-	922	71	
Operating	Lone Moose	Triple	Yan	1999-		1284	4000
Operating	Powder Seeker	High Speed Six	Doppelmayr	2016-	1800	807	2701
Operating	Lone Peak Tram	Tram 15	Doppelmayr	1995-	200	1450	2828
Operating	Lone Tree	Quad	Doppelmayr CTE	2004-	1500	650	1550
Operating	Pony Express	Triple	Garaventa CTEC	1995-	1800	573	3115
Operating	Ramcharger 8	High Speed Eight	Doppelmayr	2018-	3600	1160	4461
Operating	Sacajawea	Triple	Doppelmayr CTE	2005-	1200	538	2638
Operating	Shedhorn 4	High Speed Quad	Doppelmayr	2018-	1600	1487	4738
Operating	Six Shooter	High Speed Six	Doppelmayr CTE	2003-	1800	1828	8700
Operating	Southern Comfort	High Speed Quad	Doppelmayr CTE	2004-	1800	1250	6055
Operating	Stagecoach	Double	Skytrac	2017-			
Operating	Swift Current 6	High Speed Six	Doppelmayr	2021-	3000	1657	8302
Operating	Thunder Wolf	High Speed Quad	Doppelmayr	1993-	2400	1728	5802
Operating	Tweener	Platter	Doppelmayr CTE	2005-	121	25	768
Operating	White Otter	Double	Doppelmayr	1999-		210	2200

Image Two



Image Three

TWO-STAGE GONDOLA

A new two-stage gondola will replace the existing Explorer chair, which has been in operation since the resort's opening in 1973. The new gondola will extend all the way to the Bowl, connecting to the lower terminal of the new tram, the mid-station Learning Center, and multiple dining facilities. This replacement will transform access to the Explorer and northern Swift Current terrain with the new gondola providing massive improvements to comfort and speed.



Image Four



Chart Two

Jackson Hole, WY : Lifts

Status	Lift Name	Type	Manufacturer	Years of Operatic	Capacit	Vertical Ris	Length
Operating	Aerial Tram	Tram 100	Doppelmayr CTE	2008-	650	4084	12463
Operating	Apres Vous	High Speed Quad	Poma	1999-	2000	1748	5097
Operating	Bridger Gondola	Gondola 8	Poma	1997-	2400	2730	8730
Operating	Casper	High Speed Quad	Leitner-Poma	2012-	2160	1041	3389
Operating	Eagle's Rest	Quad	Skytrac	2019-	1200	281	1584
Operating	Marmot	Double	Doppelmayr CTE	2011-	1100	1208	3281
Operating	Moose Creek	Quad	Garaventa CTEC	2000-	1200	187	1208
Operating	Sublette	Quad	Poma	1987-	1650	1630	4118
Operating	Sweetwater Gondola	Gondola 8	Doppelmayr	2016-	2000	1275	4339
Operating	Teewinot	High Speed Quad	Poma	1996-	2000	405	2679
Operating	Teton	High Speed Quad	Doppelmayr	2015-	2223	1722	4069
Construct	Thunder	High Speed Quad	Leitner-Poma	2022-			
Operating	Union Pass	Quad	Garaventa CTEC	2000-	1200	255	1814

Image Five



Chart Three

Snowbird, UT : Lifts

Status	Lift Name	Type	Manufacturer	Years of Operatic	Capacit	Vertical Ris	Length
Operating	Aerial Tram	Tram 120	Garaventa AG	1971-	1000	2900	8395
Operating	Baby Thunder	Double	Doppelmayr	1995-	1200	638	1966
Operating	Baldy	High Speed Quad	Garaventa CTEC	2001-	2000	1019	3482
Operating	Chickadee	Double	Thiokol	1972-	1200	149	830
Operating	Gad 2	High Speed Quad	Doppelmayr	2013-	1800	1242	4017
Operating	Gadzoom	High Speed Quad	Garaventa CTEC	1997-	2600	1823	6457
Operating	Little Cloud	High Speed Quad	Doppelmayr	2012-	1800	1302	3204
Operating	Mid Gad	Double	Doppelmayr	1980-	1101	1315	4287
Operating	Mineral Basin	High Speed Quad	Garaventa CTEC	1999-	2200	1435	3515
Operating	Peruvian	High Speed Quad	Doppelmayr CTE	2006-	2400	2421	8031
Operating	Wilbere	Double	Doppelmayr	1971-	1200	668	1968

Image Six

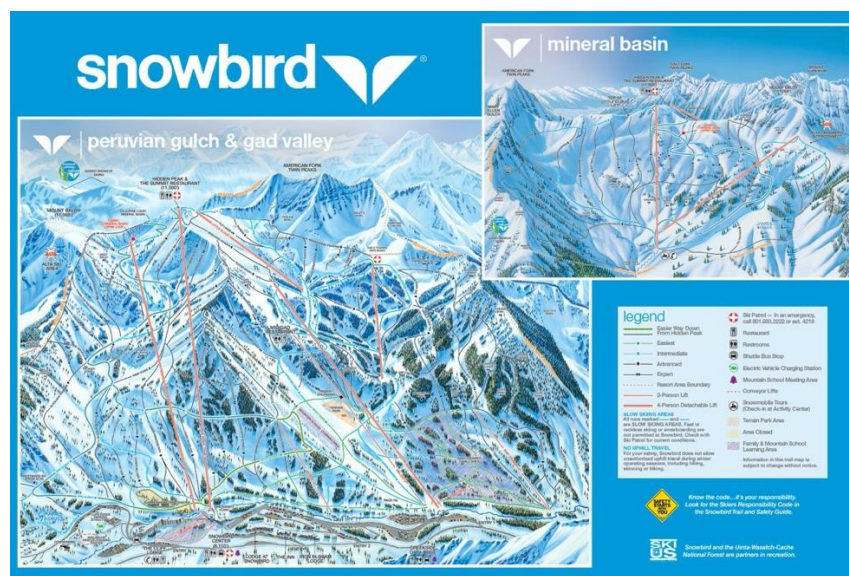


Image Seven



Features

- ❖ You no longer need to be a Tram mechanic to ride on the roof- a balcony has been added on the top of the Tram for the summer months, with room for up to 14 people.
- ❖ Floor-to-ceiling windows for uninterrupted breathtaking views of the mountain and Salt Lake Valley.
- ❖ During the summertime, take a glimpse of the mountain below through 3 sections of 3' x 3' glass floor panels for a thrilling ride to the top every time.

Image Eight

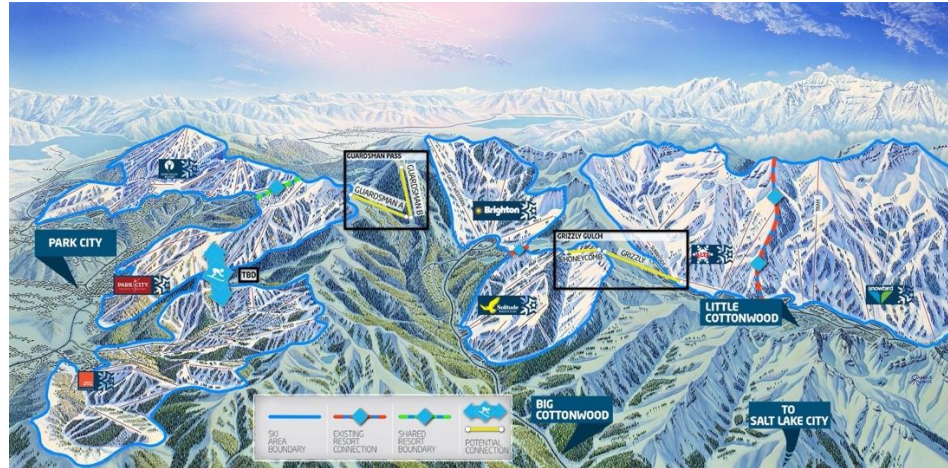


Image Nine

LITTLE COTTONWOOD CANYON SLIDE PATH ZONES

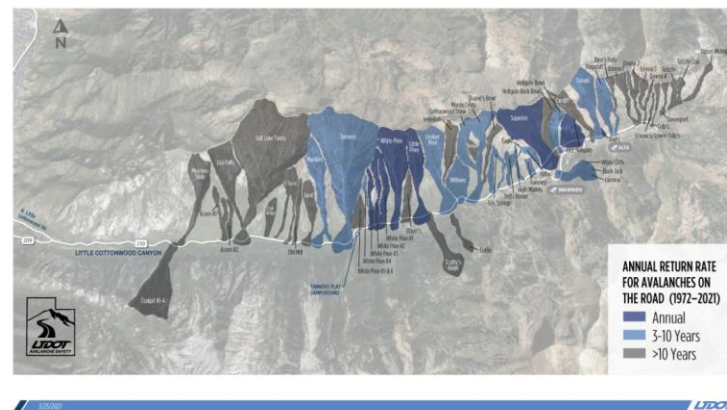


Image Ten



Works Cited

- Aerial Tram Cabin Upgrades*. (n.d.). Retrieved March 2, 2022, from <https://www.snowbird.com/aerial-tram-upgrades/>
- Ahmed, M. (2013). *ACTOR-NETWORK THEORY, TOURISM ORGANIZATIONS AND THE DEVELOPMENT OF SUSTAINABLE COMMUNITY LIVELIHOODS*.
<https://pearl.plymouth.ac.uk/handle/10026.1/2899>
- Big Sky, MT. (2015, September 9). *Lift Blog*. <https://liftblog.com/big-sky-resort-mt/>
- Big Sky Resort—2025 Vision*. (n.d.). Retrieved April 6, 2022, from <https://bigskyresort.com/2025>
- Blevins, J. (n.d.). *Pandemic accelerated Colorado ski resorts' technological advances*. The Journal. Retrieved May 9, 2022, from <https://www.the-journal.com/articles/pandemic-accelerated-colorado-ski-resorts-technological-advances/>
- Boyne Resorts | Experience the Lifestyle*. (n.d.). Retrieved April 30, 2022, from <https://www.boyneresorts.com>
- Busier-than-ever year for Grand Junction chairlift maker reveals strength of nation's resort industry*. (2021, December 27). The Colorado Sun.
<https://coloradosun.com/2021/12/27/leitner-poma-chairlifts-ski-resort-industry/>
- Christensen, S. (2022, January 27). *Opinion: Here are five reasons to reject a gondola up Little Cottonwood Canyon*. Deseret News.
<https://www.deseret.com/opinion/2022/1/27/22903073/utah-department-transportation-gondola-little-cottonwood-canyon-traffic-skiers>
- Cocuzzo, R. (2016). *Tracking the wild Coomba: The life of legendary skier Doug Coombs*. Mountaineers Books.

Conservation and Recreation: What Alta is Doing to Remain a World-Class Ski Destination.

(n.d.). Retrieved May 6, 2022, from <https://www.alta.com/stories/conservation-and-recreation-what-alta-is-doing-to-remain-a-world-class-ski-destination>

Cottonwood Canyons Avalanche Info—UDOT Cottonwoods. (n.d.). *Cottonwood Canyons.*

Retrieved May 9, 2022, from <https://cottonwoodcanyons.udot.utah.gov/avalanche-information/>

Diamond, C., & Bigford, A. (2019). *Ski Inc. 2020: Alterra counters Vail Resorts ; mega-passes transform the landscape ; the industry responds and flourishes : For skiing? A North American renaissance.*

Diaz, J. (2021, September 15). Yellowstone National Park Sets August Record for Visitors. *The New York Times*. <https://www.nytimes.com/2021/09/15/us/yellowstone-park-visitors.html>

Dunphey, K., April 5, D. N. | P.-, & P.m, 2022 at 12:57. (n.d.). *Little Cottonwood Canyon:*

UDOT delays gondola, bus recommendation. Retrieved May 9, 2022, from <https://www.deseret.com/utah/2022/4/5/23011557/gondola-utah-ski-traffic-problems-udot-delays-recommendation-little-cottonwood-ski-traffic-solution>

Epic Season Pass / Epic Season Pass. (n.d.). Retrieved May 6, 2022, from

https://www.epicpass.com/?ef_id=CjwKCAjwjOTBhAvEiwASG4bCE7RwYD_VC4aArtGlZkuEvo3rX831OIWTaMGHuGd_HUxfWZ9GBsFzhoCRK4QAvD_BwE:G:s&s_kwid=AL!11600!3!596151598711!e!!g!!epic%20pass!864359917!42477609566&CMPID=PPC&gclid=CjwKCAjwjOTBhAvEiwASG4bCE7RwYD_VC4aArtGlZkuEvo3rX831OIWTaMGHuGd_HUxfWZ9GBsFzhoCRK4QAvD_BwE

Falk, M., & Tveteraas, S. (2020). Modelling the wider effects of ski lift investments. *Empirical Economics*, 59. <https://doi.org/10.1007/s00181-019-01626-3>

- Fallan, K. (2011). Architecture in action: Traveling with actor-network theory in the land of architectural research. *Architectural Theory Review*, 16(2), 184–200.
<https://doi.org/10.1080/13264826.2011.601545>
- Farrell, J. (2020). *Billionaire wilderness: The ultra-wealthy and the remaking of the American West*. Princeton University Press.
- Fava, D. (2020, December 26). How Tourism Contributes to Global Warming. *Ecobnb*.
<https://ecobnb.com/blog/2020/12/tourism-contributes-global-warming/>
- Group, T. Z. (n.d.-a). *Jackson Hole Aerial Tram*. Jackson Hole Mountain Resort. Retrieved March 30, 2022, from <https://www.jacksonhole.com/aerial-tram>
- Group, T. Z. (n.d.-b). *Jackson Hole History*. Jackson Hole Mountain Resort. Retrieved May 1, 2022, from <https://www.jacksonhole.com/history>
- Group, T. Z. (n.d.-c). *Trail Map Winter*. Jackson Hole Mountain Resort. Retrieved May 1, 2022, from <https://www.jacksonhole.com/maps/mountain-winter>
- Hendrickson, C. (2018). Sustainable infrastructure. *Issues in Science and Technology*, 34(4), 10–11.
- Home. (n.d.). The Gondola Works. Retrieved March 30, 2022, from <https://gondolaworks.com/>
- Housing in Jackson: Is this a crisis?* (2021, June 2). Buckrail - Jackson Hole, News.
<http://buckrail.com/housing-in-jackson-is-this-a-crisis/>
- In the Alps, ski resorts are desperately battling climate change—And local resistance*. (2020, December 23). Environment.
<https://www.nationalgeographic.com/environment/article/alps-ski-resorts-desperately-battling-climate-change-local-resistance>

Jackson Hole, WY – Lift Blog. (n.d.). Retrieved May 1, 2022, from <https://liftblog.com/jackson-hole-wy/>

Kings & Queens of Corbet's. (n.d.). Red Bull. Retrieved May 1, 2022, from <https://www.redbull.com/us-en/events/kings-and-queens-of-corbets>

Kircher, S. (2022, March 27). *Steve Kircher Interview* [Zoom].

Kuprianowicz, M. (2021, August 23). To Protest the Proposed Gondola, Activists Float Giant Red Balloons in Little Cottonwood Canyon, UT. *SnowBrains*. <https://snowbrains.com/to-protest-the-proposed-gondola-activists-float-giant-red-balloons-in-little-cottonwood-canyon-ut/>

Landsman, P. (2015, June 4). Lift Profile: Sunday River's Chondola. *Lift Blog*. <https://liftblog.com/2015/06/03/lift-profile-sunday-rivers-chondola/>

Landsman, P. (2022, February 1). *Peter Landsman Interview* [Phone].

Lerman, J. (1996). An American Alp: A new tram turns Big Sky, Montana, into one of the most exciting ski mountains in the nation. *Skiing*, 49(3), 106–115.

Lift Safety. (n.d.). Retrieved April 20, 2022, from https://www.nsaa.org/NSAA/Safety/Lift_Safety/NSAA/Lifts/Lift_Safety.aspx?hkey=e8661933-6e37-48e1-9a77-84e0ed571acc

Lovett, R. A. (1983). The Role of the Forest Service in Ski Resort Development: An Economic Approach To Public Lands Management. *Ecology Law Quarterly*, 10(4), 507–578.

McKellar, K. (2021, January 18). *It's cheaper than a train, more expensive than a bus. Is it the solution to canyon gridlock?* Deseret News. <https://www.deseret.com/utah/2021/1/17/22227607/salt-lake-ski-areas-gov-spencer-cox-gondola-wasatch-canyon-little-cottonwood-canyon-alta-snowbird>

Melting Art with a Message / Climate Stories / Inside Aspen Snowmass. (n.d.). Aspen Snowmass.

Retrieved April 9, 2022, from

<https://www.aspensnowmass.com/discover/experiences/stories/melting-art-with-a-message>

Mladenović, D., & Virijevic-Jovanovic, S. (2019). THE RESEARCH OF SKIER

MOTIVATIONS AND FACTORS INFLUENCING THE CHOICE OF A SKI

DESTINATION. *Facta Universitatis, Series: Physical Education and Sport*, 043.

<https://doi.org/10.22190/FUPES180913007M>

Montana Reported the 13th Largest Population Growth in the U.S. (n.d.). Cascade Courier.

Retrieved April 20, 2022, from [https://www.cascadenewspaper.com/montana-reported-](https://www.cascadenewspaper.com/montana-reported-the-13th-largest-population-growth-in-the-u-s/article_96e05404-e012-11eb-873c-7328f804637d.html)

[the-13th-largest-population-growth-in-the-u-s/article_96e05404-e012-11eb-873c-](https://www.cascadenewspaper.com/montana-reported-the-13th-largest-population-growth-in-the-u-s/article_96e05404-e012-11eb-873c-7328f804637d.html)

[7328f804637d.html](https://www.cascadenewspaper.com/montana-reported-the-13th-largest-population-growth-in-the-u-s/article_96e05404-e012-11eb-873c-7328f804637d.html)

Mountain Maps / Big Sky Resort. (n.d.). Retrieved May 1, 2022, from

<https://bigskyresort.com/trail-maps>

Niehues, J. (2022, January 28). *Jim Niehues Interview* [Phone].

Patthey, P., Wirthner, S., Signorell, N., & Arlettaz, R. (2008). Impact of Outdoor Winter Sports

on the Abundance of a Key Indicator Species of Alpine Ecosystems. *Journal of Applied*

Ecology, 45(6), 1704–1711.

Pickering, C. M., Bear, R., & Hill, W. (2007). Indirect Impacts of Nature Based Tourism and

Recreation: The Association Between Infrastructure and the Diversity of Exotic Plants in

Kosciuszko National Park, Australia. *Journal of Ecotourism*, 6(2), 146–157.

<https://doi.org/10.2167/joe162.0>

- Pickering, C. M., & Buckley, R. C. (2010). Climate Response by the Ski Industry: The Shortcomings of Snowmaking for Australian Resorts. *Ambio*, 39(5/6), 430–438.
- POWDR. (n.d.). Retrieved May 6, 2022, from <https://www.powdr.com/?detail=snowbird>
- Release, P. (2021, October 7). Leitner-Poma of America to open new facility in Utah. *Utah Business*. <https://www.utahbusiness.com/leiter-poma-utah-facility-announced/>
- Romero, M. (2015, July 29). *Park City, Canyons resorts to be merged into largest ski area in US*. <https://www.ksl.com/article/35709426/park-city-canyons-resorts-to-be-merged-into-largest-ski-area-in-us>
- Ski Bus. (n.d.). Retrieved May 9, 2022, from <https://www.rideuta.com/Services/Ski-Bus>
- Ski Utah reveals ONE Wasatch lift connector locations. (2014, September 9). *Utah Outside*. <http://www.utahoutside.com/2014/09/ski-utah-reveals-one-wasatch-lift-connector-locations/>
- Smith, T. (2022, March 18). *Interview with Tim Smith* [Phone].
- Snowbird Trail Map / OnTheSnow. (n.d.). Retrieved May 1, 2022, from <https://www.onthesnow.com/utah/snowbird/trailmap>
- Snowbird, UT. (2015, September 29). *Lift Blog*. <https://liftblog.com/snowbird-ut/>
- Sukut, J. (n.d.). *Bozeman Yellowstone International Airport on pace for record year*. Bozeman Daily Chronicle. Retrieved April 19, 2022, from https://www.bozemandailychronicle.com/news/business/bozeman-yellowstone-international-airport-on-pace-for-record-year/article_4b9b35d1-b5cd-524f-9516-6e04494f1fd5.html

Surging tourism strains Jackson Hole, amid rising COVID-19 cases. (2020, July 27). Travel.

<https://www.nationalgeographic.com/travel/article/jackson-hole-yellowstone-grand-teton-struggle-with-record-breaking-coronavirus-tourism>

The Future of Ski Resorts on Public Lands. (n.d.). Retrieved March 30, 2022, from

<https://www.nationalforests.org/our-forests/your-national-forests-magazine/the-future-of-ski-resorts-on-public-lands>

The Snowbird Tram: An Engineering Marvel. (n.d.). Retrieved March 30, 2022, from

<https://www.snowbird.com/blog/an-engineering-marvel/>

Two Visit Salt Lake Passes, One Ultimate Ski and Après Ski Experience. (2022, February 18).

Unofficial Networks. <https://unofficialnetworks.com/2022/02/18/two-visit-salt-lake-passes-one-ultimate-ski-and-apres-ski-experience/>

Vincentelli, E. (2022, March 15). Big Sky Is Sprawling, Luxurious and Pricey. And, Maybe, the

Future of Skiing. *The New York Times.* <https://www.nytimes.com/2022/03/15/travel/big-sky-montana-skiing.html>

Why the economic situation in ski towns should scare the whole country. (2022, February 8).

Deseret News. <https://www.deseret.com/2022/2/7/22918555/what-ski-towns-tell-us-about-the-countrys-inequality-crisis-affordable-housing-healthcare>

Why Utah has The Greatest Snow on Earth. (2012, December 19). Ski Utah!

<https://www.skiutah.com/blog/authors/yeti/why-utah-has-the-greatest-snow-on-earth>

Williams, C. (2022, April 7). “Committed to this plan”: How Salt Lake City’s parks, public

lands may change in next 20 years. <https://www.ksl.com/article/50382815/committed-to-this-plan-how-salt-lake-citys-parks-public-lands-may-change-in-next-20-years>

Winter Travel in the Cottonwood Canyons. (n.d.). *Cottonwood Canyons*. Retrieved May 9, 2022,
from <https://cottonwoodcanyons.udot.utah.gov/traction-law/>