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The Use of Information and Communication Technology (ICT) in Managing High Arctic Tourism Sites: A Collective Action Perspective

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Abstract: Sustainable management of nature-based tourism sites is a pertinent issue in vulnerable Arctic environments. Arctic tourism operators often act collectively to protect their common interests of ensuring the sustainability of tourism sites. Nowadays, information and communication technology (ICT) is increasingly used to support these collaborative efforts, but the remoteness and risks associated with Arctic tourism operations challenge the success of such collective action. This study explores the use of ICT as a management tool for Arctic tourism sites to ensure their sustained quality. Drawing on a case study of an expedition cruise operators' network in Svalbard, we explore how the use of ICT affects collective action and sustainable management of tourism sites. Our findings show that, through increased noticeability, the creation of artificial proximity and the development of new management practices, ICT can help to overcome the challenges for collective action that are posed by the Arctic environment. The use of ICT results in changes in a network's relational and normative structures, which can as much add to as detract from the success of collective action. Our study indicates that the successful application of ICT depends on a high level of social capital, in particular norms, to guide interactions between ICT and network actors.

Keywords: Arctic tourism; collective action; ICT; social capital; common-pool resources; sustainable management

1. Introduction

In the fragile Arctic natural environment, the quality of tourism depends on sustainable management of tourism sites [1–3]. Tourism in the Arctic is mostly nature-based, with untouched wilderness, wildlife and dramatic landscapes being key attractions [4]. Natural resources accessed in Arctic tourism are often non-exclusive, which means that they are open to access by various actors. Prior studies qualify such resources as the commons [4,5] and conclude that the exploitation of common-pool resources (CPR) for tourism purposes can result in environmental depletion and degradation [6,7]. Addressing and minimizing the problem of natural-resource depletion has been traditionally studied from an environmental-policy perspective [8–10]. Scholars in the field claim that governmental regulations alone are insufficient to ensure the environmental quality of tourism sites and recommend involving tourism operators in the management of tourism sites to ensure their sustainability [7,11,12]. In many cases, the management of vulnerable tourism sites requires collective action by tourism operators to sustain tourism activities [11].

Collective action describes spontaneous or organized collaborative initiatives towards common goals, such as sustaining the quality of tourism sites [13]. Studies have shown that formalized tourism industry networks can play a crucial role in achieving common goals; and often the outcome of collective action depends on those networking organizations [11,14].

Arctic tourism sites are characterized by remoteness, short seasons, limited or absent human population and the dominance of multi-national tourism operators who only visit Arctic locations on a short-term basis [15]. These characteristics provide challenges for collective action [16] as there is a limited monitoring capability and control over the behaviour of individual operators and also impeded coordination of action. Advances in information and communication technology (ICT) lead to rapid changes within the tourism industry, and prior studies indicate that the application of ICT can support the sustainable management of tourism sites [15,17,18].

Although prior studies claim that ICT can support the sustainable management of tourism sites, there is little understanding of the exact functions ICT is to assume in this regard [19,20]. Lupia and Sin (2003) [21] highlight that ICT changes communication dynamics in collective action and thus becomes a means for information flow, monitoring and control. The authors show that ICT advances can either facilitate or hamper collective action and call for more research into the use of ICT in collective action. We contribute to the literature on collective action for sustainable tourism sites by studying ICT as a management tool for such sites. Our guiding research question—how does the use of ICT influence collective action to sustainably manage tourism sites?—can be broken down into two subsidiary questions: (1) How are ICT tools used in managing tourism sites? and (2) How does ICT contribute to the success of collective action? Using the example of Arctic expedition cruise tourism, in this paper we will respond to these questions in Sections 4 and 5.

The case of Arctic expedition cruising was selected as it represents a popular form of tourism in the Arctic. Expedition cruising in the Arctic is mostly nature-based and centred around the unique natural resources in a remote and isolated environment [12]. At the same time, Arctic expedition cruise tourism faces issues related to the tragedy of the commons, as it has an undeniable impact on the environment [6,22–24], just like any other human activity. The cumulative impact from tourism operations in the Arctic reduces the sustainability of the respective tourism sites and may also detract from these sites' appeal. Our paper focuses on the archipelago of Svalbard, one of the most visited expedition cruise tourism destinations in the Arctic. As the majority of tourism sites on Svalbard are unpopulated, the paper focuses on the economic-ecological interaction of the sustainability concept, addressing economic growth and environmental constraints, including environmental quality [10]. Negative externalities, such as pollution from ships, noise, soil degradation from walking and shore degradation from anchoring, are a few of the main impacts arising from cruising tourism in Svalbard [25]. To minimize their impact and organize collective action towards preserving fragile Arctic resources, the cruise industry established a formalized network to address the negative externalities and to sustain the environmental quality of the tourism sites.

Our paper consists of three main areas of focus, each of which contributes to the scholarly literature on Arctic tourism, tourism management and collective action networks. Firstly, we assess how vulnerable Arctic tourism sites can be better managed by acknowledging the role of ICT in achieving certain collective goals through a social informatics lens [26,27]. Drawing on Van Bets et al. (2017) [10], we identify ICT as a crucial tool in sustainable Arctic tourism management, while acknowledging the challenges related to the dependence on any network as well as the unreliability of networks in certain conditions. Secondly, we study how human-technology interactions can result in certain sustainability measures in tourism management by focusing on how ICT acts as an enabler for collective action, provided ICT is embedded in the social capital of the collective action network. By stressing the interactions between ICT and social capital in collective action, we gain a new perspective on understanding collective action towards sustainable resource management in tourism. Thirdly, we argue that ICT represents a new factor in collective action networks, whose roles are shaped by network interactions and the wider system of resources [27].

2. Tourism, Common-Pool Resources and Collective Action

Natural resources used for tourism purposes are often referred to as CPR [8,24]. CPR are non-excludable and accessible to all [28]. The exploitation of CPR by one actor reduces the amount available for others or adversely affects the resource quality [28–30]. Persistent overexploitation of those resources, referred to by Hardin (1968) [31] as the tragedy of the commons, leads to resource degradation and directly impacts resource sustainability [4]. Tourism commons include both natural and artificial, material (tangible) and immaterial (intangible), elements [5], which, in the context of Arctic nature-based tourism, includes landscape and wildlife resources.

Overuse of tourism commons can result in crowding in the short term and in resource degradation in the long term [32]. In the case of nature-based tourism, degradation is not an obvious result of the tragedy of the commons, but acts such as trampling, picking flowers, littering, pollution and other kinds of disturbance can reduce the aesthetics of tourist sites and negatively affect their environmental sustainability [6]. Those issues are often considered by the concept of carrying capacity of a tourism site [33], that highlights that increasing tourism demand may challenge sustainability of both natural resources and local communities at visited locations. Nature-based tourism, such as on Svalbard, depends less on hosting communities, but rather on tourism sites that remain relatively pristine to provide a positive tourist experience [34]. Therefore, ensuring the high quality of tourism sites for nature-based tourism activities requires avoiding and minimizing the negative consequences associated with CPR use, and calls for sustainable management practices.

Effective management of nature-based tourism sites is critical, as the disturbance and depletion of natural resources often results from a lack of control and coordination of use [28,35,36]. Despite the existence of official institutions designated to govern the commons [28], Libecap (2005) [37] notes that it is often too costly to (1) place boundaries around a resource; (2) secure agreements to limit individual actions; or (3) obtain enough information to determine a proper course of action to protect the resource. Therefore, scholars emphasize the importance of community-based management to supplement governmental control and monitoring, such as in coastal fisheries, forests, etc. [30,36]. On the community level, local resource users often come together and collaborate to avoid a tragedy of the commons scenario through collective action networks for decision making, control and management [13].

2.1. Collective Action to Manage Common-Pool Resources

Issues related to CPR management can be viewed as a problem of collective action [38]. Collective action occurs when actors agree on decision making arrangements governing CPR use [39] and can be formally defined as any "action taken by two or more people in pursuit of the same collective good" [40] (p. 4). Actors get a higher payoff if they cooperate than if they act independently [31], and the benefits from participating in collective action are greater than any benefits derived from free riding. Free riding refers to the process of deriving benefits from certain goods or services without paying for them and commonly occurs when goods or services are non-excludable or when external costs, such as for ecosystem services, are not being considered. Free riding is problematic as it can result overconsumption of resources [41]. In the case of expedition cruising in Svalbard, free riding could be expressed by certain operators not participating in collective action through the Association of Arctic Expedition Cruise Operators (AECO) or not contributing to information sharing and would result in a reduced ability and effectiveness to coordinate operator activities. The latter could result in unexpected and un-mitigated additional environmental impacts or conflicts between operators or with local authorities, provided that all actors collaborate [42]. For actors performing collective action, transparency, communication and coordination are especially crucial [16]. As challenges for collective action may lie in communication and coordination between individuals [43], actors often establish formalized networks to pursue such action [16].

Collective action is an integral part of CPR management, and a large body of research has been undertaken on this topic [13,14,38,39,44]. The factors determining the outcome of collective action in sustainable CPR management can be categorized as: (1) resource system characteristics; (2) actor group characteristics; (3) institutional arrangements; and (4) the external environment, such as ICT or state [45]. Collective action theory focuses on exploring the conditions that ensure effective collective action [28,45,46]. Effective collective action is often characterized by (1) involving only a small group of actors; (2) well-defined resource boundaries; (3) well-defined group membership; (4) relatively straightforward monitoring and enforcement; and (5) proximity between the locations of users and resources [45]. These design principles for robust institutions [47] tend to be treated as mandatory elements to ensure the success of collective action.

However, most proposed conditions alone are not sufficient to explain or establish successful collective action, especially as they do not consider the contextual characteristics of the collective action environment [39]. Steins and Edwards (1999) [39] argue that "variables linking collective action and the "external world" are remarkably absent," (p. 543) and argue that we need to approach collective action as the result of interactions between actors and contextual factors which emphasize the uniqueness of each collective action setting. In this study, we explore the extent to which the Arctic natural, social and political environment challenges the success of collective action and look at how actors use new technologies in collective action to overcome some of the environmental challenges associated with operating in the Arctic.

2.2. The Application of ICT in Collective Action

Collective action involves not only people, but also a variety of nonhuman resources, such as ICT, and interactions between actors and nonhuman entities [39]. The scholarly literature increasingly recognizes the contribution of technology, especially ICT, in the shaping of social processes, including those related to collective action. Vargo et al. (2015) [48] conceptualize technology as potentially useful knowledge that may offer solutions for new or existing problems. Technology, in general, includes both software, such as processes and methods, as well as hardware [48]. ICT relates mostly, but not exclusively, to the Internet, databases and communication devices [43].

Despite being a part of many collective efforts, the function of ICT in collective action has not been well understood as yet [21]. ICT changes communication dynamics and thereby has the potential to overcome collective action challenges such as free riding [16] or problems of monitoring and coordination [43]. However, it can also cause problems, for example, by making communication more difficult or increasing the relative benefits of free riding [21]. Ongoing debates on how ICT may change the premises of collective action provide evidence of both the success and failure of ICT use in collective efforts [43,49]. However, to date, we lack data on how ICT influences collective action.

To understand the function of ICT in collective action, social informatics [26,27,50,51], which can be defined as "the interdisciplinary study of the design, uses and consequences of information technologies that takes into account their interaction with institutional and cultural contexts" [52] (p. 688), offers some inspiration. In social informatics, ICT is seen as embedded in complex and dynamic social, cultural, organizational and institutional structures [53,54], and a sociotechnical network concept can be applied to understand the function ICT assumes in the actions of an organization [50,55]. A sociotechnical network is an interactive and interdependent network of co-existing human or organizational agents and technology [50]. ICT is thus socially produced, but can also act as an agent influencing its users by reconstituting social ties and redrawing social boundaries [54].

From a social informatics perspective, technology forms part of the social capital that is embedded in a network of actors performing collective action and can modify the network's structure and functioning. Social capital describes the group relations, norms and practices that drive collective efforts and is a widely recognized concept in collective action theory [13,56,57]. Social capital emphasizes the importance of relations and interactions in coordination and cooperation for achieving mutual benefits [49,58]. Networks, trust and norms are often perceived as the essence of social capital [56,59] and reciprocity and exchanges, common rules, norms, and sanctions, as well as connectedness in networks and groups play an important role too [30]. Through social capital, resource users govern resources and perform collective action. Social capital can help people overcome collective action issues, such as free riding, lack of social mobilization or overuse of resources [60].

ICT interacts with the social capital of a group of actors and, consequently, with the resources used and the specific context of their use. As collective action is an outcome of an interaction between a network of actors and environmental resources [45], ICT can be classified as a new actor in a network, which helps the human actors to embrace the complex and dynamic character of mutual relations between the varied components of collective action.

3. Methods

The relative novelty of the studied topic encourages us to use a single case study design [61,62]. Case study methodology allows for the exploration of a complex phenomenon, such as the relationship between ICT use and sustainable management of tourism sites, within a well-defined situational context [63]. Building on the argument that ICT can change the organisational principles of collective action and that it can, thereby, influence the sustainable management of tourism sites [15,19], a single case study approach enables to explore the use of ICT in ensuring the quality of tourism. It also provides room for personal interactions between the researchers and the participants, while giving study participants the opportunity to describe their views on ICT use and sustainable management of tourism sites within the Arctic context they operate [63]. Given the geographical focus on the polar regions in this special issue, we apply the theory of collective action to a unique, and spatially well-defined, polar tourism case study [62]. Through the participants' stories, we are able to explore contextual factors that are relevant to the topic. Therefore, we applied a so-called "extreme case" selection strategy [64], meaning that we have selected a case that demonstrates unusual characteristics of the phenomenon of interest. Consequently, we focused on Svalbard which is a remote location, based on natural attractions, and that is characterized by a relatively developed polar tourism industry.

The network this paper focuses on is the AECO, which was established in 2003 as an industry initiative to promote and practice sustainable Arctic cruising activities. The main objective of the network is to ensure environmentally friendly and safe cruising operations. Collective action within AECO is evident in its self-regulatory tools, which are agreed on between members and are often stricter than governmental regulations. The network has headquarters with administrative and institutional functions and is mainly financed through member fees. Participation is voluntary but necessitates compliance with the organization's goals and values. By 2015, the network had grown to 48 members from a meagre 13 members in 2009 (AECO Annual Report 2015). AECO members include primarily cruise operators but also other international and local organizations, such as ice management service providers, port agents, consultancies and airlines.

The network provides expertise to tour operators and develops operational guidelines. These guidelines define, for example, the minimum distance to wildlife or expected behaviours by both operators and tourists. The network is especially active in Svalbard, where most operators are members. Here, AECO supports programmes such as *Clean Up Svalbard*—an initiative that engages tourists in cleaning up beaches. One of its main tasks in Svalbard is to manage the use of tourism sites by its members. ICT solutions are increasingly used to facilitate the management of tourism sites.

3.1. Data Collection

Our study triangulates [65,66] insights from document analysis, participant observation and interviews with key actors. The primary data were collected between 2014 and 2016. We participated in AECO's annual conferences and thematic meetings, and had access to their annual reports. Other documents, such as official, published thematic reports and conference proceedings were also used. Throughout the meetings we participated in, we took extensive notes on the wide range of presentations and discussions. Applying an ethnographic approach to participant observation, we also duly recorded our personal reflections on the interactions observed.

Moreover, guided by snowball sampling, twelve in-depth interviews (see Table 1) were conducted with ten different network actors, of which five were held in English, six in Norwegian and one in Polish. In interviews lasting between 30 and 131 min, research participants were asked about the management of tourism sites and organization of cruise experience products in Svalbard. The interviews were semi-structured, and we followed a rough interview guide to ensure that a core set of themes and topics were covered in a comparable manner with similar open-ended questions. We then flexibly followed up on certain answers with additional non-scripted questions. This approach allows for significant flexibility in following interesting lines of thought and gave us an opportunity to explore the participants' views in depth, while ensuring that our key questions and topics were covered in each interview [67]. The interviews were recorded and transcribed verbatim, with the transcripts being viewed and approved by the research participants.

The transcripts of the interviews, annual reports and other documents form the network, and the notes from the observation and participation were loaded into NVivo 10 Software (a qualitative data-analysis software, QSR International's, Melbourne, Australia), which functions as a database and facilitates data analysis.

Table 1. Overview of research participants.

Actors	Research Participant	Interview Number
Network secretary 1	1	1 & 2
Network secretary 2	2	3
Product developer 1	3	4
Product developer 2	4	5
Operation manager 1	5	6
Captain 1	6	7 & 8
Captain 2	7	9
Captain 3	8	10
Expedition leader 1	9	11
Expedition leader 2	10	12

3.2. Data Analysis

The data were systematically analysed and iteratively coded jointly by the first two authors following the three coding stages described by Gioia et al. (2013) [68] using QSR NVivo 10, which supports "open" coding and "nested sub" coding [69]. This approach is a hybrid process of inductive data-driven coding and deductive theory-driven thematic analysis to interpret the raw data.

At the first stage, we undertook an initial inductive open coding of the raw data starting without any given coding scheme. New codes were added to NVivo as new elements appeared in the raw data. We compared and discussed the codes, our approach to coding, finding agreement on all codes, while searching for commonalities to group similar codes by adding a new overarching code and grouping the existing codes as "nested sub" codes. The process of grouping and connecting codes was interactive, and through several rounds of discussion and reorganization of the codes in NVivo, common themes and patterns in the data were discovered. Overall, the first step of our inductive data analysis resulted in 26 first-order concepts.

We then used a structural coding approach to identify second-order themes. These second-order themes were developed deductively based on theory from literature on collective action, social informatics and sustainable tourism while drawing on the empirical first-order concepts [70]. At this stage, separate themes were identified, based on the wider scholarly literature relating to our research questions. Seven second-order themes were identified that way.

Finally, further categorisation of second-order themes resulted in the identification of three aggregated dimensions [68] of ICT use in tourism site management, namely increasing noticeability of individual actions, creating artificial proximity and building new management practices.

This study employed the criteria of coding reliability, credibility and confirmability to ensure trustworthiness [65]. Following Campbell (2013) [71], we used an approach involving negotiated agreement to address issues of coding reliability related to the second-order themes and aggregated dimensions. In case of non-agreement, we searched for common themes in the literature to define the codes in a way where they were mutually exclusive, which ultimately enhanced our common understanding of the themes. We achieved credibility through the aforementioned triangulation of methods, which was further enhanced by interviewing actors with different positions in the network. To ensure confirmability related to non-matching patterns and research bias, we followed Gioia et al.'s (2013) [68] analytical approach by combining inductive open coding and structural coding that draws on published research findings. Additionally, the third and most experienced author critically assessed the themes and underlying codes developed by the first two authors to ensure confirmability.

4. Expedition Cruising in Svalbard and the Application of ICT

Svalbard is an archipelago located within 71–81° Northern Latitude and 10–35° Eastern Longitude, approximately midway between the North Cape of Norway and the North Pole. The archipelago consists of islands of a total area of approximately 61,022 km^2. Around 65% of Svalbard's terrestrial area and about 86% of its territorial waters is under environmental protection [72], because of the archipelago's rich and diverse wildlife which includes various bird colonies as well as mammals such as reindeer, the Arctic fox, polar bears, walrus, seals and whales. At the same time, Svalbard is one of the most northern populated places on earth with a population of around 2500 inhabitants across the capital of Longyearbyen, the Russian mining settlements of Pyramiden and Barensburg, and the research community of Ny-Ålesund [73].

The relative accessibility and developed infrastructure in Svalbard, as well as its abundant wildlife and stunning landscape, make the archipelago appealing for cruising activities [74]. Expedition cruises search for solitude and avoid other ships to ensure a unique Arctic experience in Svalbard. The number of expedition cruise passengers visiting Svalbard increased from 3417 in 2001 to 12,519 in 2014 [75], with Svalbard's visitors exceeding those in neighbouring Greenland, Canada or Russia [74]. However, sailing in such remote areas is challenging due to often rapidly changing or unexpected weather and sea ice conditions.

Tourism and maritime operations are regulated under the umbrella of the Svalbard multi-jurisdictional legal framework, consisting of the Svalbard Treaty, the Svalbard Environmental Act, international and state regulations, as well as the general regulatory framework of shipping, particularly for operations in polar waters [76]. Considering the nature of expedition cruising and its particular operating environment, the complex multi-jurisdictional framework is regarded as being inadequate and insufficient as a governance tool, as it lacks sector-specific elements [12].

In addition to governmental regulation, tourism management in Svalbard is supplemented by AECO self-regulation, e.g., through operational guidelines and a range of tailored technologies to facilitate the pursuit of the network's goals, such as dealing with crowding and environmental degradation.

4.1. ICT Tools Developed by AECO to Perform Collective Action

AECO makes use of two key ICT solutions in support of tourism management, a cruise database and a vessel tracking system, both of which are discussed in greater detail in the following sections. The cruise database features three tools, one for the booking of landing sites, another one to lodge a cruise itinerary, and a third one to upload and manage post visit reports. The vessel tracking system allows for real-time localization and tracking of the expedition cruise vessels of all the network members with a maximum delay of 15 min.

Publicly available ICT, such as an automatic identification system (AIS) for vessel tracking or very high frequencies (VHF) for maritime communication with vessels, supports AECO's in-house ICT management tools. AIS and VHF play crucial roles in terms of ensuring the safety of operations at sea. ICT technologies are constantly evolving to better fit challenging Arctic environment but prior studies as well as research participants note the limitations of ICT use in the Arctic [10,68] due to bandwidth issues and the availability of certain technologies. For instance, research participant 1 stresses that *"some operators have good iridium satellite connections and some do not. And these limitations are real constraints in regard to safety but also communication in regard to other things. So, this area is very important."* Improving communication technologies, such as satellite phones, will enhance communication between vessels. While we acknowledge the importance of ICT in support of safety, which has been the focus of previous research [77], our paper concentrates on AECO's in-house ICT management tools and their use in collective action to address risks associated with environmental degradation and crowding.

4.1.1. The AECO Cruise Database

The AECO cruise database assists in managing tourism visitation to specific sites and, as such, supports the minimization of environmental degradation and crowding. ICT supports planning as well as cruise operation and monitoring. Initially, the cruise database was an Excel spreadsheet for the collection of information on planned operations. In 2009, AECO had an online cruise database custom-built by an information technology (IT) company. However, this tailor-made ICT tool has been criticized as being *"static with very limited areas of use"* (AECO Annual Report 2011/2012). In 2013, an improved cruise database was developed, which better suits AECO's administrative needs and which has been in use ever since.

One of the main purposes of the cruise database is the booking of landing sites (research participant 1). The booking system requires members to register their cruise itineraries before the season starts and book landing sites in advance. The cruise itineraries, or sailing plans, consist of information about where, when and for how long a vessel will visit predefined landing sites. The system ensures that only a limited number of landings can be booked for a specific site and that the operator who booked the landing site will have sole use of the site for a specified period of time, which has environmental benefits in terms of a site's carrying capacity as has been emphasized by research participant 9. Of course, the aspect of being the only operator at any specific landing site is also attractive from a marketing perspective (see also research participant 9, and AECO Annual Report 2014). Figure 1 shows the frequency of bookings for 212 sites (out of a total of 300 sites) by AECO operators in Svalbard.

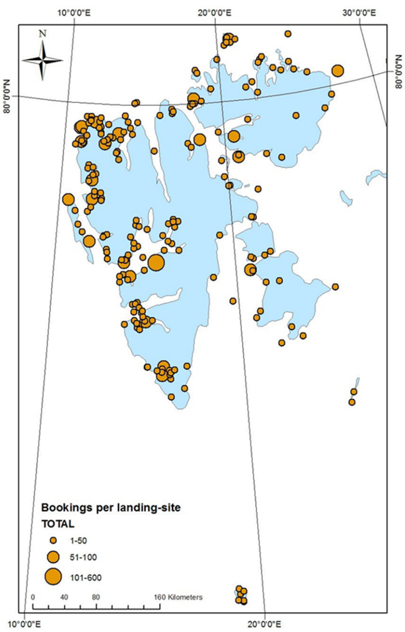

Figure 1. Expedition cruising landing sites in Svalbard 2013–2015. Source: own illustration based on Association of Arctic Expedition Cruise Operators (AECO) data (base map: TM World Borders).

During a pre-defined timeframe, interested AECO members log on to the online system and book landing sites, which they want to visit as a part of a registered sailing plan. The system is open for around three months but there is some degree of competition for the "best" landing sites as research participant 9 noted, *"I need to have all plan in my head (sic), because there are 5 others, who sit and write at the same time. So, this is my decision. If I will be doing this too slow, I may completely lose the spots."* All AECO members have access to this system and can see each other's itineraries. That way, they also know who else will be in the area and who they can contact for assistance or if ad hoc changes have to be made to the expedition itinerary.

However, the system is not yet integrated into the Governor of Svalbard reporting schemes and currently serves only AECO's collective purposes, which is somewhat problematic as research participant 2 nicely outlined:

> *"We do not have all (cruise operators) in the portfolio. Not everyone is an (AECO) member. There are cruise operators that do not register their activities in the (AECO) database and therefore, we do not have a complete overview of cruise activities in the Arctic" (translated from Norwegian).*

On any given cruise, adverse weather conditions, such as storms, high waves, sea ice or fog, or wildlife migrations, can pose challenges for the execution of the initial itineraries. Therefore, during a cruise, vessel captains and expedition leaders rely on direct communication with other vessels if they wish to change their landing sites or choose more attractive landings. Informal communication between expedition leaders and captains at sea facilitates smooth transitions between planned and actual itineraries and is considered as hugely important in providing a true cruising experience. It depends on whether *"you know other expedition leader, how well do you know each other and then you can say—hey, come on, let's come one hour later, but if it is somebody new, sometimes they do not negotiate with you. And that is a problem. So, the longer you are in the business and the more people of course you know, the easier it is to solve those problems"* (research participant 10). With good communication, vessels at sea can inform each other about current conditions, notable wildlife sightings, or the activities of non-AECO vessels operating in the area. For instance, during the 2011 sailing season, a dead whale on a beach attracted many bears to the area. This information was quickly shared between operators via satellite communication, and many ships visited the area as a result. At the same time, network members organically agreed on a new rule that increased the minimum distance to the bears in the area to minimize adverse environmental impacts through overuse.

4.1.2. AECO's Vessel Tracking System

AECO developed its own vessel tracking system. The system is based on vessel tracking technologies AIS and VTS, and it involves satellite-based surveillance. Based on the information received through AIS or VTS, depending on which of the technologies an operator uses, cruise operators can access information about other operators in the area, including the operators' names, positions, courses and speeds. The vessel tracking adds to the safety management system, but also ensures real-time monitoring of operations.

Additionally, AECO vessel tracking supports communication between the operators at sea. For example, in case of any planned changes to the sailing plan, AECO members are obliged to contact nearby expedition vessels to discuss changes of their initial plans if necessary. Following these procedures helps to reduce uncertainty and the surprise factor related to external changes while supporting the sustainable management of tourism sites. The value of AECO's vessel tracking system has also been highlighted by research participant 1:

> *"By knowing within 15 min where all the other ships are, we can work towards better planning, greater safety, and the avoidance of eventual conflicts at landing sites."*

5. Results: The Roles of ICT in Collective Action

Our data suggests that ICT can be employed as a management tool which has the potential of playing an important role in the sustainable management of tourism. In particular, our analysis reveals three distinct roles ICT assumes in collective action, (a) building new management practices; (b) increasing noticeability of individual actions; and (c) creating artificial proximity. Drawing on collective action theory and social informatics, we suggest that the use of ICT tools influences the success of sustainable tourism management by facilitating collective action to adjust norms and practices with a focus on sustainability, reduce incentives for free riding and surpass external challenges related to, e.g., the location of sites, weather or the presence of other actors. Figure 2 summarizes these findings.

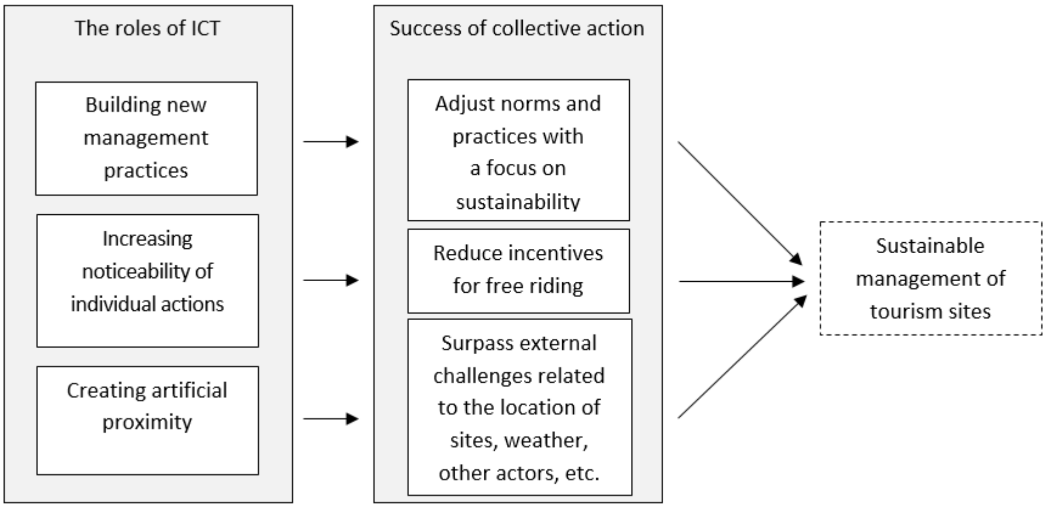

Figure 2. The roles of information and communication technology (ICT) in collective action.

The roles played by ICT in a collective-action context (see Figure 2) are undeniably linked, but for the purposes of clarity in our discussion, we address each of these roles separately in this section. The figures we developed to summarize our findings include, on the left a description of the specific role of ICT in tourism management (in response to our sub-question 1, and on the right an assessment on how ICT contributes to the success of collective action (i.e., our sub-question 2). Our exploration of the roles of ICT (i.e., sub-question 1) follows Gioia et al.'s (2013) [68] approach using first-order concepts, second-order themes and subsequent groupings referred to as "aggregated dimensions".

5.1. Building New Management Practices

The combination of real-time vessel tracking and the utilization of a cruise database builds new sustainable management practices through the sharing of strategic and operational information and flexible management practices (see Figure 3). Shared information enables the coordination of activities on tourism sites and ensures an activity level at, or even below, the predefined carrying capacity of the individual landing sites. New practices are developed as a result of the use of ICT, for example, the booking of landing sites and sharing the information with other AECO members, who often are competitors. Moreover, the use of ICT enables in situ interaction and communication between operators, which enables new practices of managing tourism sites that reduce uncertainty. An example are ad hoc changes to the initial cruise itineraries, which are common because, as research participant 2 explains,

> *"Changes can happen due to different reasons. Ice can be one reason. Another reason can be that the expedition leader can get tired of traveling to this place and finds out that they can visit another* site. *It can be that easy. But according to the agreement between [AECO] members, one shall take*

into consideration the plans of other operators. If they change the plans, they first have to check the cruise database that no one else has booked the place. And then they need to make contact or send a message to those that are close by" (translated from Norwegian).

The Role of ICT

Success of collective action

First-order concepts	**Second-order themes**	**Aggregated dimension**
- obligatory booking of landing sites and lodging itineraries in advance - making itineraries available to other AECO operators - collecting information and making it available to all the members	Sharing strategic and operational information	**Building new management practices**
- itineraries and bookings are subject to change due to harsh conditions - landings at sites not booked online - swapping landing sites with other operators - *ad hoc* information exchange on the quality of sites	Flexible management practices	

Adjust norms and practices with a focus on sustainability

Figure 3. Building new management practices.

New management practices related to ICT use are developed through the utilization of social capital. AECO possesses high levels of social capital, evidenced by close ties and frequent communication between members, the willingness to cooperate and shared norms. Social relationships within AECO were especially crucial in adopting and using ICT. High levels of social capital allow a network to apply ICT tools more easily and to adjust its norms accordingly. At the same time, technology reshapes social capital as ICT use forces the modification of existing normative structures. Those norms are comprised of internal regulations, such as obligations for using ICT systems and other common routines, which are socially agreed upon and accepted in the network. New norms had been created in the studied network resulting in certain practices, in particular to ensure flexibility in response to the dynamic Arctic conditions, to maintain activity levels that do not exceed the carrying capacity of individual sites, and to increase the quality of expedition tourism products. ICT facilitates the establishment and adoption of new norms and allows network members to adjust them to changing conditions by easier and faster communication, information exchange, and access to data.

However, ICT can also negatively affect collective action as it is not always reliable in harsh Arctic conditions. The network facilitates operational flexibility, provided formal and informal communication work efficiently and effectively. Using ICT elsewhere and relying on it during Arctic operations may also create complacency with regard to a lack of back-up plans if ICT fails or raise the level of expectation among operators that it will always be available. If limited bandwidth or adverse environmental conditions cause ICT to be unavailable, the network's reliance on ICT may hamper its collective actions.

5.2. *Increasing Noticeability of Individual Actions*

ICT also plays a role in relation to free riding, which is a common problem of collective action [21] and represents individual behaviours not complying with commonly established norms [28].

If opportunities for free riding exist, at least some of the actors will be tempted to utilize them and pursue individual benefits while not contributing to the collective efforts [16,28]. Opportunities for free riding decrease as information asymmetries are reduced, i.e., as transparency of actions taken by individual network members increases. In AECO, such increased noticeability is enabled by ICT, most notably through the monitoring of cruise traffic, the evaluation of impacts, and awareness about other operators' itineraries (see Figure 4). The noticeability of individual network members' actions is increased through real-time monitoring of cruise vessels, and it is possible to report those who do not comply with existing rules, e.g., by accessing restricted areas.

The Role of ICT

Success of collective action:

First-order concepts	**Second-order themes**	**Aggregated dimension**
- real-time monitoring of operations - seeing who accesses restricted areas - *in situ* and real-time communication	Monitoring of cruise traffic	
- gathering statistical data - local site-related information - information about operators' actions - collecting data on potential impacts on the environment	Impact evaluation	**Increasing noticeability of individual actions**
- knowing where other ships are - knowing ships in vicinity - sharing space with other ships - *ad hoc* changes	Transparency of itineraries	

Lower incentives for free riding

Figure 4. Increasing noticeability of individual actions.

Increased noticeability enables a network to assess to what extent their norms, as well as governmental regulations, are complied with, which makes free riding less attractive, provided unwanted behaviours can be sanctioned either explicitly or implicitly. Increased noticeability also builds a knowledge base about the individual actions, which can assist in decision-making, e.g., with regard to adjusting existing visitation limits or developing new visitation guidelines. Conversely, increased transparency about cruise itineraries may potentially increase opportunities for free riding as it enables operators to see which landing sites are unutilized at what times and could be accessed without anyone else noticing. Thus, social capital plays a crucial role in terms of creating relationships of trust and peer pressure which can help ensuring that norms are followed.

Further, effective monitoring of cruising activities requires the network to be comprehensive and all resource users to be involved. Challenges arise if one or more resource users are not the part of the network, which is an issue that is also lamented by AECO members: *"I see a problem, though, with people, big ships, that are not member of AECO. They still can do the same as we, but they don't pay anything and they don't have to keep to the rules of AECO"* (research participant 4). Currently, the monitoring of tourism sites in Svalbard only relates to network members and ignores the actions of other resource users. Similarly, social control is limited to the network members, as there is no obligation for external actors to comply with the network's norms.

5.3. Creating Artificial Proximity

ICT builds artificial proximity among a set of spatially dispersed actors in a remote location [78], which strengthens not only informal relations between actors but also the actors' connections to the location. Through artificial proximity, distances between the actors themselves, as well as between the actors and the location are reduced (see Figure 5). Informal contacts and arrangements are a part of network functioning, and the utilization of ICT can create informal proximity.

The Role of ICT

First-order concepts	**Second-order themes**	**Aggregated dimension**
- linking distant actors - knowing each other personally - informal arrangements - informing each other on updated conditions - arranging operations before season	Enhancing informal relations	**Creating artificial proximity**
- management from distance through online systems - no physical presence needed to perform monitoring and control - shortening time of communication	Strengthening links with the location	

Success of collective action:

Surpassing external challenges

Figure 5. Creating artificial proximity.

Our findings suggest that network actors can participate in collective action in a location different from where they reside by relying on ICT providing them with up-to-date knowledge about an area and its use. Imposing obligations on network actors to provide data, e.g., submitting their itineraries, not only assigns responsibilities to actors but emphasizes their resource use impact and offers opportunities for electronic monitoring using online resources, e.g., via the vessel tracking system.

AECO network actors are from different parts of the world and operate in Svalbard on a temporary basis, i.e., they usually only spend a few weeks or months each year in the area. Real-time communication facilitated through ICT gives the network actors greater flexibility and swiftness in decision-making, increasing the network's efficiency. In addition, as we highlighted above, the artificial proximity created by ICT supports the formation of stronger relationships between actors, which are a crucial aspect of collective action.

6. Concluding Discussion

Our results show that ICT facilitates collective action by building new management practices, increasing the noticeability of individual actions, and creating artificial proximity between actors in a network. The effective use of ICT has the potential to increase the success of collective action towards sustainable tourism management, especially by offering a way to overcome challenges related to operating in remote locations. However, while the use of ICT can add to the social capital within a network and consequently contribute to the success of collective action [55], social capital goes beyond ICT and is also defined by the relationships between network actors, trust, transparency, interdependence and existing normative systems. Actors can utilize ICT to reshape the relationships within a network, which will have a bearing on their performance [48,79] as well as the efficacy of collective action by the network.

ICT has the potential to reduce free riding and to better coordinate and monitor the actions of culturally and spatially diverse actor networks [21]. By creating artificial proximity and additional avenues for monitoring, ICT can help to overcome challenges in collective action that are common in larger groups. Our study confirms that large and spatially dispersed actor networks are in a position to successfully manage natural resources provided individual actors share the same goals and collective action is possible. Geographical boundaries can be overcome by the use of ICT [45].

Our research has also shown that, in some cases, it is prudent to consider not only the impact and collective action of local residents but also those of external resource users in sustainable tourism management [19]. However, in line with Lupia and Sin (2003) [21], we argue that ICT itself is not sufficient to reduce free riding or increase proximity as actors need to learn how to properly use the respective ICT. We recognize the role of building appropriate management practices drawing on a network's social capital as a necessary element in ensuring the success of ICT use in collective action.

Our work has expanded an ongoing debate on ICT in collective action by highlighting the importance of ICT in addressing challenges related to networks operating in remote locations. In particular, in dynamic polar environments such as Svalbard, AECO uses ICT to overcome location-related constraints to collective action, including issues arising from a tourism site's remoteness, challenging operational conditions, a lack of governmental oversight and monitoring of the activities of individual operators, or the temporary nature of Arctic tourism operations. Overall, the success of collective efforts becomes partly dependent on ICT, with the effectiveness of ICT use being built on the interaction between resource users and the wider environment [45].

The research presented in this paper has implications for the development of practices and policy in a broader context that goes beyond the tourism network. Adopting ICT solutions that are tailored to specific networks and give privileged access to network members excludes other actors from participating in collective action, whilst not restricting their access to common-pool resources. This, in turn, means that the most successful collective action to manage common-pool resources may still result in resource degradation or depletion, if actors operating outside established collective action networks cannot be not excluded from resource use [80] or at least required, e.g., by governmental mandates, to operate in accordance with the rules established by the collective action network. Alternatively, non-member operators could be encouraged to join a network, but this traditionally only works if they already share similar values and backgrounds with an existing network's members, which in turn increases network homogeneity [81]. The latter can also be strengthened by creating dependence on network-specific technologies. However, as Poteete and Ostrom (2004) [35] argue, a certain level of heterogeneity is beneficial for collective action, which would imply that collective action could benefit from making ICT systems available for all users of common-pool resources. On the other hand, access to technologies is an incentive for joining the network and accepting its sustainability goals. Hence, an externally imposed obligation to be a member of AECO to operate commercial cruise tourism in Svalbard could be beneficial for collective action.

ICT creates internal dependence within a network while contributing to its external independence. Currently, AECO's ICT systems are not fully integrated with Svalbard's governmental tourism management systems, and operators have to report through different systems at the same time. This creates confusion among operators and results in trade-offs being made between investing time and resources in reporting on activities and undertaking the actual tourism activities themselves [15]. By providing alternative tools to those introduced by governmental authorities, AECO, as a network of resource users, partially takes over responsibilities of tourism governance and in-situ management [28] and may even be more effective than the government in managing tourism sites. In our case, the introduction of ICT in support of collective action blurs the boundary between the public and private realm [43] by enabling non-governmental organizations, at least partially, to replace government functions with self-regulation.

As we have shown, in the context of Arctic tourism ICT can contribute to the success of collective action by adjusting norms to sustainability goals, decreasing incentives for free riding, creating artificial proximity between geographically dispersed actors, and overcoming some of the challenges of operating in remote places. However, we stress that, while technology is an asset in collective action, it does not automatically guarantee its success. ICT has limitations, e.g., in relation to its versatility, its structural rigidity or the users' ICT capabilities, and a broader suite of social capital is needed to effectively use ICT in collective action.

Besides, many Arctic locations are sparsely populated, but attract economic interest, not only from tourism, but also, e.g., fishing or oil and gas industry. ICT helps to better monitor changes in Arctic environment and enables on-going responses to the observed pressures. In locations far from human settlements, industry monitoring is often the only way to follow environmental changes caused by human activities.

Our study is subject to a number of limitations. Firstly, by taking a case-study approach, our results cannot be easily generalized and are to be viewed within a Svalbard context. More research with different geographical foci is needed to develop a broader, and more generalizable, understanding of the role of ICT in collective action in Arctic tourism operations. Secondly, as the approach we used to study the role of ICT in collective action in tourism is novel, further work is needed before we can conceptualize the role of ICT in relation to the social capital of tourism networks. While ICT is nowadays widely used by the tourism industry, including in the management of nature-based tourism sites, we still only have limited understanding of its roles and impact, which we explored in this study through a social capital lens.

A message that clearly emerges from our research is that ICT has a role to play in sustainable tourism management, especially in remote Arctic environments. Collaborative efforts by the tourism industry and government authorities, both with the support of ICT, could successfully minimize crowding in Arctic tourism destinations. However, with potentially more and more actors operating in the Arctic, within or outside AECO, a fine balance needs to be struck between the quantity and quality of touristic visits as an increasing number of operators may detract from the core ideal of nature-based tourism, which is essentially low-volume and high-value [34].

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