

## Sustainable logistics as a source of competitive advantage in remote locations

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**Abstract:** Governments, corporations, and other organizations are expanding further into remote locations, such as polar regions, space, and other relatively inaccessible areas with minimal development. However, with this increased interest in remote areas, there is a shortage of scholarly work to draw upon for operating in these regions. Therefore, this presents an opportunity to fill an academic gap, and the article asks, ‘How can sustainability be a source of competitive advantage for logistics in remote locations?’ To explore this question and to serve as a resource for future researchers, the article defines key terms, utilizes an interdisciplinary framework by integrating the academic disciplines of business and sustainability, and supplies a detailed literature review. From this groundwork, the article follows a qualitative methodology whereby three hypotheses emerge. The research results offer that sustainability can be a source of competitive advantage for logistics in remote locations by: sustainable logistics innovation; reducing, reusing, and recycling; and optimizing supply networks. Finally, the article closes with a discussion and summary, by recognizing research limitations and by contributing recommendations for future dialogue and research.

**Keywords:** sustainability, logistics, remote locations, sources of competitive advantage.

## Introduction

There is a limitation of scholarly work surrounding the role of sustainable logistics in remote locations. Yet, governments, companies, and non-profit organizations are working in these areas and expanding their role. Examples might include: military units operating from forward bases in austere areas; extraction companies surveying the Arctic for oil or minerals; healthcare scientists searching for miracle species in the Amazon-basin; aid organizations providing disaster relief to an island nation after a natural disaster; or even the ongoing endeavor of resupplying the International Space Station. Indeed, the topic may have direct and indirect implications for multiple stakeholders and sectors such as energy, transportation, healthcare, education, government, and tourism.

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Unfortunately, the limitation of pedagogical material poses a challenge for researchers and practitioners who wish to understand this topic or who work in remote locations, respectively, because there is little information to draw from and make claims. Therefore, the goal of this article is twofold. First, the literature review, which has been divided into four sections, is meant to serve other researchers by consolidating a variety of references. Second, the author asks whether or not sustainability can be a source of competitive advantage for logistics in remote locations - and if so, how?

As a result, the article not only fills an academic gap but may also facilitate a dialogue that could have a positive impact on our quality of life, as well as operations on and off the globe. By this means, the author utilizes a qualitative research method. From this method, three hypotheses form: 1.) Yes, sustainability can be a source of competitive advantage for logistics in remote locations. This can be accomplished via sustainable logistics innovation, 2.) Yes, this can be accomplished by reducing, reusing, or recycling, and 3.) Yes, this can be accomplished by optimizing supply networks. Admittedly, while these hypotheses may seem elementary upon first observation, it is the author's opinion that their importance shouldn't be dismissed; after all, when operating in a remote location, simple applications can be challenging, but they may also secure a source of competitive advantage and reap rewards. Thus, as alluded, it is the author's hope that this research may prove beneficial to the aforementioned stakeholders by offering hypotheses and by providing examples of social, economic, and environmentally friendly strategic initiatives.

Consequently, given the complexities, a foundation needs to be established, and the definitions below provide a summary of key words to serve this function. For the sake of clarity, these definitions are listed in bullet form. In addition, since some of the definitions are contested or are working definitions, the basis for these terms is further explained within the literature review of this article.

- Sustainability – meeting “[...] the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987).
- Logistics – “The purpose of logistics management is to obtain efficiency of operations through the integration of all material acquisition, movement, and storage activities” (Heizer & Render, 2014, p. 444).
- Sources of Competitive Advantage – are “the market positions” of “low cost,” “differentiation,” or “niche market focus” (Sigalas, 2015, pp. 2013-2014).
- Remote Location – an area of relative “inaccessibility” with minimal “development,” regularly an “off-road system” requiring “all-terrain vehicles,” “boats,” or “aircraft” (Ewers, 2013, p.41; Hulse et al., 1993, p. 2; Moselhi & Poulton, 1991, p. 86).

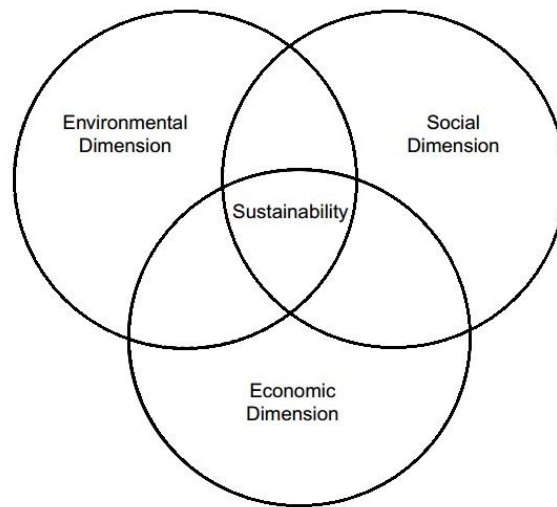
Furthermore, given the complexity of the topic, the article follows an interdisciplinary framework, and the author believes an explanation for this approach is owed to the reader. For instance, it has been noted that when taken separately, distinct academic disciplines have “unique demands,” “traditions,” and “practices” (Mansilla & Duraisingh, p. 218). Or in other words, academic entrenchment and narrow frames can produce shortcomings in research. Therefore, to adequately answer the question and to meet the goals of this article, the author integrated the academic disciplines of sustainability and business.

For example, concerning the academic discipline of business, the primary goal is to study and to understand businesses, which requires a multi-faceted approach. Some subjects within the school of business include finance, accounting, entrepreneurship, marketing, operations, management, strategy, and leadership. Thus, practitioners in business would be interested in the question because it deals directly with operations and business strategy. Therefore, from the perspective of a business scholar, an approach to the question may include determining performance metrics, quantifying economic value, or analyzing supply chain life-cycle analysis. However, a shortcoming for business is that the distinct discipline, while strong in numerous aspects, sometimes lacks the inclusion of externalities and the concepts related to sustainability.

With this noted, sustainability is an interdisciplinary study, as shown in *Figure 1*, that integrates social, environmental, and economic dimensions. Accordingly, an academic who specializes in sustainability may approach the research question by attempting to determine environmental savings, measuring potential ecological footprints, quantifying social and environmental impacts, or utilizing a corporate sustainability report. These approaches might ensure a systematic overview for social and environmental integration and could help implement policies for businesses. However, a critique for sustainability is that it is vague, inconsistent, and amoeba-like in definition, which will be noted in this

article’s literature review, and this critique is why the academic discipline of business serves as a complementary frame for this research.

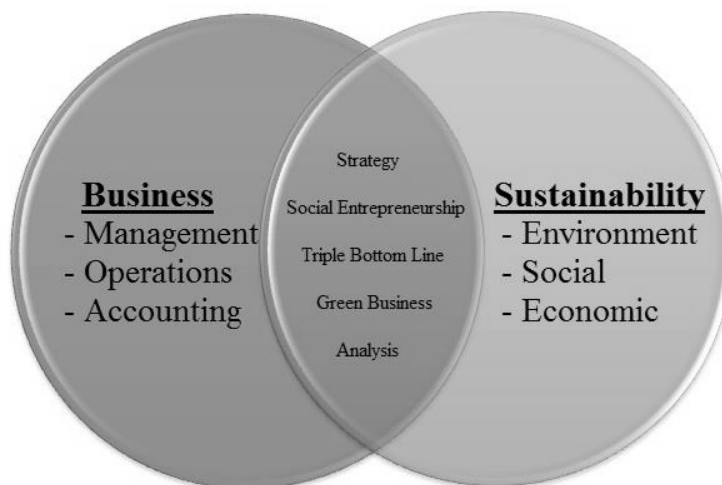
**Figure 1: Integration of Sustainability**



Source: Adapted from Winter & Knemeyer, 2013, p. 23

In fact, when taking this interdisciplinary approach, the academic disciplines of sustainability and business share common ground. This convergence may include goal-setting, analysis, and strategy, such as value chain assessment. Another example of integration would include the concept of the Triple Bottom Line, which will be discussed further in the literature review. Therefore, while the corresponding diagram below is not entirely inclusive, the text within *Figure 2* should provide a generalized sense of how these two disciplines can intermingle to provide solutions for pertinent, complex problems.

**Figure 2: Example of Interdisciplinary Overlap between Business and Sustainability**



Finally, to close the introduction, the author’s motivation for researching the topic and assimilating these two distinct disciplines originated after living and working in locations like Alaska, Antarctica, and the Marshall Islands. The hands-on experience in remote and environmentally sensitive areas forged the curiosity to integrate the disciplines of business and sustainability. Therefore, with the researcher’s personal experience articulated, and after acknowledging a limitation of scholarly work on the subject, recognizing multiple stakeholders, covering the definition of key words, and identifying the

shortcomings of a single-disciplinary approach for this topic, it is the author's belief that outlining the interdisciplinary rationale to the reader is required for moving forward.

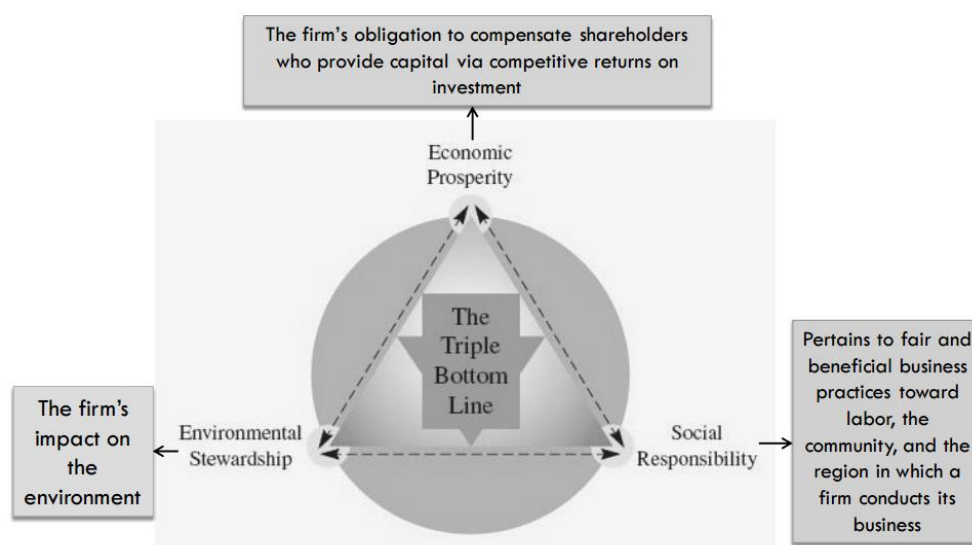
### 1.1 Literature Review: Sustainability and Business

There are varying viewpoints surrounding the concept of sustainability, and several scholars have noted that the topic of sustainability lacks a concrete definition (Holden, Linnerud & Banister, 2014, p. 130; Linton, Klassen & Jayaraman, 2007, p. 1076; Winter & Knemeyer, 2013, p. 22). In fact, Chiras and Reganold (2010) alluded that the root of these diverse viewpoints and approaches to sustainability can be traced through history. They say these varying conservation perspectives can be drawn as far back as the 1700s (pp. 4-6), and by the late 1800s, U.S. Forester Gifford Pinchot's resolution for a "utilitarian approach," meaning a "sustained yield" of resources, contrasted naturalist John Muir's desire for a "preservation approach," which is "nature-centered" (Chiras & Reganold, 2010, pp. 13-14). Ultimately, these contrasting ideals between Muir and Pinchot echo into the present and serve as an undercurrent within more recent academic debates and scholarship (Dunsky & Steinke, 2005).

Since these early contentions, there have been "waves" of conservation and sustainability in the 20<sup>th</sup> Century, but the environmental movement in the United States came to the fore during the 1960s (Chiras & Reganold, 2010, pp. 7-9; Unruh, 2016, p. 11). This decade witnessed numerous publications and scholarly debates. Several influential ones included: Rachel Carson's book about the dangers of pesticides titled, *Silent Spring* (Carson, 1962); ecologist Paul Ehrlich's controversial book, *The Population Bomb* (Ehrlich, 1968), and his subsequent bet and loss against economist Julian Simon regarding resource scarcity (Wagner & Newman, 2013, p. 17); and Garrett Hardin's "highly influential" article, "The Tragedy of the Commons" (Hardin, 1968), which connected population growth and resource extraction with social and environmental degradation (Chiras & Reganold, 2010, p. 8; Dietz, Ostrom & Stern, 2013, p. 1907).

Beyond the debates of pollution, population, and resources, a primary understanding for the subject of sustainability integrates three dimensions, which includes environmental, social, and economic factors (Markley & Davis, 2007, p. 764; Oberhofer & Dieplinger, 2014, p. 237; Winter & Knemeyer, 2013, p. 19; Wu & Pagell, 2011, p. 578). This integration makes the concept of sustainability complex and interdisciplinary itself, and for sustainability and business, some have called this integration the "Triple Bottom Line," which is sometimes identified as "TBL" or "3BL," meaning that businesses should strive for economic, social, and environmental goals. These authors have also said that integrating the goals into businesses will promote sustainable development (Akamp & Müller, 2013, p. 54; Linton, Klassen & Jayaraman, 2007, p. 1080; Markley & Davis, 2007, p. 764; Oberhofer & Dieplinger, 2014, p. 237; Winter & Knemeyer, 2013 p. 22; Wu & Pagell, 2011, p.578).

**Figure 3: The Triple Bottom Line**



Source: adapted from Jacobs & Chase, 2010, p. 22

However, Holden, Linnerud, and Banister (2014) have contended that this frame of sustainability is weak, incomplete, or incompatible, because economics is merely a “potential means” and “[...] not a primary dimension in its own right” (p. 131), and they noted that others have criticized sustainable development by quipping, “Anything on which John Major, George Bush and Fidel Castro all agree can’t really mean anything, can it?” (p. 130). Indeed, Kogg and Mont (2012) acknowledged that some business managers may see social and environmental integration as “[...] prohibitive for companies who do not see clear financial rewards with improved sustainability performance” (p. 162). Furthermore, Holden, Linnerud, and Banister (2014) also shared that some say “sustainable development” and “sustainability” are two distinct concepts (pp. 130-131). Finally, Davidson (2010) made the claim that society ought to switch from the current “paradigmatic form” of sustainability and instead develop “resilience theory” as an alternative, which “[...] is the ability to absorb disturbance without inducing ‘system changes in its structure by changing the variables and processes that control behavior’” (pp. 1135-1137).

Nevertheless, even without a concrete definition of sustainability, as well as the historical background and ongoing academic critiques, the ideal of sustainability is here to stay (Holden, Linnerud & Banister, 2014, p. 130). With this established, a commonly recognized frame for sustainability stems from the United Nation’s World Commission on Environment and Development that released a publication in 1987 titled, *Our Common Future*, also known as “The Brundtland Report” (Chiras and Reganold, 2010, p. 9; Holden, Linnerud & Banister, 2014, p. 130; WCED, 1987; Wu & Pagell, 2011, p. 578). This United Nation’s report defined “sustainable development” as meeting “[...] the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987).

Therefore, given the history, interdisciplinary nature, and complexity of sustainability, the U.N. definition of sustainable development will be used in this article. However, the integration of economics, environment, and society from the Triple Bottom Line will be a recurring theme as well.

## 1.2 Literature Review: Sustainable Logistics

The U.N. definition of sustainable development provides a framework and extends into other studies (Holden, Linnerud & Banister, 2014, p. 130). For example, whether driven by legislation, public interest, or as a source of competitive advantage, interest regarding the implementation of sustainability within the field of operations has been increasing (Heizer & Render, 2014, pp. 188-189), and the interest regarding sustainable supply chain management has steadily grown, too (Linton, Klassen & Jayaraman, 2007, pp. 1077-1078; Markley & Davis, 2007, p. 766; Winter & Knemeyer, 2013, pp. 18-19; Wu & Pagell, 2011, p. 578). In fact, the importance of sustainable supply chains will increase for researchers, because as Winter and Knemeyer (2013) argued, “The field of [Supply Chain Management] has an inherent connection to sustainability [...]” and the “[...] natural relationship gives supply chain researchers exciting opportunities to make a profound societal difference through their work” (p. 19).

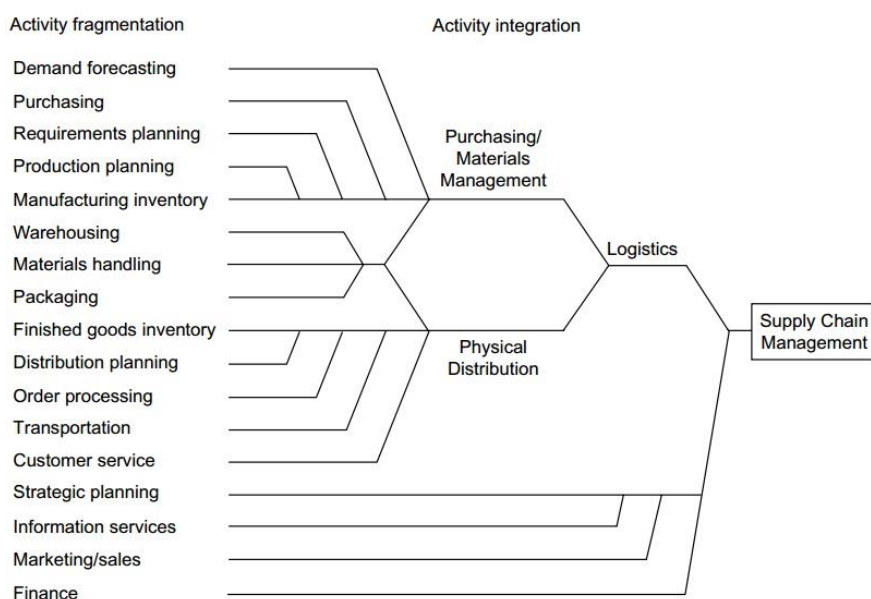
In addition, some have said the academic movement toward studying the relationship between sustainability and supply chain management is growing; albeit, for legal reasons. After all, as Linton, Klassen, and Jayaraman (2007) said, “Research into the operational implications of various policies and how business can integrate sustainability is critical, since current legal trends will force many of these changes whether or not academe and practice is prepared” (p. 1080). Furthermore, noting some of these legal trends, Dey, LaGuardia, and Srinivasan (2011) said sustainability needs to be implemented for supply chains because “government intervention” as well as “standards and regulations,” like The U.S. Environmental Protection Agency, The United Nations Framework Convention on Climate Change, The Kyoto Protocol, The Copenhagen Summit, and “cap and trade” legislation, will have the potential to “[...] affect all modes of transportation” (pp. 1242-1243).

On the other hand, the integration of supply chains and sustainability may not be nearly as “natural” as previously mentioned. For example, Wu and Pagell (2011) stated that there is a lack of inclusion for the social dimension of sustainability with regard to supply chain management (p. 589). Indeed, the lack of the social dimension in sustainable supply chain research was further acknowledged because “[...] the research community has placed much more emphasis on the environmental as compared to other aspects of sustainability” (Winter & Knemeyer, 2013, p. 19). Also, van Bommel (2011) contended that there ought to be “[...] increased attention to the political and cultural differences throughout these [supply] chains” as well as a new dimension that accounts for innovation (p. 895).

Thus, these claims insinuate that there are shortcomings in the integrated approach for the Triple Bottom Line with regard to supply chain management.

Nevertheless, because the importance of studying sustainability and supply chain management is readily noted, a clear distinction needs to be made between the relationship of supply chains and logistics to better understand logistics' role within supply chains. And to secure an understanding for logistics' role within supply chain management, it has been observed that logistics has a variety of definitions (Dey, LaGuardia & Srinivasan, 2011, p. 1240; Lummus, Krumwiede & Vokurka, 2001, p. 426; Markley & Davis, 2007, p. 767). However, the definition selected for this article was that of Heizer and Render (2014), which stated, "The purpose of logistics management is to obtain efficiency of operations through the integration of all material acquisition, movement, and storage activities" (p. 444). An example of this integration across activities is shown in *Figure 4*.

**Figure 4: Logistics' Integration within Supply Chain Management**



Source: Adapted from Dey, LaGuardia & Srinivasan, 2011, p. 1240

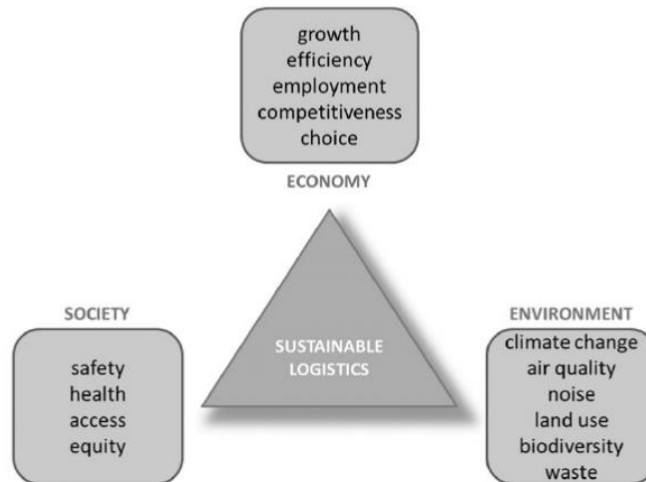
Thus, continuing with a secured definition of logistics for this paper and understanding its integrated role within supply chain management, it is now possible to establish the importance of sustainable logistics. Specifically, the subject has sometimes been referred to as "green logistics" or "environmental logistics" (Yu, Solvang & Chen, 2014, p. 404), and a challenge for companies utilizing sustainable logistics is how to run a competitive business without compromising social and environmental expectations for the future (Lee & Wu, 2014, p. 362; Wu & Pagell, 2011, p. 577).

One way to balance the trade-offs between sustainability and logistics as well as meet the environmental and economic dimensions within the Triple Bottom Line has been to use "[...] products that facilitate recycling or reuse" (Heizer & Render, 2014, p. 196). After all, as Heizer and Render (2014) claimed, "Products with less material, with recycled material, or with recyclable materials all contribute to sustainability" (p. 196). In addition, as Goldsby and Stank (2000) explained, "proactive firms" seek to reduce, reuse, and recycle products in order to try and "[...] minimize harmful environmental effects throughout their operations" (p. 190) while simultaneously pursuing cost savings, service, and a positive corporate image (p. 200). Therefore, by reducing, reusing, and recycling, companies that implement green logistics can integrate the dimensions of environment and economics from the Triple Bottom Line.

However, it has been argued that sustainable logistics does not neglect the social dimension, because as Marín (2011) stated, "[...] the development of a nation may depend largely on logistics" (p. 56). In fact, Marín's claim has been echoed by reports from developing countries calling for "friendly logistics solutions" (Mariano et al., 2016, p. 1). Moreover, Lee and Wu (2014) highlighted that transportation is a core activity of logistics (p. 364), and Mariano et al. (2016) further explained that

“[b]etween 1970 and 2004, carbon dioxide emissions increased by 70%, with the transport sector accounting for 13.1% of the emissions [...]” (p. 1). This is an important point, because as Oberhofer and Dieplinger (2014) noted, the transport sector is the fastest growing consumer of energy from fossil fuels and a subsequent emitter of greenhouse gases (p. 237). As a result, it can be surmised that the implementation of sustainable logistics can develop nations and communities and can be used to help mitigate societal risks associated with increasing greenhouse gas emissions from the transport sector.

**Figure 5: Framework for Sustainable Logistics**



Source: Macharis, Melo & Woxenius, 2014, p. xiv

Therefore, for the purpose of this article, it is important to acknowledge that sustainable logistics integrates the three realms from the Triple Bottom Line. When appropriate techniques are applied, like reusing and recycling material or utilizing efficient transportation methods to mitigate greenhouse emissions, sustainable logistics can meet social and environmental expectations as well as help a company remain economically relevant and viable.

### 1.3 Literature Review: Operations in Remote Locations

There is a limitation of academic literature detailing operations in remote locations (Moselhi & Poulton, 1991, p. 96). In fact, Hulsey et al. (1993) claimed, “In spite of the significant socioeconomic, political, and environmental impacts of the logistics of remote, short-term operations, available information is extremely limited at best” (p. 2). Yet, even with these claims made over two decades ago, there is still a limitation of dedicated literature.

Reasons may exist for this gap in research. One explanation could be slow innovation due to high risk and safety concerns. For instance, as Heiberg (1990) shared, “approaches,” “techniques,” “procedures,” and support services for operations in remote locations often go “unchanged,” because it can make “good sense” given that a mistake in remote locations “[...] can be very costly, even life threatening.” Thus, Heiberg concluded that, “There are good reasons for sticking with approaches that have stood the test of time” (p. 17).

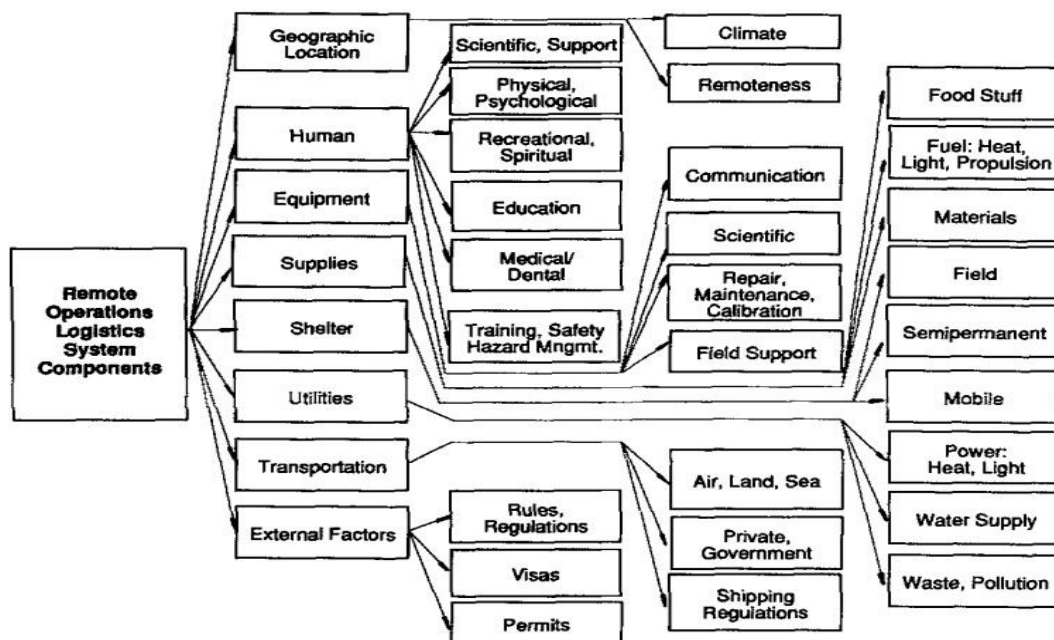
Another cause for the limitation in literature could be that remote “[...] projects can be fraught with difficulties” (Moselhi & Poulton, 1991, p. 83). These difficulties may develop during planning because remote locations regularly require “emergent,” “forming,” and “fluid” learning instead of “conventional,” “deliberate,” and “fixed” planning; and further complicating studies is that each “[...] project has its own particular characteristics and problems” (Moselhi & Poulton, 1991, p. 87). In short, individual project characteristics may be a deterrent to academic research.

To complicate matters, there are a variety of definitions pertaining to remote or austere locations and environments (Ewers, 2013, p.41; Hulsey et al., 1993, p. 2; Moselhi & Poulton, 1991, p. 86). Therefore, for this article, a working definition was developed from the literature. Here, remote locations are defined as: an area of relative “inaccessibility” with minimal “development,” regularly an

“off-road system” requiring “all-terrain vehicles,” “boats,” or “aircraft” (Ewers, 2013, p.41; Hulsey et al., 1993, p. 2; Moselhi & Poulton, 1991, p. 86).

With a working definition established, there have been several ways to address operations in remote locations. A starting point for operations in a remote location is through a “system components” approach, which includes “[...] the geographic location, human, equipment, supplies, shelter, utilities, transportation, and external factors” (Hulsey et al., 1993, p. 2). Interestingly, Hulsey et al. (1993) also argued that “comprehensive” planning ought to have “harmony” with the “ecosystems” of “[...] remote and sensitive regions” (p. 2). This “harmony” with “ecosystems” is comparable to sustainability. However, the author of this article would like to note that the “system components” diagram in *Figure 6* lacks sustainability practices, apart from the “waste, pollution” fragment via “utilities” as an ambiguous exception.

**Figure 6: Remote Operations Logistics Systems Components**



Source: (Hulsey et al, 1993, p. 3)

Building upon a system components approach, Kelley, Kuby, and Sierra (2013) called for “network-optimization,” especially for multiple, segmented modes of transportation in remote locations, such as exchanging goods between airplanes and dugout canoes in the Amazon (p. 89). This idea of “transport-optimization” was loosely indicated by Heiberg (1990) over twenty years’ prior to Kelley, Kuby, and Sierra’s model; although, amusingly, Heiberg identified the topic as “the leapfrog approach” and applied the concept to Arctic research (p. 17).

Another common characteristic of operations in remote locations includes the reliance upon local knowledge for information about the project area, for materials and “green products,” and for potential sources of labor (Ewers, 2013, p. 43; Kaltenborn, 2000, p. 31; Stevenson, Jones & Macrae, 2002, p. 40). A primary reason for local inclusion in remote locations, when applicable, includes the challenge of securing reliable local suppliers (Akamp & Müller, 2013, p. 55; Stevenson, Jones & Macrae, 2002, p. 38), and this involvement may simultaneously help “integrate local interests” with the remote operation’s success (Kaltenborn, 2000, p. 31).

Finally, even though operations in remote locations are regularly challenged with numerous contingencies, one way to combat this uncertainty is by assigning tasks. Moselhi and Poulton (1991) called this task designation the “project organization structure” (p. 84). Meanwhile, Virsnieks (1990) said that “endeavors” in remote locations ought to have a specified “Point of Contact” because it enhances safety and improves coordination (p. 31).

As a result, while a limitation in literature for operations in remote locations exists, several common themes emerge. The first is that operations in remote areas often have inherent safety risks, and the second is that managers should expect uncertainty as a norm. Conversely, these risks can be



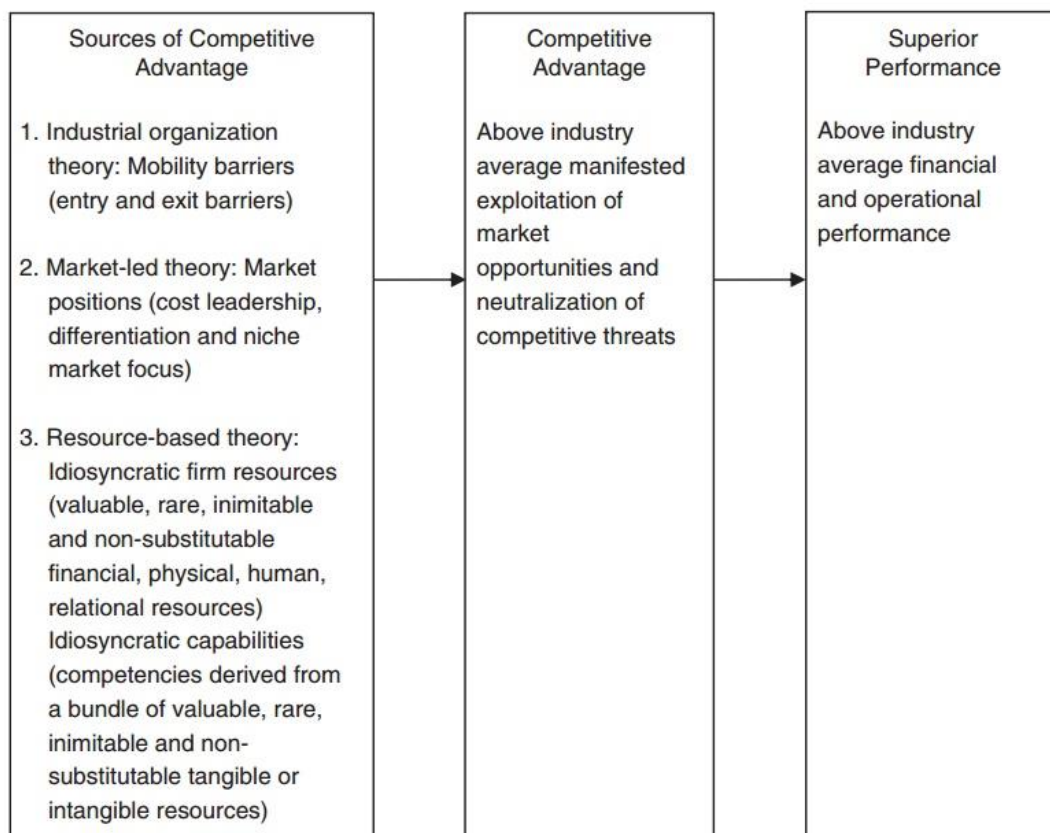
diminished or mitigated by following a systems components approach, utilizing transport-optimization, integrating local knowledge when able, and assigning realms of responsibility for project organization.

#### 1.4 Literature Review: Sources of Competitive Advantage

Competitive advantage is a growing topic and acts as a “cornerstone” in management and business strategy (Markley & Davis, 2007, p. 764; Sigalas, 2015, p. 2004). Competitive advantage also has noted importance with sustainability and sustainable supply chains (Linton, Klassen & Jayaraman, 2007, p. 1080; Oberhofer & Dieplinger, 2014, p. 250; Winter & Knemeyer, 2013, p. 33). Yet, Markley and Davis (2007) mentioned a shortcoming of research exploring competitive advantage for sustainable supply chain management, and they said, “Even in the 1990s, it was apparent to researchers that the availability of sources of competitive advantage for firms were going to become more limited and difficult to come by” (p.763). In addition, Markley and Davis (2007) shared that “[...] a number of leading US companies have significantly improved their competitiveness by engaging in such environmental performance-enhancing activities [...]” (p. 767). Therefore, exploring sources of competitive advantage for logistics may tie into sustainable development and the Triple Bottom Line.

Furthermore, Heizer and Render (2010) defined competitive advantage as, “[t]he creation of a unique advantage over competitors,” and they acknowledged that competitive advantage is achieved through “differentiation,” “low-cost leadership,” and “response” (pp. 35-37). However, Sigalas (2015) said competitive advantage isn’t always understood by most practitioners because academics use the term with varying “meanings” and “contexts” (p. 2011). Moreover, Sigalas (2015) continued to argue that this confusion is based upon the distinctions and inter-relationships between “sources of competitive advantage,” “competitive advantage,” and “superior performance” (pp. 2013-2014). These distinctions and relationships are shown in *Figure 7*.

**Figure 7: Framework for “Sources of Competitive Advantage”**



Source: Sigalas, 2015, p. 2013

To summarize, Sigalas (2015) has reinforced the “market-led” frame as presented by Heizer and Render for “sources of competitive advantage,” such as “cost leadership,” “differentiation,” and “niche

market focus” (pp. 2013-2014), and Markley and Davis’ (2007) have called for integrative research regarding competitive advantage and sustainable logistics (p. 763). Thus, clarifying the characteristics between competitive advantage and the sources of competitive advantage is essential.

## 2. Research Methods

The method undertaken is qualitative. The material and methodology include the detailed literature review of scholarly texts and peer-reviewed articles. For instance, from the literature review, three hypotheses emerge.

*Hypothesis 1:* Yes, sustainability can be a source of competitive advantage for logistics in remote locations. This can be accomplished via sustainable logistics innovation. For the first hypothesis, the concept of sustainable logistics innovations as a source of competitive advantage in remote locations is supported by the literature review. Heiberg (1990) noted that operations in remote locations often go “unchanged” (p. 17), and van Bommel (2011) highlighted innovation as a potential new framework for green logistics (p. 895). Therefore, because operations often go unchanged in remote locations, then innovation in sustainable logistics for these remote regions may provide sources of competitive advantage.

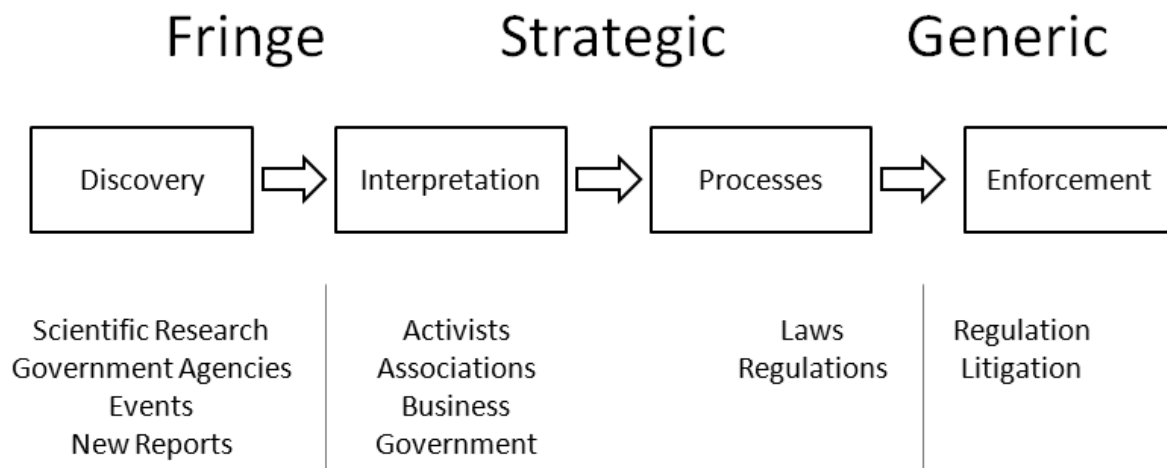
*Hypothesis 2:* Yes, this can be accomplished by reducing, reusing, or recycling. The hypothesis that reducing, reusing, or recycling material as a source of competitive advantage in remote locations is also incorporated from the literature review. Goldsby and Stank (2000) said these activities can reduce costs (p. 200). Furthermore, several authors acknowledged the burden of locating supplies and reliable servicers in remote locations (Akamp & Müller, 2013, p. 55; Stevenson, Jones & Macrae, 2002, p. 38). Thus, the sustainable practice of reducing, reusing, and recycling material for logistics activities in remote locations may provide sources of competitive advantage.

*Hypothesis 3:* Yes, this can be accomplished by optimizing supply networks. The hypothesis that optimizing transportation and supply networks in remote locations can be a source of competitive advantage is taken from the literature review. Transportation is a key activity in logistics (Lee & Wu, 2014, p. 364), and transportation is a major source of pollution and greenhouse gas emissions (Mariano et al., 2016, p. 1). Therefore, optimizing transportation networks is a sustainable initiative. Moreover, by definition and as explained in the literature review, remote locations are areas with relative inaccessibility, and Kelley, Kuby, and Sierra (2013) said that supply “network-optimization” may streamline logistics in remote locations (p. 89). Thus, optimizing transportation and supply networks in remote locations could be sustainable and may offer sources of competitive advantage.

Ultimately, given the shortage of work on the subject, the qualitative method in the research uses references from peer-reviewed journals as well as recent information from trade journals, reports, and books in order to provide relevant examples. Specifically, from these works and studies, each distinct hypothesis is winnowed and analyzed individually. Consequently, the qualitative method and each hypothesis stems from the literature review, but it is important to note that each hypothesis also has supporting examples beyond this initial review.

### 3.1 Research Results: Sustainable Logistics Innovation

Sustainable innovation is gaining recognition as an emerging business strategy. For example, Unruh (2016) has identified what he calls, “The Sustainability Frontier,” which is “[...] a conceptual - but real - boundary that progressively defines how products, companies, and industries will operate in our sustainable future” (p. 3). There are varied implications from this conceptual frontier whilst operating in remote locations. For instance, Unruh (2016) continued to share that “[...] success on the Sustainability Frontier requires careful planning, provisioning, and execution” (p. 21), and an important catalyst to this success is understanding the organization’s tactical placement on the sustainability frontier (pp. 23-29). These tactical areas include the “fringe,” “strategic,” and “generic” territories on the frontier as shown in *Figure 8*.

**Figure 8: Tactical Levels on the Sustainability Frontier**

Source: Adapted from Unruh, 2016, p. 28

Therefore, because this article evaluates sustainable logistics as a source of competitive advantage in remote locations, it would be considered part of the “fringe” on the sustainability frontier, as the issue is still emerging. Accordingly, stakeholders operating on this fringe could engage this tactical knowledge by making a ‘claim’ on the sustainability frontier and by forging “regulatory areas” and “market processes” (Unruh, 2016, pp. 27-29). In fact, this conceptual innovation and tactical leveraging on the sustainability frontier may prove significant for operations and logistics in geopolitically and commercially contested remote locations, such as the Arctic Ocean.

Numerous stakeholders are making their claims in the melting Arctic. This includes political posturing and territorial assertions by Arctic states, like Russia, Canada, Denmark, the United States of America, Finland, Iceland, and Sweden (Balton & Thomas, 2013, p. 8; Potts & Schofield, 2008, p. 151). Maritime interests and fisheries are increasing their role by influencing policy-making with regard to sustainability and harvesting (Jacobsen & Delaney, 2014, p. 1; Rixey, 2016, p. 441). In addition, the energy industry is leading sustainability-related priorities for Arctic operations and planning to benefit from this cooperation (Andreassen, 2016, p. 79; Dingman, 2011, p. 3). Thus, while staking claims on the sustainability frontier for sustainable logistics in remote locations may initially constitute an abstract conceptual innovation today, the tangible outcome of influencing legislation or crafting market norms may provide sources of competitive advantage tomorrow, such as differentiation and niche market focus.

Another example of sustainable logistics innovation comes from a recent engineering and terramechanics case study, known as the South Pole Traverse, which produced an environmentally friendly transport method in a remote region. According to Weale and Lever (2008), an ongoing challenge of resupplying the South Pole Station included the inefficiency of transporting fuel by plane as well as the competing priorities of air transport in Antarctica (p. 166). In order to mitigate these problems, a multi-year study was conducted in Greenland and Antarctica to test and implement a new innovation by transporting fuel bladders on “high molecular weight polyethylene” sheets via overland traverse (Lever & Weale, 2012, pp. 209-212). These studies found that “[...] fuel bladder sleds are an environmentally safe alternative [...]” and that a traverse fleet could “[...] offset 92 LC-130 fuel flights while consuming about one-quarter of the fuel needed by the aircraft” (Lever & Weale, 2008, p. 174). Thus, a sustainable logistics innovation freed aircraft for other purposes in Antarctica and simultaneously led to increased fuel efficiency at the South Pole Station, which produced cost savings and transformed operations in a remote location.

**Figure 9: The South Pole Traverse with fuel bladder sleds in tow**

Source: Helm, 2013

However, some may argue that sustainable logistics innovation isn't enough. In the case of the South Pole Traverse, it could be argued that these transport methods might be avoided altogether if power sources, like solar panels or wind turbines, were utilized instead of fossil fuels. For example, according to Baring-Gould, Robichaud, and McLain (2005), the "[a]nnual fuel consumption would be reduced by almost 23%, or 116,500 gallons (440,783 liters)" by installing wind turbines at the South Pole (p. v). Clearly, this sustainable initiative would result in cost savings over the long-term and help mitigate the need to transport the quantity of fuel.

The author would like to respond to this critique: "Yes!" On the one hand, installing alternative energy sources could benefit operations in a remote location by reducing the need for fuel consumption and possibly lessen transportation costs. On the other hand, the ongoing transportation of turbines, props, generators, and other material to construct and maintain alternative energy sources in a remote location would still be required. Thus, through the example of the South Pole Traverse, sustainable logistics innovations remain important for cost savings; albeit, sustainable logistics innovations are not just important for transportation but are also inclusive of the other logistics activities as previously shown in *Figure 4*, such as packaging, warehousing, and so forth. In addition, staking a claim on Unruh's "Sustainability Frontier" may help organizations obtain conceptual originality and acquire sources of competitive advantage. Therefore, sustainable logistics innovations can lead to sources of competitive advantage, such as cost savings, differentiation, and niche market focus. Even so, the author of this article agrees that reducing, reusing, and recycling shouldn't be excluded, which brings the next point.

### **3.2 Research Results: Reduce, Reuse, Recycle**

As a reminder, material management is a prominent activity within the integration of logistics (Dey, LaGuardia & Srinivasan, 2011, p. 1240), and in some remote locations, maintaining even the most fundamental necessities for operations, like managing a water supply or handling and segregating waste, may present a challenge. Therefore, it is the author's opinion that engaging in a simple sustainable measure within logistics by reducing, reusing, and recycling material can provide sources of competitive advantage in remote locations.

Reducing, reusing, and recycling are known as the "3R's" in sustainability, and one example of this application includes a study that analyzed the challenges and potential markets for recycling at "selected Pacific Islands" (Pariatamby & Tanaka, 2013, pp. 15-30). In *Figure 10*, the table lists common recyclables, the selected Pacific Islands, and markets and opportunities for recycling and reusing various bulk materials. Thus, this concept may afford opportunities for other remote locations.

**Figure 10: Recyclable materials at selected Pacific Islands**

Recyclables	Pacific Islands	Market for recyclables
Aluminum cans	Cook Islands, Fiji, Guam, Kiribati, Niue, Palau, Samoa, Solomon Islands, Tokelau, Vanuatu	Australia, USA, New Zealand
Scrap metals (ferrous metal)	Cook Islands, Fiji, Niue, Palau, Solomon Islands, Vanuatu	Australia, China, Hong Kong, Mauritius
Paper/cardboard	Cook Islands, Fiji, Palau	Local, Australia, New Zealand
Glass	Cook Islands, Palau	Local
Plastics	Cook Islands, Fiji, Samoa	Australia
Organic waste (composting)	Cook Islands, Fiji, Palau, Samoa, Tokelau, Tuvalu	Local

Source: Pariatamby & Tanaka, 2013, p. 30

In addition to identifying markets for recyclables, according to Lopez (2011), the U.S. Army and contractors stationed on Kwajalein Atoll, a remote island chain in the tropical Pacific, has several initiatives to mitigate costs by reducing, reusing, and recycling material. Logistic costs, such as shipping and transportation, are controlled by recycling water, reusing glass, and recycling oil (pp. 32-35). As a result, if the 3R's are applied to material management by identifying potential markets and services, then reducing, reusing, and recycling waste could potentially offset costs in remote locations. Therefore, these examples of the 3R's at Pacific islands should present an analogous model for thrifty logistics managers to imitate and discover sources of competitive advantage.

However, if offsetting costs by recycling material or selling waste to potential markets in the Pacific isn't a convincing example, another illustration of reducing, reusing, and recycling in a remote location is the British Antarctic Survey's Halley VI Station. In fact, Pratt (2012) mentions Halley VI is located on the Brunt Ice Shelf in Antarctica and "[...] is the UK's most isolated research facility" (p. 20). Additionally, according to Littlefield (2005), "[...] the sustainability agenda at Halley VI is dictated by the maxim 'reduce, reuse, recycle,'" and some of these initiatives at Halley VI include rationing and segregating water and energy supplies, like fuel. The station is also designed to recover waste heat and use this heat to enhance other operations, such as heating water. There is even an effort to pack and ship solid waste in order to be distributed as fertilizer elsewhere (p. 17). Thus, sustainable initiatives in material management, like integrating the 3R's within a corporate sustainability agenda, can provide a source of competitive advantage by mitigating costs associated with logistics in remote locations.

Yet, skeptics may say that if reducing, reusing, and recycling constitutes common practice for logistics in remote locations, then the 3R's do not provide a competitive advantage. They may argue: if operations in remote locations share this premise, then no clear advantage is present. In order to respond to this argument, the author of this article believes that there are two suitable responses. First, a stated purpose of this article is intended to determine whether sustainability can provide sources of competitive advantage for logistics in remote locations. With that said, the sources of competitive advantage are distinct from competitive advantage, as discussed within the literature review. Second, even with this distinction reiterated, there is at least one example of utilizing the 3R's to edge out competition for logistics in remote locations.

One company that has overcome competition by integrating the 3R's and has achieved first-mover advantage is the Space Exploration Technology Corporation, also known as SpaceX. The commercial space company designed the "Falcon 9" rocket, which is a "reusable launcher," and this rocket has launched "payloads" into space to transport cargo to the International Space Station (Baird, 2008, p. 17; Pelton, 2012, p. 17). This reusable launcher is significant, because prior to the Falcon 9, "No company or government [had] ever managed to land a spent rocket stage and reuse it [...]" (Werner, 2015, p. 38). Thus, this example should help solidify the place of the 3R's as a source of competitive advantage for logistics in remote locations, because SpaceX's reusable rocket demonstrates that it is possible to leverage the 3R's to differentiate and outperform competitors.

### 3.3 Research Results: Sustainable Supply Network Optimization

Sustainable initiatives for optimizing logistics networks in remote locations may provide sources of competitive advantage. For example, one way to optimize transportation might include adopting sustainable aircraft. Another opportunity to optimize logistics in remote locations would be to provide greater flexibility for material management through 3D printing. Each premise may provide sources of competitive advantage, such as low-cost leadership, differentiation, and niche market focus.

Air transportation is a common manner of shuttling supplies and people to and from remote locations. In fact, aircraft have had a presence in remote locations since the early 1900s, including U.S. Admiral Richard E. Byrd's expeditions to the Antarctic beginning in the 1920s (Smith & Johnson, 1968, p. 36). In addition, the practice of widespread air mobility in "austere environments" can be traced to the United States military's "extensive tactical airlift throughout South Vietnam" during the Vietnam War (Kruclick, 2013, p. 15). Other modern examples of air mobility to transport cargo and personnel in remote locations includes utilizing helicopters to resupply offshore oil rigs (Hermeto, Ferreira Filho & Bahiense, 2014, p. 41). Yet, while the benefits of air transportation in remote locations are evident, namely accessibility, there are disadvantages. For example, airplanes and helicopters have limitations for cargo carrying capacity, and air freight is an expensive method of transporting goods (Fenley, Machado & Fernandes, 2011, p. 75). Aircraft are also cited as a key anthropogenic contributor to pollutants and to greenhouse gas emissions from fossil fuel consumption (Howitt, Carruthers, Smith & Rodger, 2011, p. 7037; Michaelis & Davidson, 1996, p. 970). Thus, while airplanes and helicopters are common modes of transport in remote locations, sustainable alternatives may present opportunities for optimizing transportation networks in remote locations while simultaneously mitigating the current disadvantages.

**Figure 11. Aircraft on a sea ice runway near McMurdo Station, Antarctica**



Source: Helm, 2012

One opportunity to optimize transportation in remote locations may include adopting hybrid airships, also known as dirigibles or blimps (Gordon, 2005, p. 48). For example, Anslow (2008) shared that "[...] the idea of using airships for sustainable aviation" is gaining traction, and that estimates from climate researchers stated, hybrid airships "[...] would produce between just 10 and 20 per cent of the global warming effect of equivalent aeroplanes [...]" (p. 34). Furthermore, Amur Minerals Corporation intends to employ cargo airships for remote mining operations in Siberia. These airships will be capable of carrying "loads of as much as 250" tons, and they can "take off and land vertically" as well as "travel as fast as 160 km" per hour (Anonymous, 2014, p. 11). And Stapleton (2006) reported on a conference from the University of Alaska Anchorage that explored the "technology" and "capabilities" of airships for cargo transportation in Alaska. In their discussion, they found that airships could have a "[...] range of 500 to 1,000 miles while laden with cargo" and "[...] would gain altitude partially from lifting gas (helium) [...]" (p. 5). Therefore, implementing airships for sustainable aviation in remote locations could maintain the desired mobility and accessibility while simultaneously increasing cargo capacity, reducing fuel consumption, and reducing greenhouse gas emissions. These benefits would provide sources of competitive advantage.

On the other hand, opponents of hybrid airships for logistics in remote locations may cite two reasons for their resistance. The first would be in reference to the dangers of airships after the Hindenburg disaster. The second is the shortage of airships with cargo carrying capacity. To briefly

counter these arguments, aerospace technology and material science have improved considerably since 1937 (Anslow, 2008, p. 34). As for the shortage of cargo airships, defense and space contractors, like Lockheed Martin and ATG, have cargo airships on order or in production (Gordon, 2005, p. 53). Even so, a scientific expedition already used an airship to measure sea ice thickness in the Arctic (Anonymous, 2007, p. 52). Therefore, sustainable initiatives for transport optimization are underway, and hybrid airships are just one example.

Sustainable supply network optimization can also include flexibility for end-users in remote locations. As mentioned in the literature review, remote locations are areas of relative inaccessibility, and operators in these regions often have difficulty obtaining supplies and finding reliable suppliers (Akamp & Müller, 2013, p. 55; Stevenson, Jones & Macrae, 2002, p. 38). A sustainable way to circumvent this problem may include additive manufacturing technology, also known as 3D printing.

Of course, while there are admittedly current limitations in 3D printing technology, such as the time required for production, maneuvering through “data rights,” a deficiency in “quality,” and a “lack of scale” (Brown, Davis, Dobson & Mallicoat, 2014, p. 10; Nyman & Sarlin, 2013, pp. 4195-4198), the potential benefit for remote locations isn’t going unnoticed. In fact, according to Mazhar, Osswald, and Negrut (2016), “NASA has sent a 3D printer to the International Space Station and recently printed a wrench in anticipation of future missions to Mars in which astronauts will print their own tools and replacement parts” (p. 291). This makes sense. For instance, Nyman and Sarlin (2013) said, “Many of the benefits with 3D printing relate to its additive, rather than subtractive, nature,” and “[t]his can eliminate entire steps [...]” in logistics and supply chains. Consequently, they argued that the implications of 3D printing’s additive nature “[...] affects overproduction, waiting time, and excess inventory as all of these are better managed with a very reactive production process” (pp. 4195-4196). Therefore, for logistics in remote locations, if material and products can be printed and manufactured on-site, instead of relying upon ongoing shipments, then 3D printing can cut waste, mitigate the storage of excess material, and minimize the number and occurrence of deliveries, which is a sustainable logistics measure, frees resources for other priorities, and thereby provides sources of competitive advantage, respectively.

#### **4.0 Discussion**

The author would like to emphasize that the three hypotheses presented in this article are not inclusive, and more possibilities for sustainability as a source of competitive advantage for logistics in remote locations undoubtedly exist. Specifically, this research had limitations; namely, there is a shortage of scholarly work to draw upon for analysis. However, these limitations present opportunities for future research. Examples may include: developing ways to improve innovation methods for sustainable logistics in remote locations, integrating social dimensions for sustainable logistics, conducting surveys about sustainable operations in remote locations, and implementing specifics for network optimization with quantitative case studies. Ultimately, unraveling these possibilities will require other material and methods.

For instance, the inclusion of local knowledge for operations in remote locations is a shortcoming of this research. One potential way to incorporate local, indigenous knowledge for sources of competitive advantage in remote locations would be to study Tribal Ecological Knowledge (TEK). Chandra (2014) noted, “TEK is a body of knowledge and beliefs transmitted through oral tradition and first-hand observation. It includes a system of classification, a set of empirical observations about the local environment and a system of self-management that governs resource use” (p. 121). Yet, tapping into TEK is an often overlooked, but historically influential, way of improving logistics in remote locations. Norwegian Roald Amundsen’s expedition became the first to reach the geographic South Pole in 1911 by successfully applying his practical knowledge with “dogs,” “skis,” “igloos,” and “fur clothes” after his experience living and working alongside the Inuit people of the Arctic (Lorange, 2007, p. 5; Pratt, 1999, pp. 117-118; Sörlin, 2014, p. 283). Furthermore, integrating TEK into logistics for remote locations could be considered a sustainable measure because it engages the social dimension within sustainability and simultaneously expands beyond the “dominant Western mindset” (Chandra, 2014, p. 119).

**Figure 12: Amundsen's expedition used TEK to reach the South Pole**

Source: Huntford, 2011, p. 191

Moreover, TEK needn't be limited to the Polar Regions, because it could include knowledge from indigenous peoples in other remote locations, like in the Amazon-basin, the Saharan and interior Africa, New Guinea, the Australian Outback, and so on. This would be important because, as mentioned in the literature review, Wu and Pagell (2011) said there is a lack of inclusion for the social realm of sustainability in regard to supply chain management studies (p. 589). Albeit, acknowledging a lack of information pertaining to TEK's potential benefit for logistics in remote locations, this presents a vast opportunity for research.

Conducting surveys with the various stakeholders that operate in remote locations to obtain more data is another opportunity. Survey questions might comprise: what initiatives does your company implement for logistics while operating in remote locations? Has your organization or company developed specific innovations to overcome logistics challenges in these areas? If so, did the(se) innovation(s) have sustainability as an intended goal? Did these initiatives produce a source of competitive advantage? While this approach may admittedly prove tricky because some companies and organizations may be reluctant to provide answers or openly cooperate, questions like these may shed light on other hypotheses.

Finally, cooperating with stakeholders to analyze novel ways of operating in remote locations could tease out other hypotheses. In order to develop methods, an initial step may require conducting specific supply network case studies. For instance, perhaps humanitarian logistics efforts could piggyback off pre-existing and established networks in remote locations, especially for medical service to remote communities. Thus, supply network optimization studies with quantitative analysis may draw attention to specific risks and opportunities in ways that this qualitative research does not, and recognizing these factors may influence future strategies. Therefore, quantitative approaches could potentially lead to unique answers.

## **Conclusions**

The author set out to fill an academic gap by answering how sustainability can be a source of competitive advantage for logistics in remote locations. In order to answer the question and given the shortage of scholarly work on the topic, this article defined key terms, which were sustainability, logistics, sources of competitive advantage, and remote locations. In addition, the complexity of the research required an interdisciplinary approach by integrating the academic disciplines of business and sustainability. To achieve successful integration, the material and methodology of this interdisciplinary research was qualitative. Therefore, a thorough assimilation of the academic disciplines necessitated a comprehensive literature review, which described: sustainability and business; sustainable logistics;



operations in remote locations; and sources of competitive advantage. By concentrating on these themes, the literature review aimed to assemble references for future investigation and to provide a preliminary groundwork for other researchers, which was a stated goal in the introduction.

From this foundation, a thesis formed, and the argument is supported by three hypotheses. The author believes that sustainability can be a source of competitive advantage for logistics in remote locations: via innovations in sustainable logistics; by reducing, reusing, and recycling; and by optimizing transportation and supply networks.

These hypotheses are supported by the literature review and other practical examples. First, two examples of sustainable logistics innovations providing a source of competitive advantage exist. One includes the South Pole Traverse, which experienced substantial cost savings. The other leverages pedagogical assertions, such as staking a claim on “The Sustainability Frontier,” for an organization’s benefit; be it, differentiation or niche market focus. Second, the practice of reducing, reusing, and recycling, also known as the 3R’s, provides sources of competitive advantage in remote locations. Some examples of the 3R’s offering sources of competitive advantage include recycling programs for remote islands in the Pacific and for scientific stations in the Antarctic, and it even includes reusable material designs, like reusable rockets that created a first-mover advantage and revolutionized the private space industry. Third, optimizing supply networks in remote locations can provide sources of competitive advantage. Examples of optimizing transportation and supply networks in remote locations include employing hybrid airships for cargo transport or supplementing end-users with 3D-printing capabilities. Thus, while the hypotheses of innovation, the 3R’s, and optimization may seem generic, the implications shouldn’t be ignored. Because the benefits of adopting these sustainable measures for logistics in remote locations are even more pronounced than normal due to the added costs and risks associated with operating in these areas.

Finally, like many questions, this article identified opportunities for future research and scholastic exploration. Indeed, the author would like to emphasize that the hypotheses presented in this article are not inclusive, and more possibilities for sustainability as a source of competitive advantage for logistics in remote locations undoubtedly exist. Therefore, prospects for future investigation may include: conducting surveys, studying Tribal Ecological Knowledge, and implementing specifics for network optimization with quantitative case studies.

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