



Selecting sustainable alternatives for cruise ships in Venice using multi-criteria decision analysis



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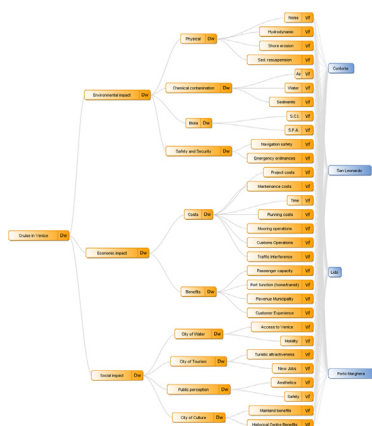
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HIGHLIGHTS

- Alternative routes were compared for cruise ships passing the Venice historical center.
- Multi-criteria decision analysis (MCDA) facilitated route alternatives comparison.
- Decerns software supported the development of the Venice MCDA model.
- Local experts were involved selecting and weighting sustainability criteria.
- Results represent complex influences in the current decision process.

GRAPHICAL ABSTRACT



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ABSTRACT

The rapid growth of cruise ship tourism increases the use of historic port cities as strategic hubs for cruise ship operators. Benefits derived from increased tourism for the municipality and cruise ships are often at odds with the environmental and social impacts associated with continued historical port use. This study illustrates the use of Multi-Criteria Decision Analysis (MCDA) for weighing of various criteria and metrics related to the environment, economy, and social sustainability for the selection of a sustainable cruise line route. Specifically, MCDA methodology was employed in Venice, Italy to illustrate its application. First, the four most representative navigational route projects among those presented to local authorities were assessed based on social, economic, and environmental considerations. Second, a pool of experts representing the local authority, private port businesses, and cruise line industry were consulted to evaluate the validity and weight assignments for the selected criteria. Finally, a sensitivity analysis was employed to assess the robustness of the recommendations using an evaluation of weight changes and their effects on the ranking of alternative navigational routes. The results were presented and discussed in a multi-stakeholder meeting to further the route selection process.

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1. Introduction

The cruise industry has steadily developed to become one of the fastest growing segments of the travel industry worldwide with a steady increase from 500,000 annual visitors in 1970 to more than 24 million in 2016 (Murphy, 2013; CLIA, 2016a). The rapid expansion of tourism in markets such as Europe and Asia, and stability of the North American market, has led to an increased number of cruise ship operations with positive economic impact in the billions of dollars (CLIA, 2016b).

The tremendous growth in cruise tourism has triggered a variety of concerns related to the environment, economic benefits, social climate and cultural integrity of cruise destinations, particularly in port cities whose rich cultural heritage have made them strategic destinations for cruise line operators (Adams, 2017; London and Lohmann, 2014; Klein, 2011; Brida and Zapata, 2010; Hritz and Cecil, 2008; Klein, 2007; Johnson, 2002; Marsh, 2012; Ritter and Schafer, 1998; Rodrigue and Notteboom, 2013). From an economic perspective, the use of historical ports as a home base for cruise liners has led to positive growth in the tourism sector. Cruise lines positively affect employment statistics due to needs related to passenger services, fuel, provisions, customs inspections, and tugboat pilotage (Rodrigue and Notteboom, 2013). Passengers also have the option to spend additional time in the city centre, leading to increased usage of hotels, restaurants, public transportation, and local attractions. From the perspective of cruise lines, business is constrained by the size and development of existing infrastructure and regulations implemented to preserve historic importance and environmental sensitivity. The growth of environmental awareness and increased threat potential, especially after the 2012 Costa Concordia disaster (Manera, 2012; Zicchiero, 2012), has increased research efforts related to the impacts of cruise ships on the local population and the environmental and historical heritage of port cities (Brida and Zapata, 2010; Marsh, 2012; Carić and Mackelworth, 2014).

This paper discusses the concerns related to one historical port city and shows the benefit of using a decision analytic tool referred to as multi-criteria decision analysis (MCDA) to balance the risks and benefits of alternative navigational routes. In particular, this paper considers the problem of cruise ships navigating into the historical centre of Venice, a system made complex due to the interactions among a high number of diverse stakeholders. The MCDA tool is useful in this case study because it has been developed specifically to assess highly uncertain, complex alternative scenarios through the use of a systematic and flexible methodology that incorporates multiple sources of information, as well as stakeholders' views, to compare decision alternatives (Figueira et al., 2005; Huang et al., 2011).

MCDA has previously been applied to address challenges in the tourism sector related to tourism sustainability modelling (Shcherbina and Shembeleva, 2010), climate change impacts on tourism management (Michailidou et al., 2016), measurement of competitiveness among tourism destinations (Botti and Peypoch, 2013), as well as selection of suitable sites for ecotourism development (Gigović et al., 2016). Further, MCDA methodologies have previously been applied within the context of Venice to consider alternative reuses of its historical buildings (Ferretti et al., 2014), as well as alternative uses of an offshore port outside the Lagoon (Libardo and Parolin, 2012). Finally, MCDA enables decision-makers to structure the problem within the context of sustainability, evaluating environmental, economic and social impacts of each proposed alternative.

This paper extends the application of the MCDA methodology to the context of cruise ships in Venice and uses MCDA as a tool to guide and support decision-making, highlight trade-offs between the three pillars of sustainability, and facilitate a dialogue between stakeholders, eliciting common dialogue as well as differences of opinion and leading to a consequent improvement of transparency and acceptance of the strategic decisions.

1.1. Case study: the port of Venice

The port of Venice in Italy is a clear example where all concerns related to the economy, environment, and social climate are present and where measures need to be taken to enhance sustainable development of the cruise industry. For over a millennium, Venice has sought to develop and maintain its status as a port city (Madricardo and Donnici, 2014). This status has only been enhanced with the advent of mass tourism, where the historical, cultural and environmental heritage of Venice has become accessible to an increasing number of visitors each year. Tourism in Venice comes in many forms, with cruise ships serving as a means of transportation into and out of the city.

Currently, the historical setting, location and accessibility via water from the Adriatic Sea make the port of Venice the second most commonly used cruise port in Italy, and the fourth in Europe (CLIA, 2016a, 2016b). Venice also leads in number of docks made in port cities along the Mediterranean, with more than 500 cruise ships arriving in Venice and carrying more than 1.5 million passengers each year (VTP, 2016). Nationally, local business generates a total of € 436.6 million in the form of expenditure by passengers, companies and crews each year. Of this national total, € 283.6 million is spent in Venice and its territory compared to € 153 million spent throughout the remainder of Italy (CLIA, 2017). Ships arriving in Venice also generate up to €170 million for related sectors such as passenger and hospitality services (Dosi et al., 2013). Further, the cruise industry employs nearly 4300 people and provides business opportunities for more than 200 companies in and around Venice.

Despite the benefits of the cruise ship industry to the Venice local economy, multiple stakeholders, laws, and regulations (Dosi et al., 2013; Tattara, 2013) have called for changes in the navigational route of cruise ships, which currently pass through the historical centre and ecologically sensitive areas of Venice (UNESCO, 2012; Casagrande, 2015). A vigorous debate burst onto the public stage after the tragic accident of the Costa Concordia in front of the Isola del Giglio in January 2012. The concerns about the possibility of a similar event happening in the waters of the lagoon of Venice brought to the emanation of the "Clini-Passera" Decree: Inter-ministry Decree n° 79 in March 2012. The decree is an administrative act that imposes a ban on the use of the St. Mark Channel and of the Giudecca Channel for vessels over 40,000 tons (Art. 2). However, in the same decree the ban is temporarily halted until an alternative safe navigation route is made available (Art. 3). Further pressures have arisen also from international organizations. The United Nations Educational, Scientific and Cultural Organization (UNESCO), an organization involved in the establishment of educational, scientific, and cultural reforms, has put pressure on the Italian government to avoid the placement of Venice on the list of World Heritage in Danger sites through implementation of preventative measures by the end of 2017 (UNESCO, 2016). While several alternative navigational routes and terminal locations have been proposed, none have yet been implemented because of the level of controversy revolving around each route, as well as the difficult endeavour of appropriately weighing the trade-offs between economic benefits, environmental impacts, and social discontent for each route. On November 2017, the Interministerial Committee for the direction, coordination and control of the Venice Lagoon (the so-called "Comitatone") declared that a shared decision on the alternative solution had been reached: the largest ships weighing 100,000 t or more will not navigate the St. Mark Channel and the Giudecca Channel, but instead will take a different route (the main industrial and commercial channel "Canale dei Petroli") to the industrial port of Marghera, far from the historical centre of the city (Ministry of Infrastructure and Transport, 2018). Since then, however, no official document has been published, leaving the situation substantially unchanged (Marcon, 2018). Finally, the Ministry of the Environment's rejection of the new morphological and environmental plan of the Venice lagoon in March 2018 is an additional hurdle contributing to the persistent status of uncertainty that surrounds the future of

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