

Developing a Comprehensive Proposal for Tourism Management in Venice



By
Joseph Crognale,
Ari Elfenbein,
Justin Korn,
Benjamin Mart

Fabio Carrera, Advisor
Peter Hansen, Advisor

December 15, 2017

VE17-WISE <https://sites.google.com/site/venice17wise/>

This report represents the work of WPI undergraduate students submitted to the faculty as evidence of completion of a degree requirement. WPI routinely publishes these reports on its website without editorial or peer review. For more information about the projects program at WPI, please see <http://www.wpi.edu/academics/ugradstudies/project-learning.html>

Abstract

We developed a comprehensive proposal for tourism management in Venice using our analysis of existing proposals. We observed how people navigated the city, the state of signage, and tour group sizes. Using this data, we determined steps Venice could take immediately to improve public safety and city signage. Our proposal then introduces a phased implementation of short-, medium-, and long-term tourism management interventions in Venice to enhance the quality of life for residents and commuters and the experience for tourists.

Executive Summary

The increase in global tourism has brought more tourists than ever to Venice. Over 20 million people visit the city annually, overwhelming the 55,000 residents. The sheer number of tourists impedes resident mobility and degrades their quality-of-life. The quantity of people in the small city streets, bridges, and squares creates unsafe conditions and necessitates that a comprehensive tourism management plan be implemented as soon as possible. Several plans for limiting and managing the flow of tourists have been proposed, though none have been implemented by the city.

We analyzed past proposals and identified individual tourism management interventions in order to develop our own proposal for tourism management while contributing information towards individual interventions. We observed how people navigated the city, the state of city signage, and tour group size to determine steps the city could take improve public safety **immediately**, as well as additional steps in the **short-, medium-, and long-term to improve tourism management**. We conducted cost analyses and created visualizations to show how each step could be implemented. Ultimately, our tourism management proposal represents a sustainable and comprehensive approach which could be implemented in phases and improve the safety and quality of life in Venice.

We analyzed three distinct tourism management proposals (Pass4Venice, the San Marco Pass, and ZTL Revolution), as well as the broad Venice Project Center proposal, as a starting point in developing our own proposal. After extracting the relevant information from each proposal, we supplemented our understanding by meeting with the main proponents of each one. We used these interviews to learn about smaller details and variations of each plan's proposed implementation. With this information, we created a detailed resource of possible tourism management interventions. We then combined these interventions into a comprehensive proposal that addressed both short-term and long-term concerns. Our proposal follows a sequential approach that consists of **immediate** and **short term enhancements**, followed by **medium- and long-term tourism management interventions**.

Immediate Enhancements to Current Systems in Venice

Immediate enhancements are actions the city government could and should take as soon as possible, in part because of their feasibility and pressing nature. They include:

1. Supplementing Venice's **emergency** notification system so that it can better help non-residents, and improving communication with the public via a proposed mobile application and accompanying website.
2. Issuing regulations that limit the size of **tour groups** in Venice to no more than 20 people traveling together.
3. Conducting a study to determine how best to **improve city signage**, and then improving it (including the type, information displayed, style, and placement of signs).

Emergency Management: The most pressing concern for the city is the unsafe situation caused by mass tourism, which we addressed by developing potential improvements to Venice’s emergency plan. The current emergency communication system employed by Venice — using radio and TV broadcasts — might work well for residents but would not reach tourists directly. To give the city government a direct line of communication to everyone with a smartphone and taking inspiration from the apps and systems used by other governments, we proposed supplementing Venice’s current systems via a mobile emergency notification platform and accompanying website.

Limit Group Sizes:

Streets in Venice are frequently congested or blocked by large and slow-moving tour groups. We gathered information on the number of people in tour groups in St. Mark’s Square, one of the most popular tourist attractions in Venice, at peak hours. Even at the start of the off-season, tour groups comprised 24 people on average, but several tour groups with over 40 people were noted. Thus, we suggest the city pass regulations restricting tour companies from booking tours in groups larger than 20. Using public safety as a legal basis, this legislation could be passed quickly.

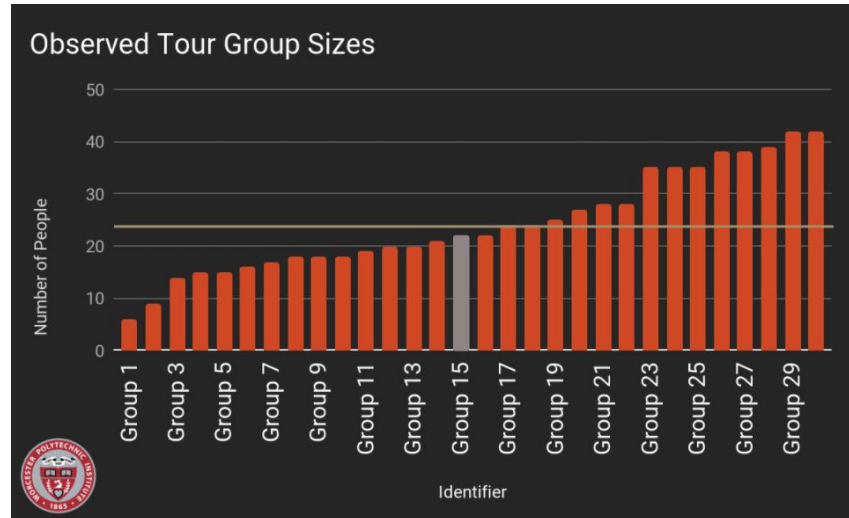


Figure 15: Observed Tour Group Sizes

Improving City Signage in Venice: After reviewing previous proposals for updating the signage in Venice, we decided to investigate whether a change was required and how to approach changing the signs. We envisioned that by improving signs, the city could reduce congestion and possibly plan for signage that would help in emergency situations.

We began by investigating how people navigate through the city. We counted how many people used paper maps, mobile applications, or signs to get through heavily trafficked intersections, finding that more than half of the 910 people using navigational aids looked at signs. Next, we attempted to follow the directional signs to St. Mark’s Square to understand the effectiveness and clarity of current signage. We found that although the route was clear, several locations included cluttered signs and unofficial signs offering additional information.

After establishing the importance of signage in navigating the city, finding many examples of confusing and cluttered signs, and finding examples of additional information to be included in signage around Venice, we developed a proposal for designing and testing new signage in the city.

Our signage proposal booklet lays out a plan to interview the public about what information is needed and how that information should be displayed on signs. The plan culminates in testing prototype signs for effectiveness in the field. Our proposal splits the information we recommend the city gather into several categories that can be collected individually or at once. We recommend the interviews or focus groups reach out to both residents and tourists to ensure that the signs are effective for all people. The categories are sign type, sign information, and sign style. Sign type seeks to determine what material the public believes the signs should be made out of and whether all information should be displayed on one sign or on multiple signs. Sign information seeks to determine what information should be displayed on signs. Sign style seeks to determine how best to show this information, whether with icons or with text as well as determining which icons and colors to use. After collecting all of that information, our proposal recommends designing a prototype sign and then testing the sign to ensure it is effective. We also recommend recursively testing the prototype sign to ensure that it is as effective as possible.

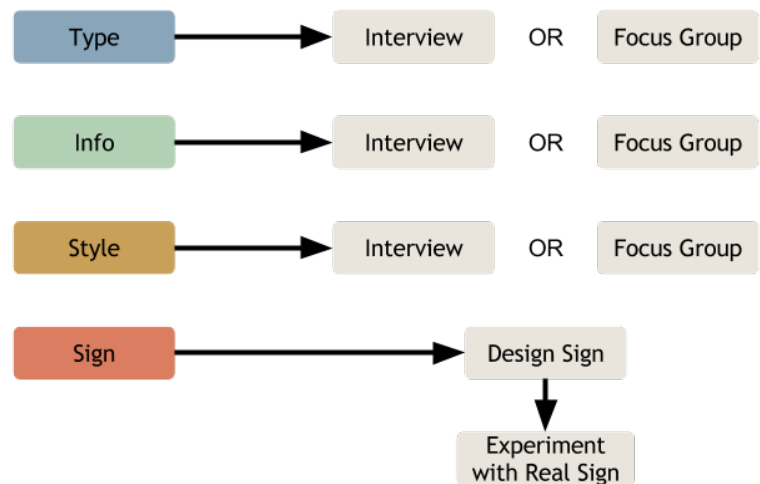


Figure 9: Sign Testing Procedure

Short-term Tourism Management Enhancements

Short-term enhancements are those that prepare for the medium- and long-term interventions. They include:

1. Creating **digital infrastructure** to both make easier the everyday life of residents and commuters, and improve the experience of tourists. It should consist of a customizable universal city card (digital and physical), an accompanying mobile platform, and an enhanced website, acclimating both residents and tourists to using these electronic systems.



Figure 12: Proposed Universal City Card Options

2. Expanding **limited-traffic zones (ZTLs)** by legal agreements with transportation and parking companies, so that tourists entering the city on all vehicle types will be charged a small fee. This step is important to both raise revenue for future

interventions (around €93 million annually) and to reward those tourists who stay overnight with refunds of the fee.

Medium-Term: Restrict access to St. Mark's Square via an Access Pass System

We then propose limiting non-resident access to St. Mark's Square, one of Venice's top tourist attractions, as a medium-term intervention. Restricting access to the square will convince some tourists to visit other areas of Venice or not visit the city at all on that day, thereby decreasing the overall number of people visiting the city and spreading out those who do visit. Tourists will have to buy access passes to enter the square, which will be cordoned off by gates and fencing at all entrances. We suggest increasing the price of the pass as the number of tourists going to St. Mark's Square increases, up to a hard cap of 65,000 tourists. Setting up this system could cost around €150,000, minimal in comparison to the potential income for charging to access the square.

We identified all the entrances to St. Mark's Square and recommend using some as dedicated exits and entrances to avoid bottlenecking of crowds. We also suggest dedicated resident entrances or lanes, to ensure that residents can get through as quickly and painlessly as possible.

Long-term Tourism Management: Restrict Access to Venice via Access Pass System

If limiting access to St. Mark's Square fails to discourage people from visiting the city and spread out those who do visit, we alternatively suggest expanding this concept to the entire historic city of Venice. The city should then restrict access to Venice, using the same system of electronic or physical passes, and the same dynamic pricing system coupled with a hard cap of 65,000 tourists. This requires creating 12 hubs to process all people coming into Venice, using both existing and new infrastructure.



Figure 19: Proposed Hubs Around Venice

Access to the city via car and private bus would be controlled by tollbooths set up on the highway just before Ponte della Libertà. Tourists, buses, and residents and commuters would have their own lanes, though these could be changed depending on the numbers of each coming

into the city. Driving through the tollbooths would require the city access pass. Public buses would pass through unchecked, but would be processed at another hub at Piazzale Roma.

Santa Lucia train station would act as a third hub, where tourists would have to use their access passes to leave the station. Dedicated side exits for residents and commuters would ensure their ability to leave the station unhindered by tourists.

Hubs at the docks at Punta Sabbioni, Marco Polo Airport, Lido (S.M.E.), and the seasonal docks of Treporti, San Nicolò, Lido Casino, Chioggia, and Fusina would require passes to use the ACTV and Alilaguna boat lines. Passengers of private boats docking near Caserma Cornoldi would have to use their passes to get through turnstiles and enter the historic city.

Conclusions and Recommendations

The completion of our project resulted in several valuable resources for future study into managing tourism in Venice.

Both the procedures we developed and the data we obtained in determining how people navigated through the city and the size of tour groups can be used by future students or the city itself, especially if they wish to expand upon our ideas.

In addition, we recommend investigating the use of signs in marking evacuation routes, as well as studying pedestrian flow patterns, to better increase the emergency preparedness of the city. In the event of an emergency, there are not any signs that indicate the direction in which people should take. The use of emergency signs can help both residents and tourists get to the safe areas of the city depending on where the emergency is happening.

Furthermore, our **tourism management proposal** acts as a source of information on several tourism management interventions. It combines the most feasible and self-sustaining parts of various competing tourism management proposals into one, using detailed visuals and cost analysis calculations that may aid in convincing the city to adopt such measures.

Authorship

Each member contributed equally to this project and each member's contribution was essential for completing this IQP project. This project would not be the way it is without the hard work and collaboration of each team member. Each team member's individual contributions are described below.

Joseph Crognale

The main contributor to all mathematical analysis in this report. He also designed a majority of the renderings and other infographics for the report and the final presentation.

Ari Elfenbein

One of the main contributors to the writing of the report. He also contributed to editing many sections of the report.

Justin Korn

The other main contributor to the writing of the report. He also contributed to editing many sections of the report.

Benjamin Mart

The main editor of the final report and presentation. He also was the main presenter during meetings with the advisors, liaisons, and collaborators throughout the project. In addition, he designed the team website.

Acknowledgements

Professor Fabio Carrera

For his continuous guidance and feedback on our project. He was instrumental for reaching out to our liaisons and collaborators for team meetings.

Professor Peter Hansen

For his helpful feedback and advice on our project. His edits were essential for completing the final paper.

Professor Melissa Butler

For her helpful feedback and support for helping us develop our project proposal.

Marco Scurati

For taking the time to talk to us about S. Marco Pass. He also provided feedback on the final presentation.

Andrea Casadei

For taking the time to talk to us about Pass4Venice.

Emanuele Tosatto

For taking the time to talk to us about ZTL Revolution.

Emanuele Dal Carlo

For taking the time to talk to us about the signage proposal, *Nizioleto 3.0*.

Table of Contents

Abstract	i
Executive Summary	ii
Authorship	vii
Acknowledgements	viii
Table of Contents	ix
List of Figures	xi
List of Tables	xii
1. Introduction	1
2. Background	3
2.1. Global Tourism	3
2.2. State of Tourism in Venice	3
2.3. Consequences of Mass Tourism in Venice	4
2.4. Tourism Management in Venice	5
2.4.1. Current Policies	5
2.4.2. Tourism Management Proposals	6
2.5 Communication Systems as Emergency Management Procedures	11
2.5.1 Current Examples of Public Communication Systems	11
2.5.2 Venetian Emergency Response Plan	11
3. Methodology	13
3.1. Analyzing possible tourism management interventions for Venice	13
3.1.1. Identify tourism management interventions	13
3.1.2. Compiling additional information on tourism management interventions	14
3.2. Determining first steps that can be taken to improve safety in Venice	14
3.3. Creating a comprehensive proposal for tourism management in Venice	15
4. Results and Analysis	16
4.1. Analyzing possible tourism management interventions for Venice	16
4.2. Determining the first steps that can be taken to improve safety in Venice	17
4.3 Creating a Comprehensive Proposal for Tourism Management in Venice	18
5. Tourism Management Proposal	22

5.1.	Immediate Enhancements	22
5.1.1.	Increasing Emergency Preparedness	22
5.1.2.	Restrictions on Tour Groups	22
5.1.3.	Improving City Signage	23
5.2.	Short Term Steps	23
5.2.1.	Digital Access Infrastructure	23
5.2.2.	Funding Medium and Long Term Steps	24
5.3.	Medium and Long Term Solutions	24
5.3.1.	Control Access to St. Mark's Square	24
5.3.2.	Control Access to the Old City of Venice	24
6.	Signage Proposal	25
7.	Conclusions and Recommendations	26
	Bibliography	28
	Appendix A: Individual Interventions	33
	A1: Emergency Notification System	33
	A2: Universal City Card	34
	A3: Online Tourism Platform	36
	A4: Mobile Information Platform	37
	A5: Improved Signage	38
	A6: Limited Traffic Zone	38
	A7: Tour Group Size Regulation	41
	A8: Access Pass	42
	A9: St. Mark's Square Controlled Access	42
	A10: Full City Controlled Access	45
	Appendix B: Signage Proposal	51
	Appendix C: ZTL Expected Revenue Calculations	62
	Appendix D: Observation Session Procedures	66
	Appendix E: Sign Observation Results	68
	Appendix F: San Marco Pass Cost Estimate Calculation	69

List of Figures

Figure 1: Number of Global Tourists (Statista, 2017)	3
Figure 2: Projected Population and Number of Tourists in Venice (Venipedia, 2015).....	4
Figure 3: Spending by Tourist Type	5
Figure 4: Pass4Venice Proposed Hubs	6
Figure 5: Location of St. Mark's Square	7
Figure 6: St. Mark's Square.....	8
Figure 7: Evacuation of San Marco Area	12
Figure 8: Navigational Aid Usage	25
Figure 9: Sign Testing Procedure	25
Figure 10: Emergency Notification Mobile App	33
Figure 11: Emergency Notification Website	34
Figure 12: Proposed Universal City Card Options	36
Figure 13: Proposed City Card Mobile App	38
Figure 14: Map of ZTL Implementation.....	40
Figure 15: Observed Tour Group Sizes	41
Figure 16: Proposed Entrances and Exits to St. Mark's Square	43
Figure 17: Potential Entrance to St. Mark's Square	44
Figure 18: St. Mark's Square Access Alerts	44
Figure 19: Proposed Hubs Around Venice	45
Figure 20: Santa Lucia Station Hub.....	46
Figure 21: Santa Lucia Station Entrance and Exit Details.....	46
Figure 22: Caserma Cornoldi Hub.....	47
Figure 23: Turnstiles and Gates by Caserma Cornoldi	47
Figure 24: Tollbooth Before Ponte della Libertà.....	48
Figure 25: Tollbooth Lanes.....	48
Figure 26: Piazzale Roma Hub	49
Figure 27: Directional Sign Mapping	68

List of Tables

Table 1: Breakdown of Tollbooth Lanes	10
Table 2: List of Interventions and Proposers	16
Table 3: Interventions and Intended Effects	19
Table 4: Functions of Universal City Card	34
Table 5: ZTL Projected Revenue by Transportation Method	39
Table 6: Dynamic Pricing Model for St. Mark's Square.....	42
Table 7: Tourist Arrivals by Transportation Method (COSES, 2009).....	62

1. Introduction

Mass tourism contributes to the global economy but puts substantial stress on cities popular with tourists (WTTC, UNWTO). It forces these cities to choose between the needs of tourists, such as short term housing and a large tourism industry, and those of the residents, such as affordable housing and a balanced economy. When tourism is not properly managed, the sheer number of tourists causes gridlock that restricts resident mobility. These issues have been exacerbated by a growing trend to see historic sites as quickly as possible (Magraw) without tourists realizing the impact their presence has on the city they are visiting.

The old city of Venice was once a vibrant residential city, but as the tourism industry has rapidly expanded in recent years, the city is at risk of becoming an overcrowded, congested, open-air museum for tourists rather than a home for residents. Each day, an average of 60,000 tourists visit Venice, outnumbering the 55,000 residents (Cardone, 2017; Capua, 2012). Therefore, congestion has become a common occurrence, making everyday tasks such as buying groceries or walking to school difficult (Under Siege, 2007). Additionally, the employment opportunities for Venetians (especially young ones with families) have narrowed greatly because most jobs are in the tourism industry. Furthermore, wealthy realtors buy and rent property at exorbitant prices to tourists, driving up property and rental costs for locals (Ross). Since life in the old city has become difficult, an estimated 1,000 residents per year have been pushed to leave the city (*Irresistible*, 2017).

Venice has several systems in place to mitigate negative effects of tourism, but these systems do not manage the flow of people into the city. Venice's transportation company, the ACTV, sells the Venezia Unica pass to improve the accessibility of the old city (Città di Venezia, 2016). Directional and street signs aid the flow of people to important landmarks through the city (Imboden & Imboden, 2017). The city has also implemented a small tax on overnight stays to raise revenue from tourists ("Overnight Tax," 2014). Since these initiatives do not address the number of people visiting Venice, they alone will not be the solution; however, they may be useful for future comprehensive solutions.

Currently, several Venetians have developed comprehensive proposals to manage tourist flow. These proposals suggest sweeping changes to tourism policy, focusing on movement into and around the city. None have been implemented due to a lack of unified support or information.

The goal of this project is to contribute information for the development of a comprehensive tourism management plan that will help improve the experience of tourists and the daily life for residents and commuters while enabling the Venetian government to manage the flow of tourists in and around the city. This will be accomplished by completing the following objectives:

1. Analyzing possible tourism management interventions for Venice
2. Determining the first steps that can be taken to improve safety in Venice
3. Creating a comprehensive proposal for tourism management in Venice

The completion of these objectives will create a baseline of information to be used to better understand and address the issues of tourism in Venice.

2. Background

Mass tourism on a global scale has increased dramatically over the last twenty years (Figure 1). Venice has not been an exception to this upward trend and predictions show that Venice can expect even more tourists to visit in coming years (Venipedia, 2015). Unfortunately, the increase of mass tourism has also left the city struggling to cope with the needs of almost ten million tourists a year and the vastly different needs of residents (Irresistible, 2017). Venice's current systems seek to improve the tourist experience by making the city more accessible, but do nothing to address the issues caused by tourism. Therefore, several possible solutions have been proposed that seek to create effective and coherent tourism management in line with that of other heritage sites.

2.1. Global Tourism

As seen in Figure 1, there has been a steady increase in the number of tourists arriving over the last twenty years, excluding dips due to large economic crisis. Since 1996, the number of people travelling as tourists has doubled and projections show that number could reach 30 billion by 2030. Europe consistently has been the most visited region, and Italy serves as one of the top ten destinations in the world for tourists [UNWTO Tourism Highlights, 2016].

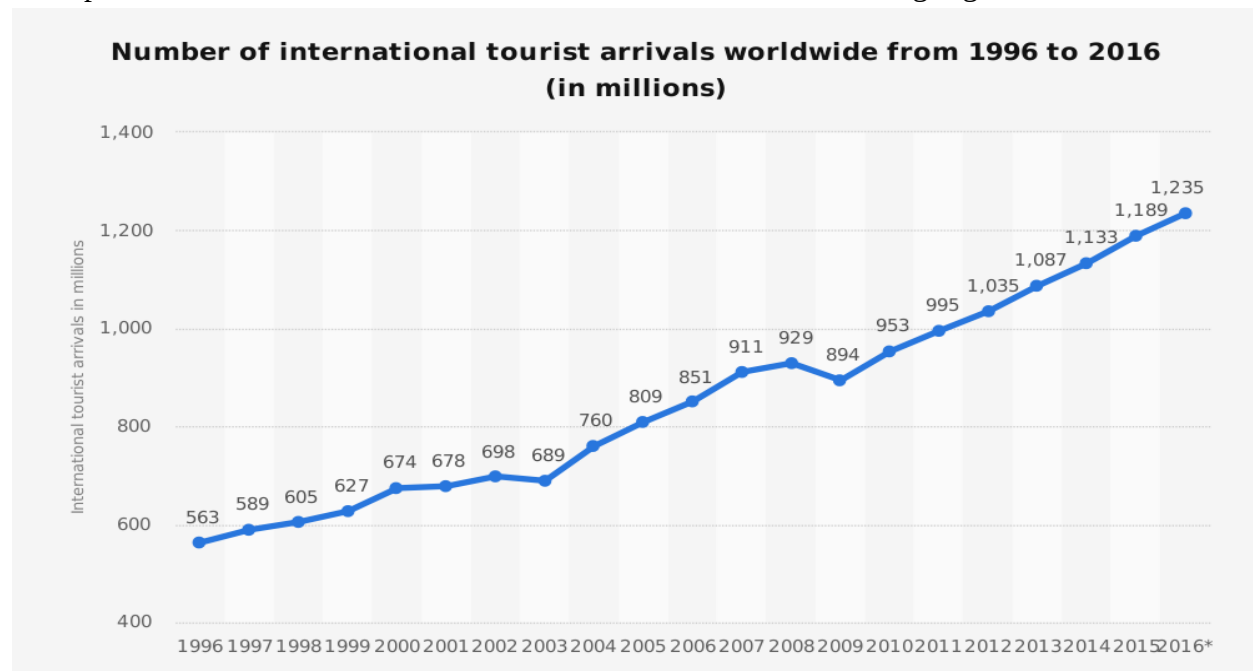


Figure 1: Number of Global Tourists (Statista, 2017)

2.2. State of Tourism in Venice

Though it has always been an immensely popular tourist destination, the number of people coming to Venice has sharply increased over the past two decades from just over 4

million in 1994 to 10 million by 2014, due to cheaper transportation options and a booming cruise industry, and projections show that tourism in Venice is expected to increase in the future (Venipedia, 2015).

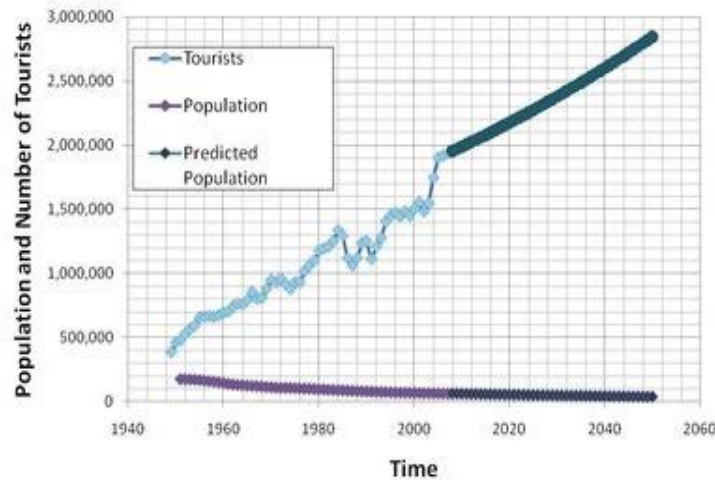


Figure 2: Projected Population and Number of Tourists in Venice (Venipedia, 2015)

The majority of tourists arrive between April and October. The largest number of overnight visitors comes from the United States (637,000), the UK (346,000), France (304,000), and China (255,000) (Assessorato, 2015). Some of the most popular sites include the area around Saint Mark's Square, including the Palazzo Ducale, and the Rialto bridge on the Grand Canal.

In addition, the majority of tourists to Venice are day-trippers – nicknamed *turisti mordi e fuggi*, or “hit-and-run tourists” by Italians, as they are known for spending very little time and money in a city. In fact, while day-trippers represent 80% of all tourists to Venice, they only account for 20% of the total money spent by visitors to the city (Safe, 2015). Furthermore, the perception among Venetians is that day-trippers learn less about the layout of Venice and its culture and want to visit only the “must-see” sites of the city (ZTL).

2.3. Consequences of Mass Tourism in Venice

Mass tourism has caused numerous problems for both infrastructure and quality-of-life of residents in Venice. Bridges especially are damaged by the number of people walking on them and boats going below them (“Bridge,” 2014). Plus, the small number of entry points into the city combined with the tendency of crowds to all visit a select few locations causes congestion in Venice's narrow streets and bridges. Residents who need to buy groceries or go to work are forced to navigate – on foot – the morass of tourists, making daily life challenging. Moreover, the cost of living has risen above what most people can afford (*Under Siege*, 2007). Many young Venetians see little future for themselves in the city, in terms of both employment and starting a family; as such, the city is depopulating at a rate of 1,000 people annually (*Irresistible*, 2017).

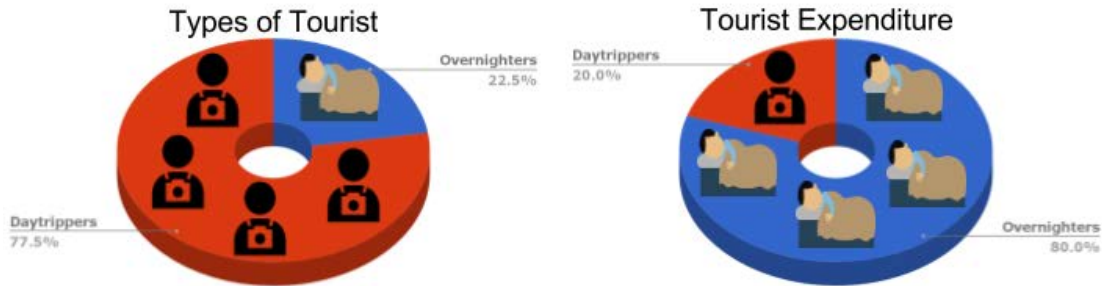


Figure 3: Spending by Tourist Type

2.4. Tourism Management in Venice

Because Venice lacks direct and effective tourism management, residents and members of the Venetian government have begun discussing possible solutions.

2.4.1. Current Policies

Venice has several systems to address the effects of mass tourism. While these policies have not addressed the flow of tourists into the city, they may provide tools that can be used in future comprehensive solutions.

The first of these systems is a transportation card called the Venezia Unica City Pass, designed to make Venice more accessible to tourists. Tourists can purchase a public transportation pass on the card and purchase additional options separately, such as guided tours and museum access. This includes popular museums such as the Doge's Palace in Saint Mark's Square and the Murano Glass Museum (Venezia, 2014). The pass was implemented in 2013 as a way of simplifying the tourist experience and took elements of two previous passes, the imob city pass and the museum pass. This museum pass was implemented in 2008 "with the purpose of managing and enhancing the profile of the cultural and artistic heritage of the Civic Museums of Venice" ("City Pass," 2014). There is no available evidence to show the museum pass or the new pass have driven more tourists than before to museums, but the Venezia Unica City Pass can simplify the overall tourist experience.

Venice also implemented a tourist tax to collect money directly from tourists that can be put towards city improvements. This is a practice that happens across Italy and involves charging a tax based on the length of an overnight stay. In Venice, this is one Euro per star of hotel per night per person (Perillo Tours Inc, 2017). There are reductions that apply during certain off-season months or for hotels on the mainland and in Lido to lessen the pressure on the old city of Venice. The city states, "The collected funds will help the City improve the quality of the tourist services (services, museums, events,...) and finance works aimed at maintaining, using and salvaging the city's cultural and architectural heritage" (Overnight tax, 2014). Over 10 million overnight stays per year allows the city to reinvest into more management infrastructure (comune.venezia.it). Since this program does not target both daytrippers and overnights, its

potential is limited as tourism management tool. Instead the tax serves as a tool to generate income for the city.

Venice's only method of directly managing the flow of tourists throughout the city is the directional signage found along city streets. Venice has multiple types of signs, showing the names of plazas, streets, and bridges, called *nizioleti*, as well as general directions for major attractions (Imboden & Imboden, 2017). Although these signs help direct tourists when they attempt to visit different destinations, they often lead tourists through crowded alleyways even though other routes are available. There is currently a proposal to modify signage in the city to display more information clearly while maintaining the historic atmosphere of the city (Dal Carlo & Carrera, 2016).

2.4.2. Tourism Management Proposals

Pass4Venice

The Pass4Venice Association was founded by ten people with a plan to decrease tourism in Venice to manageable levels while also earning money for the city. They envisioned a system that uses an array of access hubs and dynamically priced access passes to control the overall number of people entering Venice.

This system proposed by the Pass4Venice Association emphasizes that it does not close off any part of the city directly, but uses dynamic pricing models to discourage entrance as Venice becomes too congested. When there are less than 37,000 tourists in the city, passes will cost €25 and increase to €100 as that number approaches 100,000 (Pass4Venice). To allow constant access to the city, any tourist entering by foot over the 2.4 mile long Ponte della Libertà will be excluded from having to pay for entrance and will not be counted. However, very few tourists would choose this option because it takes time away from seeing the city while also being much more difficult than other available options.

The seven hubs proposed are Mestre Via Righi, Mestre Stazione, Punta Sabbioni, Tessera Aeroporto, Chioggia, Fusina, and Venezia "lagunare" (Pass4Venice). The Righi hub will be at the bus station on the mainland, shortly before the bridge that leads into the city and will be first for those driving into the city and eventually for the new cruise ship port being constructed at Marghera Port. The Mestre station hub will be for rail access into Venice. Hubs at Punta Sabbioni, Tessera Aeroporto, Chioggia, and Fusina will all be for lagoon access from

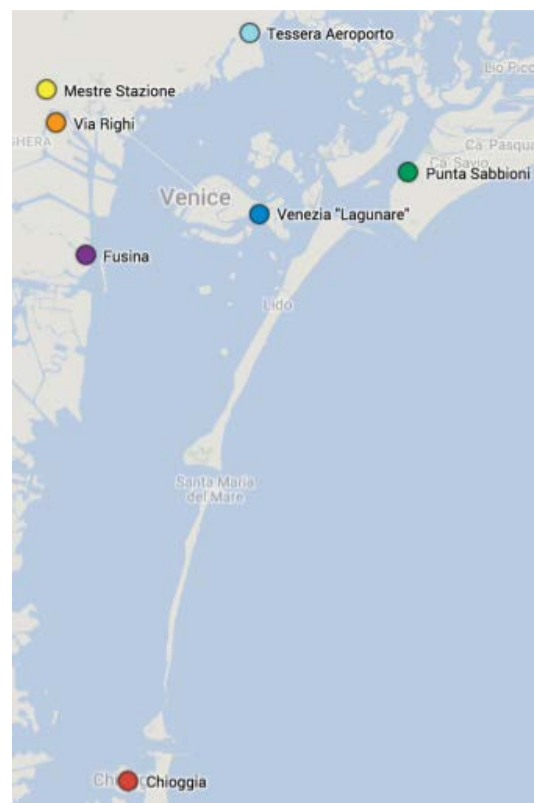


Figure 4: Pass4Venice Proposed Hubs

different directions with the last hub on the city of Venice as a way to allow ships not coming from any of the other locations to offload tourists.

The plan has multiple suggestions for handling residents and commuters entering and exiting the city without having to deal with tourist accommodations. The first is creating “fast passes” that allow regular visitors to the city to pass through the hubs without having to wait in lines for tourists. The second is specific routes and ports dedicated to frequent travelers, which tourists cannot use. Another is dedicated lanes with gates on the roads entering the city that do not allow tourists, but allow commuters and residents to pass through easily. They also suggest the possibility of reserved parking lots at each of the hubs to allow easy access (Pass4Venice).

The proposal suggests that after 3-4 years of construction, the project will make 700 million Euro per year for the city (Pass4Venice). There are some suggestions for how to use that money, but they are not described in the plan. Overall, Pass4Venice will lower the number of tourists in the city without directly disallowing anyone, only discouraging them with higher prices. Residents and commuters may have to change their travel plans to adjust to the new systems but will have an easier time dealing with tourist lines getting into the city. Tourism companies will need to inform tourists about the need for the pass and possibly adjust prices based on the dynamic prices being set for the pass. The implementation of this proposal would require a large investment by the city to construct the hubs and manage and maintain them, but the proposed return is large both financially and in benefit to the city's tourism and congestion problems.

San Marco Pass

In 2015, Marco Scurati, a local business owner, proposed the San Marco Pass, which limits the number of people entering the city by limiting access to Saint Mark's Square, as shown in Figure 5, and the buildings around the square.

Saint Mark's Square was chosen as the limiting factor for two reasons: it is easier to block off access to a smaller space than a larger space, and Saint Mark's Square is a must-see site for tourists. By blocking off access to only Saint Mark's Square instead of the entirety of the old city, Venice will spend less on policing and

Figure 5: Location of St. Mark's Square

infrastructure. Moreover, the importance of Saint Mark's Square can be observed in imitations of

Venice around the world. These imitations recreate little beyond Saint Mark's Square and Ponte di Rialto (Strutner, 2013). Additionally, almost every tourist visiting Venice passes through Saint Mark's Square and a vast majority of those spend little time outside of the square and in the surrounding streets (Davis & Marvin, 2004; Fenlon, 2014).

The San Marco Pass proposal uses a system of checkpoints and passes to control access to Saint Mark's Square while implementing a dedicated tourist transportation system to facilitate movement throughout the city.

The proposal defines the Saint Mark's Square area and its entrances as shown in Figure 6. At each entrance, there would be a system to monitor who is entering with which pass. In addition, pass holders would be able to use a dedicated transportation system to facilitate access to Saint Mark's Square and other popular destinations. This system would also require the purchase of a pass; however, it would be less expensive than the price for a pass on the current public transportation system and a seat would be guaranteed with every pass, making it more attractive to tourists.



Figure 6: St. Mark's Square

The proposal differentiates between two main groups of tourists, daytrippers and overnighters. It targets daytrippers through the sale of a limited number of passes for every day that allow access to Saint Mark's Square, the surrounding buildings, public bathrooms, and free Internet access. For overnighters, purchase of a pass would not be required. Instead, through paying a tourist tax at their hotel, they would be given unlimited access to Saint Mark's Square. Although the San Marco Pass limits access to Saint Mark's Square, it would not limit tourism to the other parts of the city. If tourists choose not to buy the San Marco Pass or stay overnight, they are still allowed to visit all other parts of the city. Additionally, when riding public transportation, they would not be allowed to get off at Saint Mark's Square and instead would be redirected to several different locations around the city. This would both spread the crowds of tourists more evenly throughout the city and help to prevent congestion on public transportation heading towards Saint Mark's Square.

The city government would pay to implement, maintain, and enforce the policies, which would create additional strain on the current city budget. However, the city could expect additional revenue from selling passes, which could be used to offset the price of maintenance and enforcement. Unfortunately, the proposal requires that residents carry a resident pass, which adds hassle to everyday life and creates additional bureaucratic hurdles associated with another form of identification.

ZTL Revolution

Another proposal is the ZTL Revolution, which aims to expand the use of traffic fines, stimulate the local economy, and decrease the number of day trippers in the city. The plan was proposed by Emanuele Tosatto of the Italian Five Star Movement (*Movimento 5 Stelle*, 2017), which is a major anti-establishment political movement centered on five core values involving sustainability and public access to resources (“Programma,” 2014).

Tosatto’s proposal calls for an expansion of pre-existing laws to protect Venice from the harmful effects of mass tourism. A ZTL (*zona al traffico limitato*, or “limited traffic zone”) is an area in which any vehicles passing through are charged a fee, depending on the time or the day. ZTLs already exist around Italy and in Mestre, though the M5S proposes expanding these laws to apply to boats, cruise ships, and trains and enforcing them at all times at the main access points to Venice (ZTL, 2017). Transport companies would pay the city government the ZTL fee and, in turn, charge their customers an extra €3-€6 on their tickets. The tickets to park in Piazzale Roma and Tronchetto would also contain the extra ZTL charge.

The proposal calls for overnights to be exempt from the ZTL charge and reimbursed the cost of the €3 tourist tax in the form of gift vouchers to be spent at local artisan shops, with the twofold goal of encouraging overnight stay and buying goods made in Venice. To be eligible for reimbursement, overnights would register online to receive a special Venezia Unica card, which also grants a 20% discount to municipal museums and boat access at the prices locals pay. Residents, their friends and families, students, and commuters would be exempt from paying any ZTL fees. As for day-trippers, who are most targeted by the plan, they would always have to pay the €3-€6 fee (which fluctuates depending on how many people are in the city) every time they passed through a ZTL. They do, however, have the option to register and get the museum ticket discount.

The latest estimates provided by the M5S suggest significant income generated for the city through their plan, whether from the enforcement of the ZTLs or indirectly from the stimulation of the local economy and reduction of tourist-related stress. Assuming there is no excess of day-trippers to put the city’s number of visitors over 54,000, and modestly assuming that only 50% of the gift vouchers are redeemed, the M5S calculates that €49 million per year could be generated for the city (ZTL, 2017). Local craftsmen could benefit from increased revenue of €14 million per year, and if successful, most commuters and residents would enjoy decreased congestion if more day-trippers are discouraged from entering the city from the tax. The government’s budget would also grow substantially with the increased tax income.

VPC Proposal

The Venice Project Center (VPC) proposal, written by Professor Fabio Carrera, outlines detailed steps for managing tourists as their number in the city approaches an unsafe limit. This will be accomplished using a combination of methods suggested by the Pass4Venice, ZTL Revolution, and San Marco Pass proposals and new content.

The proposal outlines four steps for the city to implement that limit the number of tourists in the city during the day and night, create new create new access points for the old city, and improve the mobility of tourists throughout the city.

The first step of the proposal recommends capping the total number of tourists entering the city per day at 55,000 to preserve an approximate one to one ratio between residents and tourists (Carrera, 2016). Furthermore, the number of beds available to tourists would be limited to 40,000 to ensure a less than one to one ratio of residents to tourists while filling every bed currently available (ibid).

The next two steps deal with managing the flow of tourists into the city. The proposal starts by creating new hubs around the perimeter of the old city. In order to enter the city, people need to purchase an access pass. Tollbooths would be built on the Ponte della Libertà, the bridge leading to the old city, to manage periodic blockages and guarantee access into the city. The lanes of the bridge will be broken up according to Table 1.

Table 1: Breakdown of Tollbooth Lanes

Lane 1	Residents and frequent visitors
Lane 2	Buses and Taxis
Lane 3	Vehicles with Parking Reservations
Lane 4	Vehicles without Parking Reservations
Lane 5	Bicycles and Motorcycles
Lane 6	Pedestrians

The final step is to limit the number of tourists per group coming into the city to 25 people regardless of their mode of transportation and add additional restrictions on their movement within the city. There would be banned areas in which groups cannot get into as well as lines for water buses that are reserved for groups only (Carrera, 2016). Groups of more than ten need to register in advance to enter the city and must be accompanied by a tour guide. If the a member of the group violates any rule in the city, the tour guide can ban the entire group from the city (ibid). There would be banned areas in which groups cannot get into as well as lines for water buses that are reserved for groups only (ibid). If the group is more than ten people, then that group needs to be register in advance to enter the city. These groups will be accompanied by a tour guide. If the a member of the group violates any rule in the city, the tour guide can ban the entire group from the city (ibid).

Estimates show this proposal will provide more than 100 million euros for the city to be used in reinvestment plans for locals. Revenue will be collected through the sale of access passes and the collection of tolls in the ZTL zones. The city government can then use this money to invest improvements that increase the quality of life for residents (ibid).

2.5 Communication Systems as Emergency Management Procedures

Communication with the public is an essential part of any emergency plan. Several large scale emergencies in recent years have shown that poor communication can hinder the public's response to the emergency (Jones, J.A., Walton, F., Smith, J.D., Wolshon B., 2008).

2.5.1 Current Examples of Public Communication Systems

Many governments have researched how to use new technologies, especially website integration and mobile alert systems, to better communicate with the public. New York City has implemented a continuously updating website and mobile app for users to track all emergency notifications in real time (About Notify NYC, 2017; Notify NYC App, 2017). Similarly, the French government created a smartphone app intended to give warnings to users about terrorist attacks or other disasters (Chrisafis, 2017). Additionally, the European Union has expressed interest in a universal platform that would be effective in all member states and capable of sending messages to as many devices as possible. A project to investigate the feasibility of this kind of platform was completed in 2013 and determined it was technically feasible (Horizon, 2017).

2.5.2 Venetian Emergency Response Plan

During the summer tourist season, the overall number of tourists in Venice can soar to well over 50,000 people in the old city alone (Assessorato, 2014).

Research completed by a 2015 IQP team has shown that the area around Saint Mark's Square and the Rialto Bridge, two of the most popular destinations in Venice, can have 29,000 people safely evacuated in eight minutes (Connor, Hanna, Rennsselear, Wingerter, 2015). However, when accounting for residents and workers, the number of people in this area can surpass this safe limit (ibid).



Figure 7: Evacuation of San Marco Area

Venice currently has emergency management procedures outlined in a large citywide plan, including a section detailing their evacuation procedure and communication protocols (Piano, 2017). The city's plan calls for using loudspeakers, television broadcasts, and radio announcements to alert those in the affected areas (ibid). While effective for those with access to radio and television, tourists who are walking in the streets would lose critical time while notifications are spread by other means, such as word of mouth. While still conveying information, officials lose direct control of the information spread using these other means of communication.

3. Methodology

The goal of this project is to contribute information for the development of a comprehensive tourism management plan that will help improve the experience of tourists and the daily life for residents and commuters while enabling the Venetian government to manage the flow of tourists in and around the city. We met this goal by completing the following objectives:

1. Analyzing possible tourism management interventions for Venice
2. Determining the first steps that can be taken to improve safety in Venice
3. Creating a comprehensive proposal for tourism management in Venice

Our project took place within and around the Old City of Venice. The majority of the project was concerned with previous tourism management proposals by citizens of Venice, as well as the city plan for tourism management. Our project was completed within the 7 week IQP period, October 22nd to December 15th, 2017.

The focus of the project was tourism management, specifically aimed at reducing the number of tourists in Venice at one time. Tourist in this project refers to both daytrippers and overnighers. Daytrippers visit the city for short amounts of time purely to see the sights and have fewer opportunities to absorb local culture, while overnighers who, through staying for an extended period of time, learn about Venetian culture and positively impact the economy.

The following section explains our methods used for completing the above objectives, beginning with our process for analyzing possible tourism management interventions.

3.1. Analyzing possible tourism management interventions for Venice

We created a set of documents containing all tourism management interventions contained within each of the current proposals.

3.1.1. Identify tourism management interventions

The first step was identifying all of the interventions that have previously been proposed. For this project, we considered an intervention any action that can be taken by the city towards the goal of managing tourism. Interventions are separated by their ability to be implemented independently as a management strategy, regardless of scope or effectiveness.

We identified these interventions by primarily using the existing tourism management proposals. We went through each proposal's suggested actions and determined which could be classified as interventions and which were details.

These interventions were then compiled in a master list of interventions containing all of the interventions mentioned and details about them. We combined similar interventions, which were mentioned in multiple proposals, into a single entry while retaining the differing details across proposals.

Then, we compared our master list with the plan put forth by the city in "Project of territorial *governance* of tourism in Venice" to see if the city identified any additional interventions. Afterwards, the master list was used as the guide for collecting further information and analyzing each intervention.

3.1.2. Compiling additional information on tourism management interventions

We interviewed key sponsors of each proposal to clarify points of confusion as well as gather additional information about each proposal. To do this, we created interview questions that built on our previous research and provided us new knowledge. We also gathered data from the city, especially about costs, to contribute more information to our understanding of the interventions. To gather additional data about possible navigation-based interventions, we first determined how people currently navigate within the city and the effectiveness of those systems.

To understand how people navigate through the city, we observed two well trafficked intersections with many signs. Over a one hour period at each location, we counted the number of people using the following categories of navigational aids: maps/tour books, signs, and phones. We also counted the total number of people passing through the intersection. The procedure for these sessions can be seen in **Appendix D**. We used the resulting data to determine the most used forms of navigational aids and direct our focus moving forward.

To determine the effectiveness of directional signs in the city, we looked at the signs that lead to Saint Mark's Square from the Rialto Bridge. This data was collected by following the procedure outlined in **Appendix D**. The resulting data was then overlaid onto a map of Venice, showing all of the signs as well as problem areas and unofficial signs (**Appendix E**). Additionally, we presented our procedure as a method of finding all errors and routes laid out by directional signs for future study.

Finally, to determine the average size of a tour group, we went to St. Mark's Square and the area outside of Doge's Palace to count the number of people in each tour group, as outlined in **Appendix D**. After this session was completed, we calculated the mean and median tour group size.

3.2. Determining first steps that can be taken to improve safety in Venice

Building off of work done by the 2015 "Safe and Sustainable Tourism: Managing Venice's Millions of Visitors" IQP and the *Nizioleti 3.0* presentation by Professor Fabio Carrera and Emanuele Dal Carlo, we researched the current city emergency plans for the city to determine where they could be improved.

We began by researching what elements make up emergency plans. This research was used to create a foundation of knowledge that allowed us to determine how the systems proposed in the *Nizioleti 3.0* presentation could be used in emergency situations. With this understanding, we then researched what other governments are doing to plan for emergency situations to understand where Venice's plan was lacking compared to other governments and what measures could be taken to improve it.

3.3. Creating a comprehensive proposal for tourism management in Venice

The first step in creating a tourism management proposal was establishing the objectives that our proposal was attempting to accomplish. We then determined which interventions would be most useful in accomplishing these objectives. Then using the documentation about each intervention, we determined how each intervention would be implemented. To provide further information, a cost analysis was done on certain interventions to understand their expected cost and any revenue they earn. To help explain how some interventions would be implemented, we created visualizations showing their implementation. These were digitally-altered images of certain locations in the city that would be affected by the intervention's implementation. Furthermore, we created mockups for digital interventions such as website and mobile application layouts.

4. Results and Analysis

Based on the information gathered from the previous proposals, interviews conducted with proposal sponsors, field observations, and discussions with advisors, we developed the following findings that create a base level of knowledge about tourism interventions in Venice. These findings also foster discussion about tourism management in Venice for the present and in the future.

4.1. Analyzing possible tourism management interventions for Venice

By analyzing previous proposals and supplementing data from sponsor interviews, our findings create a baseline of knowledge about possible tourism management interventions in Venice as well as proposed ways of implementing them.

Venice has numerous interventions available for modifying the current tourism model, many with multiple proposed implementations. Using the previous proposals, interviews conducted with proposal sponsors, research about other locations, the city tourism management proposal, and discussions with advisors, we determined that the following interventions were possible:

Table 2: List of Interventions and Proposers

Intervention	Proposer
Entrance Hubs	Pass4Venice, VPC Proposal
Soft Cap Model for Access Pass	Pass4Venice
Hard Cap Model for Access Pass	San Marco Pass
Variable Price Transportation Pass	Fabio Carrera, Emanuele Tosatto, WISE Tourism Team
Tourist Card	Current System, Pass4Venice, VPC Proposal, San Marco Pass, ZTL Revolution
Online Tourism Platform	Current System, WISE Tourism Team
Mobile Information Platform	Nizioleti 3.0, WISE Tourism Team

Limit on the Size of Tour Groups	VPC Proposal
Limited Traffic Zone	VPC Proposal, ZTL Revolution
Checkpoints	San Marco Pass, Fabio Carrera
Dedicated Tourist Transportation Line	San Marco Pass
Signage	Nizioleti 3.0

After compiling this list, we compared our list with the list created in the city's plan and determined that all of the interventions they listed were already included in some form or fell outside the scope of our project.

Creating a comprehensive list of interventions is a complicated process relying on incomplete information. Determining the exact implementation of proposed interventions was more difficult than expected because after conducting our interviews, we discovered that no further resources existed beyond the proposed plans we previously accessed. We were then required to adjust our attention away from recording the exact implementation details of each proposal and focus on the broad interventions in our later objectives. This was especially prohibitive for cost benefit analysis, which we were unable to perform on many of the interventions because the exact details were not available.

The list of interventions, and the details associated with each intervention, serve as an inspiration for further tourism management proposals rather than exact blueprints for implementation. After combining all the details for each intervention into one document, the different levels of detail became very clear. For example, both Pass4Venice and the VPC Proposal suggest implementing entrance hubs around Venice and the lagoon. However, the Pass4Venice proposal expands on that concept only by providing possible locations and noting that money would be allocated towards building them. The VPC Proposal provides similar information while going into detail about one hub.

4.2. Determining the first steps that can be taken to improve safety in Venice

Our research into emergency systems resulted in a method of analyzing the Venetian emergency management system and categorizing the steps proposed in the *Nizioleti 3.0* proposal. Our research on other government emergency plans then revealed how both steps could be implemented to improve safety systems in Venice.

Research showed that there exist a set of important actions that each emergency management system must include, especially when managing large scale evacuations. A study completed by the Nuclear Regulatory Commission of large evacuations in the United States identified several key features of emergency management plans (Jones, J.A., Walton, F., Smith, J.D., Wolshon B., 2008). These included:

1. Training
2. Public Education
3. Communication (Public)
4. Communication (Responders)
5. Education
6. Special Needs
7. Shelter

Understanding the different elements of emergency management, we determined which elements fit within the scope of our project. The *Nizioleti 3.0* presentation introduced the concept of using notifications within a navigation app and controllable signage. We decided to move forward with the notification function of the proposed app rather than the full app because successful navigation apps already exist. Furthermore, we determined that the implementation of such a signage system could not be done in the short term and would need to be implemented in conjunction with an overhaul of city signage. The concept of a notification app falls under the third feature of emergency management plans, communication with the public.

The notification app concept combined with research about other governments led to the development of a new intervention. Research about other government notification systems showed that implementing a digital notification system for emergencies, similar to the concept proposed, allowed greater communication between governments and residents. Because this could be implemented immediately and improve safety in Venice, we added an emergency notification system to our list of interventions.

4.3 Creating a Comprehensive Proposal for Tourism Management in Venice

After reading the current tourism management proposals for Venice and researching other cities and sites, we determined that a tourism management plan should have these four objectives:

1. Reduce the number of people in Venice
2. Increase preparedness for emergency situations
3. Be financially self-sustaining
4. Streamline tourism experience under city management

Setting these as the objectives of our proposal, we looked at the list of interventions and attempted to figure out which aligned most with each of these objectives. Using those lists, we worked to see which interventions would work well when implemented together, and which had

overlapping results or implementation that would be redundant or impossible. We then thought about the objectives in terms of urgency, and determined phases for implementation. Each phase was designed containing steps that consist of the individual interventions. These phases are our final recommendations for the city to manage tourism effectively.

Each intervention from our list of interventions was included in a proposal because of an intended effect on tourism, and isolating that helped us organize and choose from the list. For some interventions, identifying the intended effect was simple. For others, we used interviews with the proposers and research into Venice's current systems to understand the possible and intended effects.

Table 3: Interventions and Intended Effects

Intervention	Intended Effect
Entrance Hubs	Control access to the city
Soft Cap Model for Access Pass	Reduce the number of people in Venice
Hard Cap Model for Access Pass	Reduce the number of people in Venice
Variable Price Transportation Pass	Reduce congestion on public transportation
Tourist Card	Streamline tourist experience
Online Tourism Platform	Streamline tourist experience
Mobile Information Platform	Streamline tourist experience, convey notifications
Limit on Size of Tour Group	Reduce street congestion
Limited Traffic Zone	Raise money for the city from tourist traffic
Checkpoints	Control access to specific areas
Dedicated Tourist Transportation Line	Reduce congestion on public transportation

Signage	Align city signage to what both residents and tourist want and need
---------	---

We used this understanding of each intervention’s intended effect to determine which interventions align with each objective. The first objective, reducing the number of people in Venice, is exactly what people caps are designed to accomplish. The second objective, preparing for emergency situations, is not the direct goal of any of the interventions, but reducing congestion and conveying information are both goals that can lead to better emergency response. The third objective aligns with the goal of the ZTL, in that the plan overall should generate at least as much revenue as expense. Finally, streamlining the tourism experience under city management directly aligns with the goals of the tourist card and digital infrastructure interventions when they are created by the city.

Both soft and hard caps on the number of people, as interventions, we realized have very similar goals but different end results. A soft cap done through dynamic pricing that scales infinitely has the benefit of increasing the disincentive to visit as tourism increases, but theoretically allows infinite people to enter if they’re willing to pay. A hard cap puts a strict restriction on the tourist population, but does nothing to reduce the number of people until that cap is reached. We decided to combine these into a single pricing structure for access passes which scales up to a hard cap. We also realized that implementing a cap does nothing without the supporting infrastructure for enforcing that cap. Both entrance hubs and checkpoints are designed to serve as that infrastructure, at different scales.

The idea of phased implementation of interventions is something we considered from the very start of our research. Without being able to know exactly the effect certain interventions will have on tourism, starting with the less expensive options and increasing scale and scope as necessary prevents wasting city resources. Addressing the first objective, we propose a phased implementation of access control, starting with Saint Mark’s Square and expanding that to the entire city only if deemed necessary.

The second objective, increasing the preparedness for emergency situations, is incredibly important for the safety of residents and visitors to Venice. Access control indirectly helps manage this problem by reducing congestion, but we also wanted to address this objective in our proposal directly. From our list of interventions, it seemed best to suggest an informational system that could be wrapped into larger tourism interventions as they are completed. We decided this would be best as a mobile application and accompanying website after researching existing systems used by other governments.

After doing some calculations and looking at predictions in the other proposals, we determined a ZTL similar to what is suggested in the ZTL Revolution proposal would most likely be able to support the financial investments required by some of the other interventions. Speaking to Emanuele Tosatto helped us refine that idea into what appears in our proposal.

We decided to address the fourth objective with a tourist card and digital infrastructure in the form of an app and website. However, instead of a tourist card, we refined that idea into a proposal for a universal city card. This functions as a tourist card but also has options available for residents and commuters. The integration of these systems creates an easy process for tourists to follow from planning to visiting. The city being in control of parts of this process allows for the communication of important messages such as changing tourism management policies and procedures quickly and effectively. Changing city signage also helps to address this objective, creating a consistent and visually appealing system of signs that allow tourists to get where they're going and reduce congestion.

We sorted the interventions into four categories. These categories are differentiated by when we recommend planning and implementing the intervention, being immediately, short term, medium term, or long term. We left the actual time frames to be decided by the city, because we felt unable to define them more strongly than that without knowing the city's processes intimately. Most urgent are the interventions that address emergency preparedness as emergencies are unpredictable and it is important to have these systems in place in advance of any problems. Controlling access to Saint Mark's Square or the entire city requires a lot of infrastructure, and while it may be the most direct way to address the tourism issues, it will take the most time to design and implement.

We recommend that signage and tour group regulations are done immediately, as relatively simple ways of reducing some of the problems caused by tourism. In the short term, we suggest implementation of the universal city card and the ZTL as preparatory stages for the medium and long term solutions, getting tourists used to city systems and generating funds to pay for the high initial costs of the next steps. We then considered controlling access to Saint Mark's Square as a medium term step, with the implementation of an access pass as an option on the city card and the construction of checkpoints for managing entrances and exits to the square. The long term solution should only be implemented if it is determined that restricting access to Saint Mark's Square does not accomplish the goal of reducing tourism issues, and for that we suggest limiting access to the entire city with the same access pass used for Saint Mark's Square. This involves a heavy infrastructure component in order to create the hubs that check for access, but is nearly guaranteed to make huge progress in reducing the problems caused by tourism.

For each of the interventions we recommend, we researched and discussed further details about their implementation as an example and resource to help. We described the interventions at varying levels of detail, deciding to focus on the details that we considered relevant to tourism management. For some of the interventions, we were able to find general pricing information to give a sense of scale, but for others, there was either not enough details about exact implementation or available cost-determining resources. For the San Marco access pass, for example, without data on the number of visits to the square daily or yearly, predicting expected revenue was not possible.

Our full recommendations can be seen in in the next chapter.

5. Tourism Management Proposal

This document serves as an explanation of the proposal we recommend for managing tourism in Venice. This proposal has four phases that will manage tourism in Venice while improving everyone's overall experience. These phases are:

1. Immediate enhancements
2. Short term steps
3. Medium term steps
4. Long term solutions

These phases serve as the broad definition of our proposal and are designed to be implemented in chronological order, although the time frame is not definitive to allow for modifications based on feedback from the public and other factors. Each phase is then broken down into several steps that address individual aspects of tourism and safety. Further information about the individual processes discussed in each step can be found in **Appendix A**.

5.1. Immediate Enhancements

This phase is centered around implementing new regulations and systems in the short term that attempt to address some of the problems related to tourism and to expand the capabilities of the city for resolving emergency situations. The steps included in this phase are:

1. Increasing Emergency Preparedness
2. Restrictions on Tour Groups
3. Improving City Signage

These steps are designed to be implemented simultaneously and independently.

5.1.1. Increasing Emergency Preparedness

We propose implementing an emergency notification system, using a mobile app and an accompanying website, which build off the current Venetian emergency plan (**see A1**). The objective of implementing this system is to facilitate communication between the Venetian government and tourists while improving communication with residents. By implementing this system, the city will be addressing safety concerns about evacuating the area between St. Mark's Square and the Rialto Bridge introduced in previous research (Connor, Hanna, Rennsselear, Wingerter, 2015).

5.1.2. Restrictions on Tour Groups

We propose limiting the size of tour groups. The objective of this step is to decrease congestion on many of Venice's narrower streets that are easily blocked. By implementing this step the city will be able to take direct steps to improve the everyday life of residents (**See A7**).

5.1.3. Improving City Signage

We propose redesigning current city signage according to the sign design procedure we also proposed. The objective of this step is to improve the quality of each sign while reducing the overall number of signs. This measure is directed at helping tourists but requires input from residents to ensure that the signs are appropriate for Venice. This step would also allow the city to research controllable signage which could be used in emergency situations or future tourism needs. For more information about our signage proposal, see **Chapter 6**.

5.2. Short Term Steps

This phase focuses on preparing the city for long term solutions. This includes creating management infrastructure and raising capital for the construction of additional infrastructure for long term solutions. The steps included in this phase are:

1. Digital Access Infrastructure
2. Funding Medium and Long Term Steps

These steps are designed to be implemented simultaneously.

5.2.1. Digital Access Infrastructure

We propose creating new tourism systems that both provide tourists a better experience in Venice while creating direct lines of communication between the city and tourists who plan on visiting. We propose that these systems become a new city card, a redesigned website, and a mobile app that integrates with both seamlessly.

The new universal city card we propose is designed in order to be valuable and easy to use. As opposed to the current system, which requires tourists to seek out and purchase the card, this card will be offered for free as a part of the mobile app or for a small €2 fee for the physical card. The card will have options available for purchase that are useful for both tourists and residents. Residents will be able to, with proof of residence, claim a resident version of the card with larger discounts. Commuters will have a similar deal, where with proof of employment they will get a commuter version of the card that must be claimed again each year (**see A2**).

The redesigned tourism platform is designed to be fully integrated with the city card, so that viewing information on any of the card's offers will allow for purchase of that offer directly. It will also serve as the new host for the emergency notification system developed in the previous phase (**see A3**).

The third initiative we propose for creating city-owned infrastructure for tourism is a mobile application that integrates with the previous two initiatives. Full card functionality being available for free on mobile will help adoption of the card by tourists, and easy access to the information available on the website (**see A4**).

Once these systems are in place, important messages and changes are easily communicable along the channels tourists are already involved with. Messages can be displayed on the top of the website, as a notification in the app, or on the pages used to make purchases for

the city card. Through this, larger changes to the process are possible while keeping tourists informed and the systems simple.

5.2.2. Funding Medium and Long Term Steps

We propose expanding limited-traffic zones (ZTLs) to include all manner of vehicles coming into the city (bus, car, boat, ship, train) and charging any tourists on those vehicles a fee. Rather than attempting to deter tourists with a large fee, we propose to implement ZTLs with a small fee with the objective being to raise money for the city. Our estimates show that the ZTLs would generate enough money to fund our long term solutions (**see A6**).

5.3. Medium and Long Term Solutions

These phases are designed to improve the quality of life for residents and commuters and the experience for tourists by decreasing the number of people in the city. The steps included in these phase are:

1. Control Access to St. Mark's Square
2. Control Access to the Old City of Venice

These phases are designed to be implemented in chronological order. We propose implementing the second phase only if the first phase has been deemed ineffective which means that the problems associated with tourism have not decreased.

5.3.1. Control Access to St. Mark's Square

For this phase, we propose limiting access to St. Mark's Square through the implementation of an access pass system (**see A8**) built on our proposed city card using a dynamic pricing model. Access passes are then checked at several entrances and exits around the square (**see A9**). By limiting access to St. Mark's Square, the overall number of people visiting Venice is expected to decrease, which would in turn reduce many of the problems associated with tourism.

5.3.2. Control Access to the Old City of Venice

The next phase, if the previous proves inadequate, should be creating hubs around Venice. They will act as mandatory entrance points for everyone entering Venice and require the same access pass mentioned above. The objective is to decrease the overall number of people entering Venice to reduce the problems associated with tourism. This measure is directed at tourists, and therefore, residents and commuters will have free access to Venice at all times (**see A10**).

6. Signage Proposal

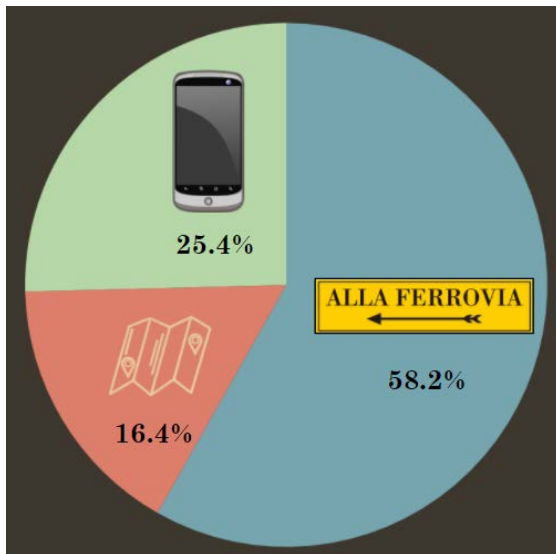


Figure 8: Navigational Aid Usage

Large numbers of people use some form of navigational aid in Venice and the majority of those people use signage. We found that of the 5,400 people we observed 910 used some form of navigation. We believe this number does not entirely reflect the percentage of people using navigational aids due to nature of our observation method. We observed two intersections and only counted people when they were in the intersection or incredibly close to it. Therefore, it is possible more people were using navigational aids either directly before or directly after reaching the intersection but we were unable to observe them. Of the 910 people we did observe using navigational aids, 58 percent of them used signage in some capacity, including determining directions based on signs as well as noting street

names to locate themselves in Venice.

This signage is not perfect and requires additional aesthetic and functional improvements. When following the sign path between the Rialto Bridge and St. Mark's Square, we discovered several locations where additional unofficial signage had been added (**Appendix E**). This additional signage reinforced the idea that the current signage does not convey all of the information that people are looking for. Additionally, we noted several locations where multiple signs were placed which added unnecessary clutter to the walls.

We developed a procedure for testing new signage in Venice by a series of successive focus groups and/or surveys of the public (full proposal in **Appendix B**). The procedure divides testing into several categories: the type of sign to use, the information that should be displayed on a sign, and the most visually appealing styles, all of which are combined into prototype signs that are then tested for effectiveness in the streets. This procedure can help the city determine whether the current signage needs to be changed, and if so, how to change it based on public opinion.

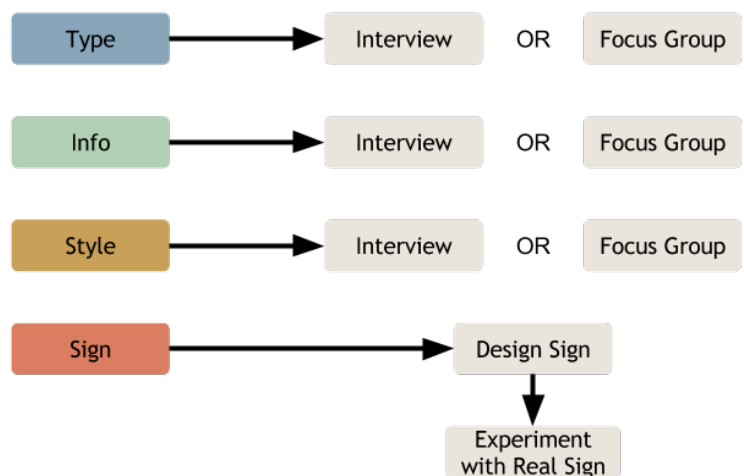


Figure 9: Sign Testing Procedure

7. Conclusions and Recommendations

The problems caused by tourism in Venice continue to grow every year as does the discussion about how to solve them. The ideas we present will contribute important information for identifying the steps that need to be taken and how to begin the process. Tourism and tourism management are multifaceted issues, and our research and plans are designed to highlight and address the most important of those facets. Much of our work focused on the application of modern technologies to these problems, as computerization and automation can open up many possibilities that were not available for past attempted solutions. Cities and sites around the world have begun incorporating these technologies into their tourism management solutions, and we think Venice has the ability to make large changes that address these problems and put the city at the forefront of modern tourism management.

Along with our proposal, we have identified several areas that would benefit from focused future research, especially in regards to specific interventions, as well as an interesting research opportunity to study the movements and motives of tourism in Venice.

Recommendations on Signage

The completion of our signage booklet provides an opportunity for both the city of Venice and the VPC to conduct more research into the city signage. We recommend the VPC work closely with the city to facilitate improving the signage in Venice. If the booklet interests the city, we recommend that a procedure be created and tested following the guidelines we laid out. The VPC can also contribute information towards that goal by studying individual parts of the procedure to understand what residents and tourists would like signs to be. Additionally, we recommend studying possible flow routes within the city to improve both the location of signs and possibly determine evacuation routes to improve Venice's emergency preparedness. These recommendations provide a first step to take towards improving city signage and help Venice address their tourism problem.

Recommendations on Saint Mark's Square

Our next recommendations center around a study into the habits of tourists who visit Saint Mark's Square and attempts to prove the belief that the majority of tourists visit Saint Mark's Square. Multiple sources state that the majority of tourists visit Saint Mark's Square during their stay in Venice; however, we did not find a study verifying that statement.

We also recommend that the VPC or city begin in depth research on how to control Saint Mark's Square, including understanding how people enter and exit the square, how long they stay there, where they come from, and where they go after leaving. This information will prove helpful when determining how to control access to the square as recommended in our proposal and allow for the refinement of our ideas into a detailed plan of implementation.

Recommendations on Implementation of Tourism Management Solutions

We recommend taking steps towards implementing the immediate recommendations of our proposal. Before progressing further on our proposal, we recommend that the VPC discuss our proposal with city leaders to contribute further information towards their proposal and discuss additional areas of research. One area that would be especially useful is a study to understand how people currently enter the old city.

If the city likes the ideas presented in our proposal, we recommend that the VPC begin working on prototyping the emergency mobile application and website. Additionally, the city should begin research into the legality of the medium- and long-term solutions we propose, and whether they can be made to work given European and Italian laws about the free movement of people. These plans also require strict definitions of what the categorizations of tourist, resident, and commuter entail, and the city should look to strictly define these terms. With these defined, research into how other cities manage friends and family of residents being invited to visit and whether those solutions would be acceptable to residents of Venice should be conducted.

These recommendations would strengthen the connection between the VPC and city and position the VPC to become a central partner in managing tourism in Venice, as well as lead to meaningful positive change against the tourism issues plaguing the city.

Bibliography

- [ABC Australia.] (2007, October 17). *Venice Under Siege [Video File]*. Retrieved August 28, 2017, from <https://www.youtube.com/watch?v=XrOoW38JWsw>
- About Notify NYC. (n.d.). Retrieved December 10, 2017, from <https://a858-nycnotify.nyc.gov/notifynyc/About.aspx>
- An emergency alert system for Europe - Horizon 2020 - European Commission. (2017, October 12). Retrieved December 10, 2017, from <https://ec.europa.eu/programmes/horizon2020/en/news/emergency-alert-system-europe>
- Assessorato al Turismo della Città di Venezia. (2014). *Annuario del turismo 2014*. Venice, Italy.
- Assessorato al Turismo della Città di Venezia. (2015). *Annuario del turismo 2015*. Venice, Italy.
- Best, C. (2017, July 27). Venice introduces 12 golden rules in new responsible travel campaign. Retrieved September 14, 2017, from <http://us.hellomagazine.com/travel/2017072741001/venice-12-golden-rules-tourism-campaign/>
- Borg, J. V., Costa, P., & Gotti, G. (1996). Tourism in European heritage cities. *Annals of Tourism Research*, 23(2), 306-321.
- Bridge. (2014) Retrieved from <http://www.venipedia.org/wiki/index.php?title=Bridge>
- Burgen, S. (2017, January 27). Barcelona cracks down on tourist numbers with accommodation law. Retrieved September 21, 2017, from <https://www.theguardian.com/world/2017/jan/27/barcelona-cracks-down-on-tourist-numbers-with-accommodation-law>
- Capua, M. R., Guyette, J. L., Hetherman, B. J., & Hock, L. A. (2012). The impact of tourism on the venice public transportation system. Worcester: Worcester Polytechnic Institute.
- Casagrande, M. (2016). *Heritage, tourism, and demography in the island city of venice: Depopulation and heritagisation*. (). Retrieved from <https://drive.google.com/file/d/0B87jz200TNjnby1FTlM3VkhPWVE/view?usp=sharing>
- Cardone, A. (2017, September 12). Concerns about future, identity grow in Venice amid influx of tourists. Retrieved September 16, 2017 from http://news.xinhuanet.com/english/2017-09/12/c_136604363.htm

- Carrera, F. (2016, December 5). FC: Soluzioni 'made in Venice' per un turismo sostenibile (breve). Retrieved September 26, 2017, from https://docs.google.com/presentation/d/1mflWZVNO7_aQjSpcFhgpgq9g5ip7k393741riqp-b8Hk/edit#slide=id.g19f9fb6e13_0_56
- Carrera, F. (2016). Promemoria per un futuro sindaco di Venezia. Retrieved November 1, 2017 from https://docs.google.com/document/d/1GMDAIsPBRRk-UPEB8bfvQBNVrE2h_CLRo2jTIIICyGM/edit#heading=h.pzhpesf06ohj
- Carroll, M. J. (2010). Design Resources. Retrieved September 30, 2017, from <http://www.udeworld.com/documents/designresources/pdfs/TextLegibilityandReadabilityofLargeFormatSignsinBuildingandSites.pdf>
- Chrisafis, A. (2016, June 08). France launches smartphone app to alert people to terror attacks. Retrieved December 10, 2017, from <https://www.theguardian.com/world/2016/jun/08/france-smartphone-app-alert-terror-attacks-saip>
- Comune.venezia.it. (n.d.). Number of tourist overnight stays in the city of Venice, Italy from 2003 to 2015 (in 1,000s). In Statista - The Statistics Portal. Retrieved September 23, 2017, from <https://www.statista.com/statistics/732551/overnight-stays-in-venice-italy/>
- Connor, C. J., Hanna, T. S., Rennselaar, W. V., & Wingerter, Z. R. (2015). *Safe and Sustainable Tourism: Managing Venice's Millions of Visitors*. Worcester: Worcester Polytechnic Institute.
- Constitution of Italy, 1947. Articles IX and XVI.
- Declaration of Madrid, 2010, Presidencia Española de la Unión Europea. 4.
- Demographics. (n.d.). Retrieved December 10, 2017, from <http://www.venipedia.org/wiki/index.php?title=Demographics>
- De Steiguer, J. E. A Student's Guide to Cost-Benefit Analysis for Natural Resources. Retrieved September 30, 2017 from <https://cals.arizona.edu/classes/rnr485/ch5.htm>
- Electro Automation (n.d.) Retrieved December 10, 2017, from <http://www.turnstiles-northern-ireland.co.uk/wp-content/uploads/brochures/Electro-Datasheet-SpeedBlade.pdf#zoom=75>
- Engel, K. (2017, November 29). How Much Does a Website Cost? Retrieved December 10, 2017, from <https://www.whoishostingthis.com/blog/2014/07/29/website-cost/>
- Entrypass Corporation (n.d.) Retrieved December 10, 2017, from <http://www.entrypasse.net/w3v1/products/uhf-reader-tag/upass-reach-0>

- EXNOVO. (2017, April 07). 2017 Barcelona's new hotels regulation in force. Retrieved September 21, 2017, from <http://exnovo-rehs.com/en/2017-barcelonas-new-hotels-regulation-in-force/>
- GrilliVenezia. (2017). *ZTL Revolution [PowerPoint slides]*. Retrieved September 16, 2017 from <http://www.grillivenezia.org/wordpress/2017/06/04/ztl-revolution/>
- Hawkins, D.E., Chang, B., & Warnes, K. (2009). A comparison of the National Geographic Stewardship Scorecard Ratings by experts and stakeholders for selected World Heritage destinations. *Journal of Sustainable Tourism*, 17(1), 71–90.
- Home. (n.d.). Retrieved December 10, 2017, from <http://www.turnstiles-northern-ireland.co.uk/turnstiles/speedblade-turnstile/>
- Hop on hop off. (2017). Retrieved from <https://www.salzburg.info/en/hotels-offers/guided-tours/hop-on-hop-off>
- Hop-on, hop-off bus tours. (2017). Retrieved from <https://www.hop-on-hop-off-bus.com/>
- Horowitz, Jason. (2017, Aug 2.) Venice, Invaded by Tourists, Risks Becoming ‘Disneyland on the Sea.’ *The New York Times*. Retrieved September 4, 2017 from <https://search.proquest.com/docview/1925064453>
- HOW IT WORKS. (2016, November 02). Retrieved September 14, 2017, from <http://www.veneziaunica.it/en/content/how-it-works>
- Imboden, Durant, Imboden, Cheryl. (2017). Walking in venice page 4. Retrieved from <http://europeforvisitors.com/venice/articles/finding-your-way-in-venice-street-signs.htm>
- International tourist arrivals worldwide 2016 | Statistic. Retrieved December 10, 2017, from <https://www.statista.com/statistics/209334/total-number-of-international-tourist-arrivals/>
- Jones, J.A., Walton, F., Smith, J.D., Wolshon B. (2008). *Assessment of Emergency Response Planning and Implementation for Large Scale Evacuations*. Retrieved December 10, 2017 from <https://www.nrc.gov/docs/ML0829/ML082960499.pdf>
- Kohyama, H. (2006, May 22). *Selecting Discount Rates for Budgetary Purposes*. (Harvard Law School Federal Budget Policy Seminar). Retrieved September 30, 2017 from http://www.law.harvard.edu/faculty/hjackson/DiscountRates_29.pdf
- Kottasová, I. (2017, August 25). These European cities are fed up with tourists. *CNN Money* Retrieved from <http://money.cnn.com/2017/08/25/news/economy/tourism-backlash-europe/>

- Larson, L. R., & Poudyal, N. C. (2012). Developing sustainable tourism through adaptive resource management: a case study of Machu Picchu, Peru. *Journal of Sustainable Tourism*, 20(7), 917-938.
- Logar, I. (2009). Sustainable tourism management in Crikvenica, Croatia: An assessment of policy instruments. *El Sevier*, 31, 8.
- Magraw, L. T. (2013, April 15). Is Tourism Destroying the World? National Geographic. Retrieved September 16, 2017, from <http://intelligenttravel.nationalgeographic.com/2013/04/15/is-tourism-destroying-the-world/>
- Mink, J. (2009, January 19). Top 5 Endangered Heritage Sites - Tourism. Retrieved September 16, 2017, from <http://www.cyark.org/news/top-5-endangered-heritage-sites-tourism>
- Menu principale di navigazione. (n.d.). Retrieved December 10, 2017, from <http://archive.comune.venezia.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/242>
- Movimento 5 Stelle. (2017, May 18). Programma Turismo: Movimento 5 Stelle. Retrieved September 22, 2017 from <http://www.movimento5stelle.it/programma/turismo.html>
- Notify NYC App. (n.d.). Retrieved December 10, 2017, from <http://www1.nyc.gov/site/em/resources/notify-nyc-app.page>
- Overnight tax. (2014). Retrieved from <http://www.sleepinitaly.com/overnighttax>
- Pass4Venice (n.d.). Retrieved December 10, 2017, from <http://www.pass4venice.org/pres/assets/player/KeynoteDHTMLPlayer.html#0>
- [PBS NewsHour.] Irresistible to tourists, has venice become unwelcoming to its inhabitants? [Video File.] Retrieved September 4, 2017 from <http://www.pbs.org/newshour/bb/irresistible-tourists-venice-become-unwelcoming-inhabitants/>
- Perillo Tours Inc. (2017). Tourist city taxes in Italy. Retrieved from <https://www.italyvacations.com/tourist-city-taxes-italy>
- Piano Comunale di Protezione Civile. (n.d.). Retrieved December 10, 2017, from <https://www.comune.venezia.it/it/archivio/6197>
- PYMNTS (2015, October 15). The Cost Of Loyalty For Retailers. Retrieved December 10, 2017, from <https://www.pymnts.com/in-depth/2015/the-other-side-of-loyalty>

- Reinfeld, M. (2003). Tourism and the Politics of Cultural Preservation: A Case Study of Bhutan. *Journal of Public and International Affairs*, 14, 13-16.
- Scurati, M. (2013). San Marco Pass. Retrieved from <https://flussiturismo.wordpress.com/>
- Strutner, S. (2013). Fake Venices in China, Korea prove that Venice is one of everyone's favorite cities. Retrieved from http://www.huffingtonpost.com/2013/11/28/fake-venice_n_4181552.html
- Tourism Council of Bhutan. (2017). Tourism Council of Bhutan FAQ. Retrieved on September 26, 2017 from <http://www.tourism.gov.bt/plan/faq#>
- UNWTO. (n.d.). International tourist arrivals worldwide from 1990 to 2016, by region of origin (in millions). In *Statista - The Statistics Portal*. Retrieved September 15, 2017, from <https://www.statista.com/statistics/273694/international-tourist-arrivals-by-region-of-origin-worldwide/>.
- Venice's Official City Pass. (2014). Retrieved from <http://www.veneziaunica.it/en/content/musei-civici-venezia>
- Venipedia. (2015). Venipedia Demographics. Retrieved on October 2, 2017 from <http://www.venipedia.org/wiki/index.php?title=Demographics>
- WTTC. (n.d.). Direct and total contribution of travel and tourism to the global economy from 2006 to 2016 (in trillion U.S. dollars). In *Statista - The Statistics Portal*. Retrieved September 15, 2017, from <https://www.statista.com/statistics/233223/travel-and-tourism--total-economic-contribution-worldwide/>.

Appendix A: Individual Interventions

Below is listed all of the individual interventions used in each step of our tourism management proposal, as well as more information about each.

A1: Emergency Notification System

We propose an emergency notification system as an immediate enhancement to Venice’s current systems. This system is designed to notify residents and tourists about warnings and emergencies that will help the entire city respond to circumstances in an organized and safe manner. The system itself is a mobile application and accompanying website, which display all warning and emergency notifications that are currently important to people in the city. These notifications all include specific information including the time and date, a description of the problem, the location it is occurring or affecting, and the proper response. They should be available on the website translated into the most common foreign languages to be accessible to as many tourists as possible. If possible, deals with the telecommunication companies to allow special notification communications, or custom SMS messages, should provide the required information to the app, with further information and translations available on a linked website that does require an internet connection.

Mockups

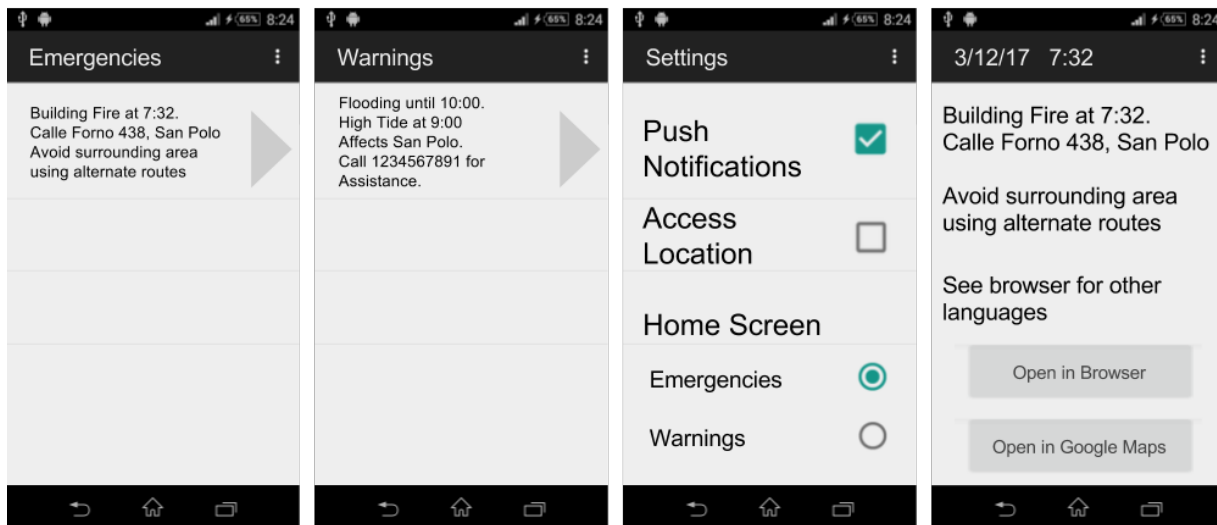


Figure 10: Emergency Notification Mobile App

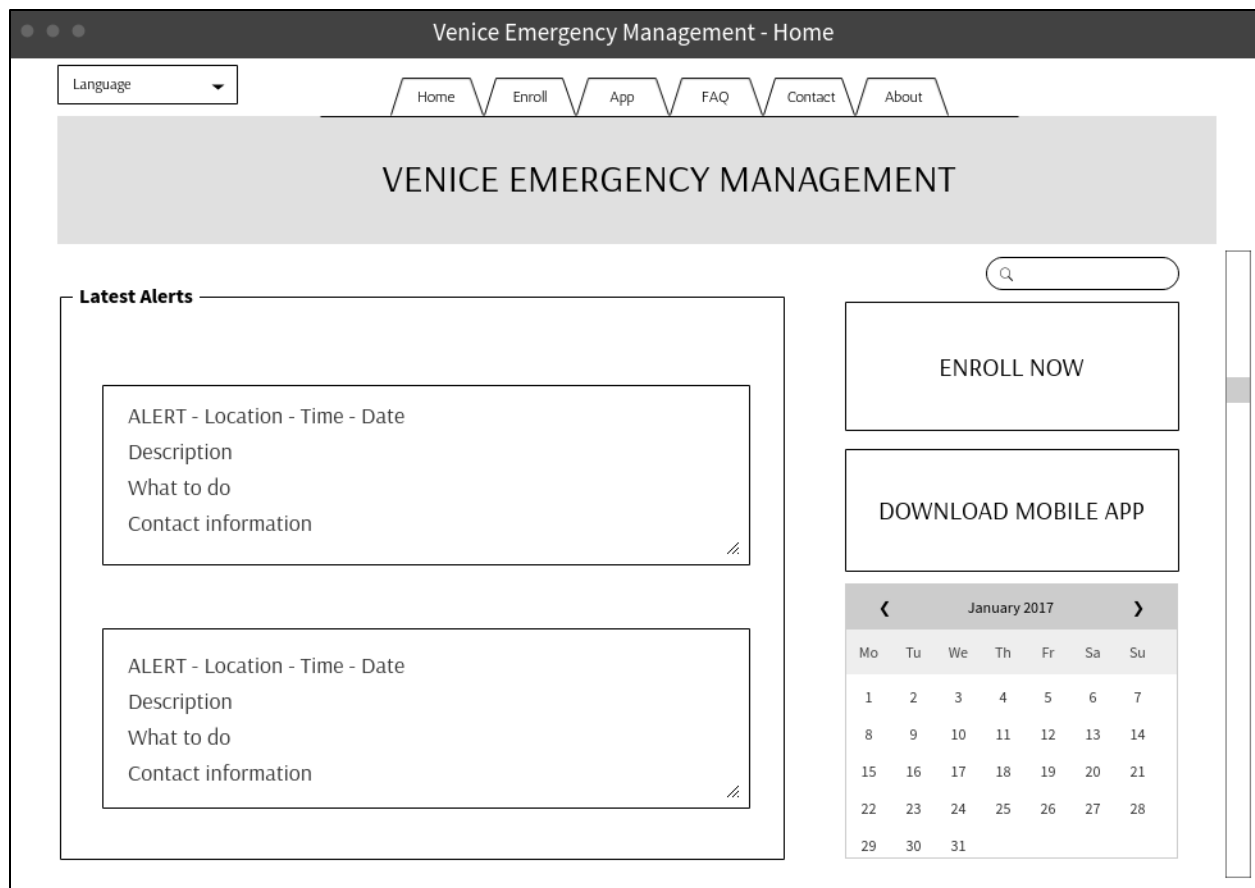


Figure 11: Emergency Notification Website

A2: Universal City Card

A city card is designed as a comprehensive, personalized system for obtaining and using benefits and offers from the city and city partners all on one platform. This can be used for both residents and tourists, and it should have a simple method for purchasing and adding options to the card through a website. The card can be physical and/or digital, with the physical version containing an RFID chip for easy scanning and the digital version being connected to a larger mobile platform.

Functions

The universal city cards should be created with various options made available to users:

Table 4: Functions of Universal City Card

Function	Description	Justification
Access Pass (only available once medium or long term steps have been implemented)	Allows access to restricted areas (such as St. Mark's Square or the entire historic city of	Allowing the city card, physical or digital, to be scanned at pass checks creates a simple system and keeps

	Venice).	tourists from having to deal with multiple passes or tickets for various amenities.
Public transportation booking, discounts	Allows for the options to add public transport at a discount on both the ACTV and Alilaguna systems.	Makes travel to different parts of Venice simple for tourists and helps to reduce street congestion.
Museum & church booking, discounts	Allows for booking of visits to churches and museums, with discounts.	By varying the pricing structure, this should be redesigned to promote the smaller museums in the city and help clear congestion issues at the more popular sites.
Guided tour booking, discounts	Offers guided tours by the city pass at discounts through partnerships with tour companies.	Guided tours through the city are exceptional for conveying history and cultural norms to tourists.
Car parking	Allows loading of parking passes for Tronchetto and Piazzale Roma lots.	Combining parking passes with all other passes on one card simplifies one's experience in Venice.
Wi-Fi access	Grants access to public Wi-Fi available in the most popular parts of the city.	Public Wi-Fi allows tourists to easily find out more about the city and how to navigate it. Also provides incentive for using card.
Restaurant discounts	Restaurants can partner with the city and offer discounted meals to those who use the card to purchase them.	Encourages more tourist spending at local establishments.
Bathroom access	Provides access to the public paid bathrooms.	Provides incentive for using card.
Store discounts	Certain shops in Venice, especially those selling Venetian artisan goods, could partner with the city to offer discounts on goods primarily aimed at tourists.	Encourages more tourist spending at local shops.
Resident/Commuter option	A specific version or option on the card that requires proof of residence or work in Venice, and	Prevents residents and commuters from being hindered by tourists and the system managing tourists — like “fast

	gives heavier discounts, free access to San Marco and/or the city, and the ability to skip tourist lines for public transportation or parking.	lane” access for locals.
--	--	--------------------------

Visualizations



Figure 12: Proposed Universal City Card Options

A3: Online Tourism Platform

The existing tourism website for Venice is designed around the Vènezia Unica card, and should be redesigned as the new city card is implemented. It should clearly provide information about the card's systems and offered options, including a link to download the mobile application. The website should have a sleek and modern design, with clear organization that makes the various pages easy to find and use effectively. It also should be equipped for mobile and tablet traffic, be available in several common languages, and link to our proposed emergency notification site. The universal city card should be fully integrated into this website, so that informational pages show links to applicable packages and purchases that can be loaded onto the card.

Effect on Tourism

The website would provide tourists with a comprehensive source of information about the city card and more streamlined process for visiting Venice, encouraging greater use of all of the services offered within the city. At the same time, the website would encourage tourists to expand their plans and do more than visit the most popular sites in Venice.

Cost Analysis

Creating the website could cost anywhere between €700 and €5000, depending on the skill of the web developers hired (O'Connor). Of this, design can cost between €400 and €2500, and creating actual content typically costs about €85 per page when using professional web agencies. The average starting price to create e-commerce websites is €1900 in the UK and €2200 in the US (Engel). The cost of purchasing a web domain would be negligible, though there would be an annual cost of around €85 per month to host the site on dedicated servers (Engel).

Buying Domain	Negligible
Web Hosting	€1020/yr
Site Design and Content Creation	€5000
Total	€6020 for first year, €1020/year thereafter

A4: Mobile Information Platform

This application will be designed in order to provide an easy system to access important information while in the city. It should follow all of the principles of modern application design, and be available for both Android and iOS devices. The home page of the app will be a list of the available features, allowing users to easily and quickly navigate to the feature they plan to use.

Features

This application will contain two major features:

- Emergency Notifications
- Digital City Card

The emergency notifications section will be the app recommended in Section A1, with the rest of this application built around it.

The digital city card portion of the app will use the phone's NFC (Near Field Communication) system or displayed QR codes to communicate with devices around the city to check for purchased packages and make transactions. It will also contain links to the mobile version of the website that allows for further purchases. This should allow the app, for those that have it, to replace the need for a physical city card.

Effect on Tourism

This application is designed to be a companion app for tourists, as well as possibly useful and informative for residents who make use of the city card and want emergency notifications. Overall, this helps streamline the tourism process for tourists, and allows them to focus more on all that Venice has to offer. The app can also promote guidelines for “smart tourism” — general rules for how to behave in Venice.

Cost Analysis

Costs for this intervention are development and then server hosting and maintenance. It is possible much of the development can be done while creating the website, and can be added on to those costs. There is also the necessity of keeping the app updated with current information, which may require new personnel be hired and trained on the system in place.

Visualizations

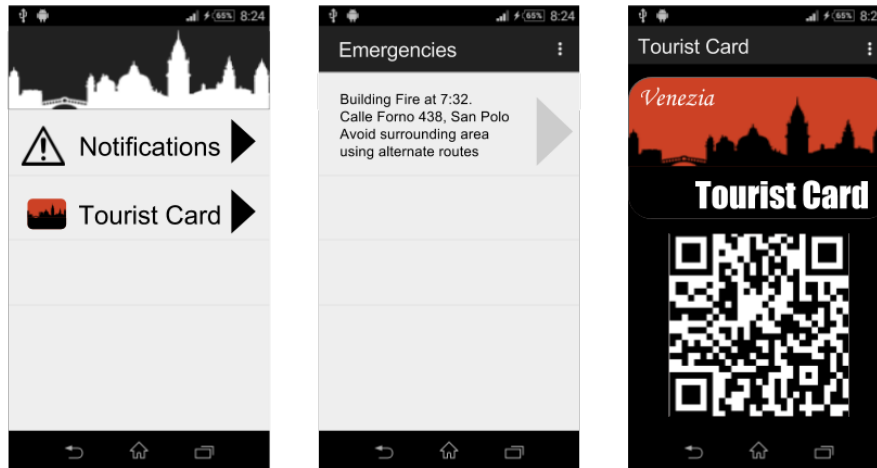


Figure 13: Proposed City Card Mobile App

A5: Improved Signage

We developed a procedure for testing new signage in Venice by a series of successive focus groups and/or surveys of the public (full proposal in **Appendix B**). The procedure divides testing into several categories: the type of sign to use, the information that should be displayed on a sign, and the most visually appealing styles, all of which are combined into prototype signs that are then tested for effectiveness in the streets.

Effect on Tourism

Improved signage has the potential to keep tourists from getting lost when attempting to navigate Venice's confusing layout of streets. Confused pedestrians often cause bottlenecks by walking slowly and erratically, stopping suddenly, and doubling back when lost, which can impede the movement of residents and commuters. Furthermore, adding more signage related to safety, such as signs pointing to the hospital and ways to get out of the city in the event of an emergency, can aid anyone in need of help who does not know the city layout well.

A6: Limited Traffic Zone

This intervention takes the existing concept of ZTLs (*Zone a Traffico Limitato*) in Italy and extends it to travel into and out of the old city of Venice. ZTLs currently are only used for automobiles but may be extended to trains and water vehicles. They are used in order to limit traffic pollution and congestion in historic areas and raise revenue for local governments. They declare an area as off-limits at certain times of the day to anyone without a specific pass providing the right to drive through, and charging violators large fees through an automatic system of traffic cameras.

For Venice, with no car traffic inside of the city and only one entrance (Ponte della Libertà), this would have to be adapted. The idea would be to expand this to all vehicular modes of travel into the city, charging a small fee to both public and private vehicles. For public transportation managed by private companies, such as water and land buses and the trains, the city would deal with the companies, charging them a fee per passenger, which the companies could then add to their ticket prices for each passenger (*ZTL Revolution*). Similarly, cruise companies would be charged per passenger on arrival. For private cars, a simple system would be to add the ZTL fee to the parking price.

Effect on Tourism

The effect on tourism of implementing a ZTL is minimal, with the small added fee likely to have little deterrent effect on tourists traveling to Venice. The primary reason for implementing a ZTL is raising funds to support other interventions and city improvements by using the unique nature of Venice as an island with specific arrival options.

Cost Analysis and Implementation

We split ZTL implementation into three possible options:

- (1) Charge both day-trippers and overnighers the same fee (€6)
- (2) Charge day-trippers double that of overnighers (€6 and €3, respectively)
- (3) Charge day-trippers double that of overnighers, but give overnighers the option to pre-register for the city card and pay nothing (€6, €3, and €0, respectively)

The projected revenue from each plan is shown below (COSES, 2009; Assessorato, 2015). Detailed calculations and assumptions used can be found in **Appendix C**. We assumed that three-quarters of all tourists will pay these fees.

Table 5: ZTL Projected Revenue by Transportation Method

Transportation Method	Details	Option 1 Annual Profits	Option 2 Annual Profits	Option 3 Annual Profits
Car	Extra fee on parking at Tronchetto, Piazzale Roma	€2.4 million	€2.3 million	€2.2 million
Bus	Add fee to tickets for buses that stop in Piazzale Roma	€24 million	€23.5 million	€23.3 million
Train	Add fee to tickets for trains coming to Santa Lucia Station	€48.2 million	€46.7 million	€46 million
Cruise Ship	Add fee to cruise tickets	€9.5 million	€8.4 million	€7.9 million

Boat	Add fee to tickets for ACTV lines	€16.3 million	€14.5 million	€13.5 million
Combined		€100.4 million	€95.4 million	€92.9 million

The increased revenue of charging the flat rate in (1) is 5% greater than the revenue generated from (2) and 8% greater than the revenue generated from (3). Since this is a small percent increase in revenue, choosing plan (1) over (2) or (3) is not vital, especially when plan (3) can be coupled with incentives to spend money in the city of Venice. We recommend plan (3) because it incentivizes overnight stay. Overnighters who pre-register with the universal city card will likely spend more money around the city, with the city only losing a small percentage of revenue for reimbursing the overnighters the cost of the fees.

Additionally, the costs associated with implementing these ZTLs would be minimal and are as such neglected (*ZTL Revolution*). A system would need to be in place to distinguish between residents and non-residents but could easily use the city card that already differentiates between them. For overnighters who do or do not pre-register with the city card, it makes the most sense to charge them the full €6 and then refund the €3 or €6 when they reach their hotel upon showing travel receipt and city card. Thus, it is neither a matter of cost nor infrastructure to implement new ZTLs.

Visualization

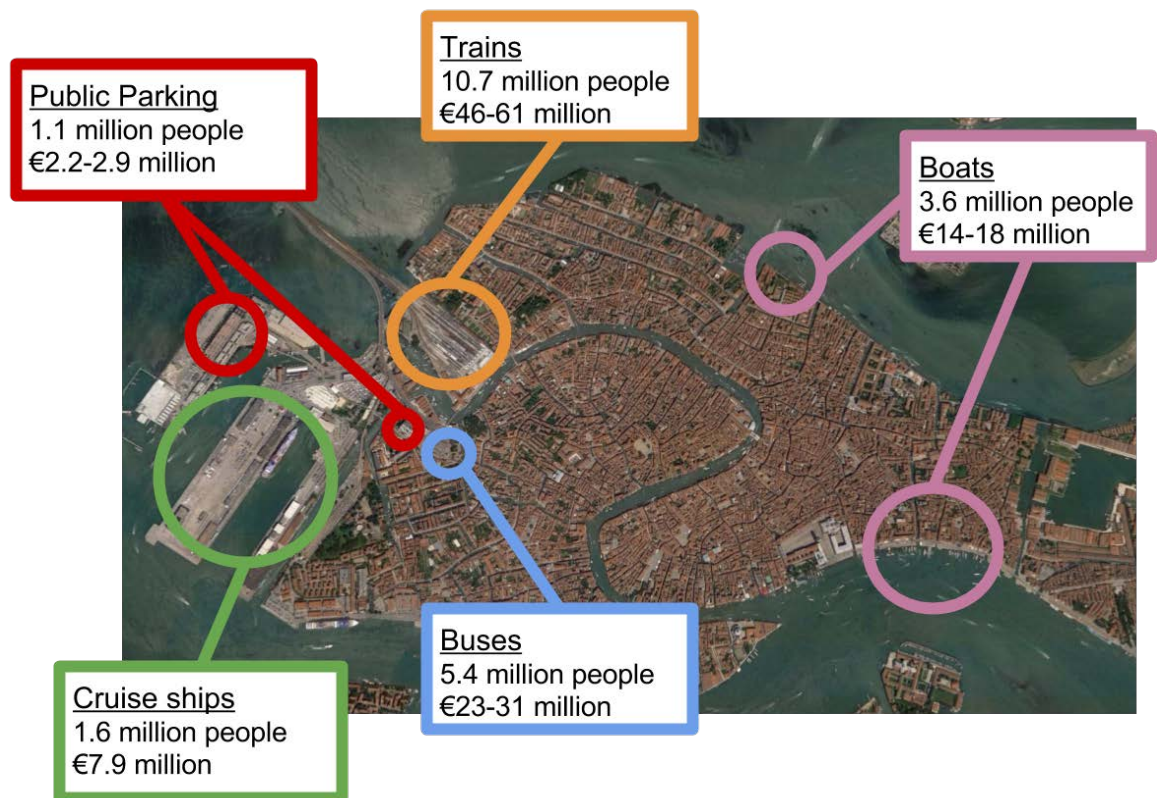


Figure 14: Map of ZTL Implementation

A7: Tour Group Size Regulation

This intervention would limit the size of tour groups. We propose that the city passes a regulation requiring tour companies to limit the size of their tours. Our research shows the average group size is 24 people and the median group size is 22. Therefore, we propose the limit be set at 20 people.

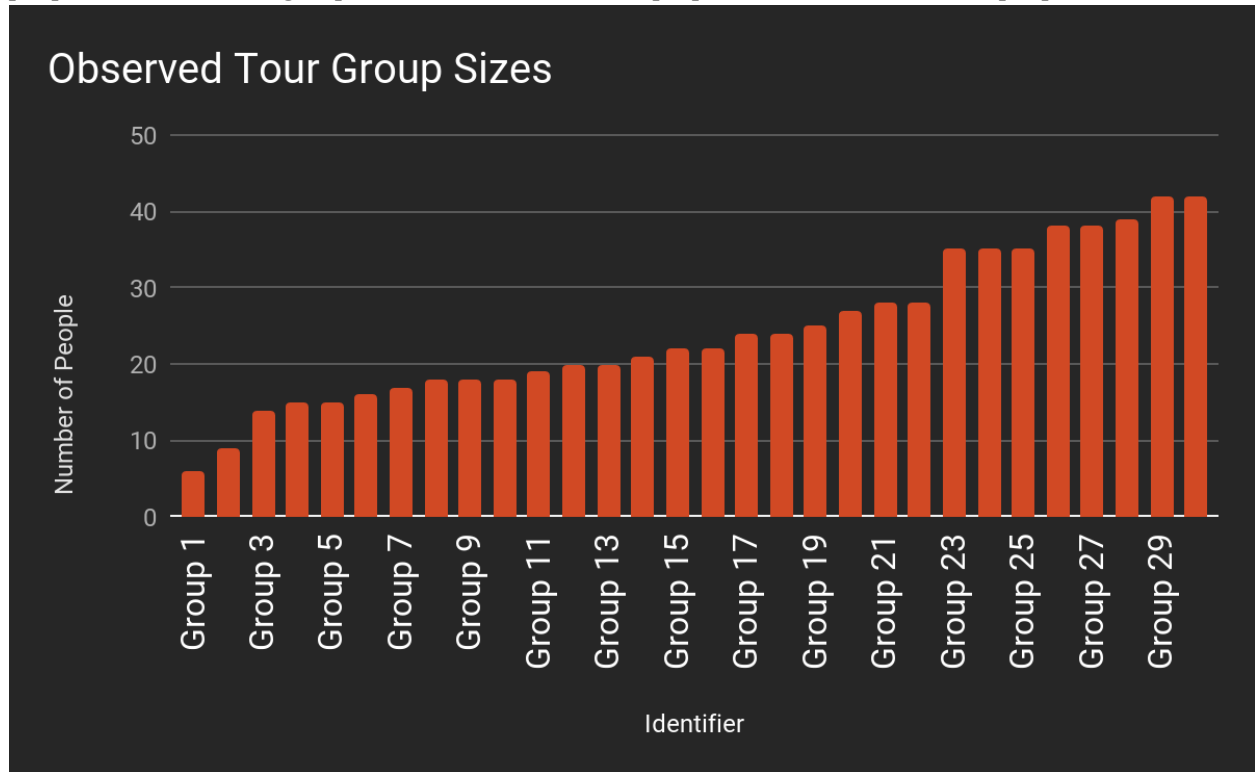


Figure 15: Observed Tour Group Sizes

The tour companies would be responsible for limiting their tours and could be fined for not complying with the regulation. Local police would be tasked with ensuring tour groups comply with regulations.

Effect on Tourism

This step would reduce congestion around the city by preventing large groups from blocking small streets. Additionally, tour guides will be able to better manage the group and help to prevent disruptive behavior.

Cost Analysis

The cost of this intervention will be negligible since the tour companies will be required by law to comply, and the local police will be able to fold this responsibility into their normal role.

A8: Access Pass

This pass is setup to work alongside physical infrastructure to limit access to an area. We propose this pass is built onto the proposed universal city card, as an adaptation and extension of it. For the area being controlled, one of these passes is required for entry. They are designed to be dynamically priced, increasing in cost as more are sold per day. To encourage overnight guests, these passes will be included with hotel stays at no cost to the buyer. Each pass is personalized, as a way of preventing pass hoarding and artificially raising the price. Residents and commuters will be provided free versions of the pass upon proof of residence or employment. There are only a certain number of tourist passes available per day, and no more are sold when those run out.

Effect on Tourism

The implementation of an access pass directly limits the number of tourists able to enter the controlled area. The dynamic pricing helps lower the number of tourists as it approaches that maximum, as a higher price disincentivizes tourism.

Proposed Pricing

Table 6: Dynamic Pricing Model for St. Mark's Square

		Number of Passes Sold				
		<25,000	<40,000	<60,000	<65,000	>65,000
Time of Year	Nov-Mar	€5	€10	€20	€50	X
	Apr-Oct	€10	€20	€40	€100	X

Residents, commuters, and overnight tourists are all exempt from this pricing model and pay nothing. Discounts would be available for various groups such as student groups.

A9: St. Mark's Square Controlled Access

This step is the creation of infrastructure for the implementation of the access pass. It involves restricting access to St. Mark's Square to only those with an access pass, and checking for those passes at the entrances to the square. We propose dividing up access to the square into four different categories: Large group entrances, dedicated resident access, tourist and resident entrances, and dedicated exits (Seen in figure 16). Large group entrances will have large rows of modern turnstiles to support large tour and school groups arriving to see the square, as well as most of the tourist traffic. Dedicated resident entrances are open, with an RFID scanner checking for a resident pass on everyone that passes through. The combined tourist and resident entrances will utilize this technology for residents, and use modern

turnstiles for tourist entrances (example rendered in figure 17). Dedicated exits will be designed for one way traffic flowing out of the square, and may require one way gates or turnstiles that do not require a pass in order to prevent entrance via the exits.

Effect on Tourism

Controlling access to St. Mark's Square is designed to make the square easier to enjoy for residents and tourists, but also help with the tourism issues throughout the city. By charging for access to St. Mark's Square, the intent is to direct tourists to other parts of the city and spread out the congestion. In addition, with a limited number of dynamically priced passes, tourists booking a trip may reschedule their trip when passes are less expensive and help reduce tourists at peak tourism times, or rethink their trip to Venice altogether. In this way, restricting access to one specific part of the city can help reduce congestion in the entire city.

Images

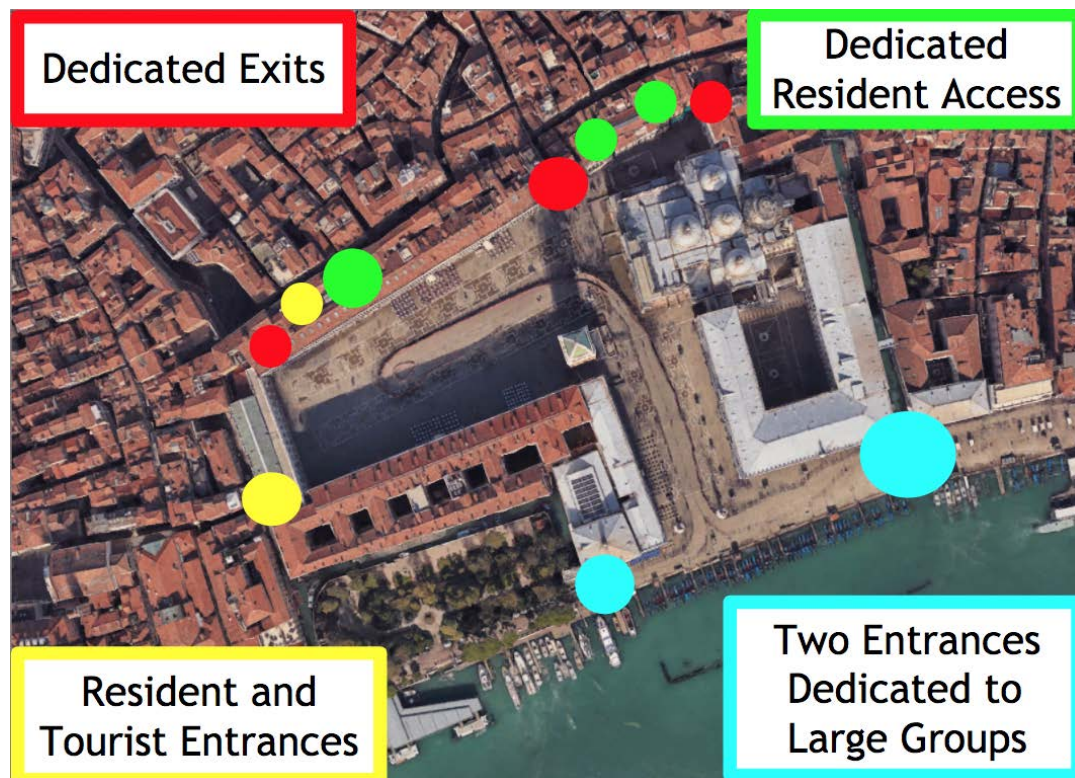


Figure 16: Proposed Entrances and Exits to St. Mark's Square

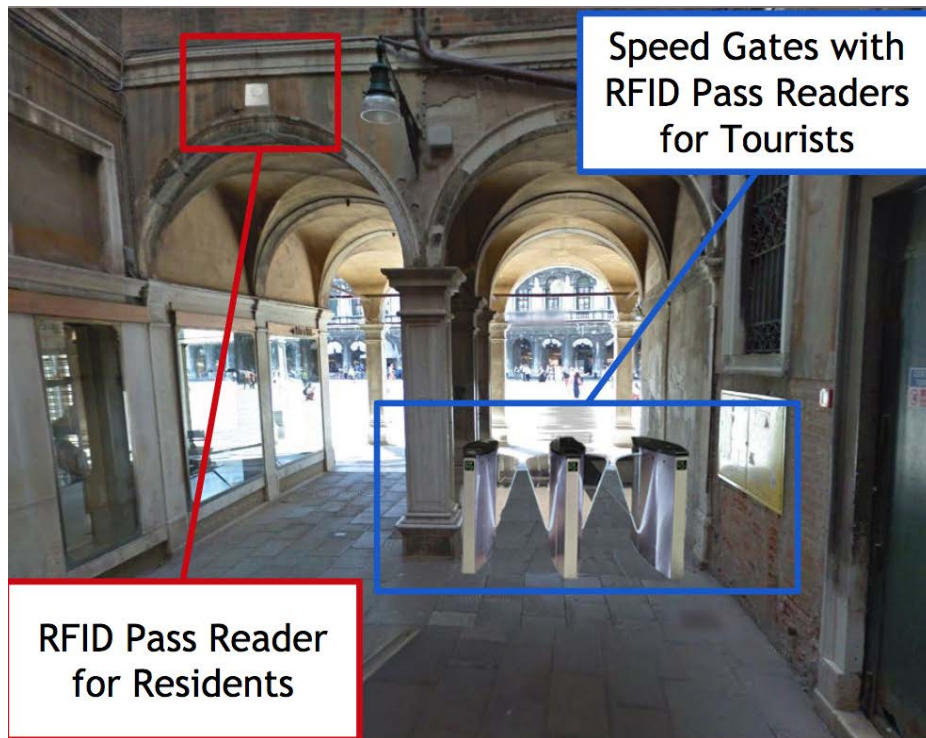


Figure 17: Potential Entrance to St. Mark's Square

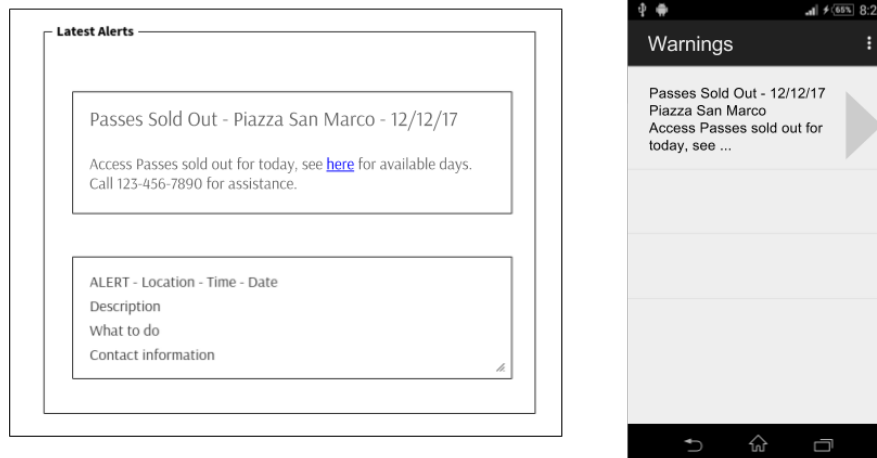


Figure 18: St. Mark's Square Access Alerts

Cost Analysis

The cost to set up Speed Gates (a specific type of turnstile we investigated, due to its safety, speed, and visual appeal) and RFID scanners in the entrances to St. Mark's Square that we propose would be around €140,000. Depending on the actual set-up of dedicated exits, dedicated resident/commuter entrances, and combined tourist/resident entrances, the cost may change. To see the full details of these costs, see **Appendix F**.

This cost, as well as the cost of powering the devices, are minimal in comparison to the potential income from charging tourists to access St. Mark's Square, and the project would be self-funded.

A10: Full City Controlled Access

This intervention is designed to be implemented in conjunction with the access pass previously mentioned as a final step in controlling the number of people entering the old city of Venice. We propose creating twelve new hubs around the city, situated at current transportation hubs, which anyone entering the city would be required to use. These hubs would generally be structured like checkpoints, requiring either a physical or digital access pass to gain entry. Each hub will have a specific lane or line that requires the resident or commuter pass to avoid tourist congestion for residents and commuters.



Figure 19: Proposed Hubs Around Venice

The Hubs

1. Santa Lucia

The purpose of this hub is to control all people arriving by train. We propose using the limited number of exits at the train station to separate between the various groups of people who use the station. Tourists will be directed to leave through the current front of the new station. Tourists will be required to pass through turnstiles where they can scan their access pass before being able to enter the city (figure 21). Residents and commuters will be able to leave through both the main exit or through two side exits to avoid being hindered by large crowds of tourists. Residents will be able to pass through RFID scanners that will scan their pass. This will allow them to pass through the train station hassle free. Entrance to the train station will not require any pass and will be controlled through another set of one way turnstiles.

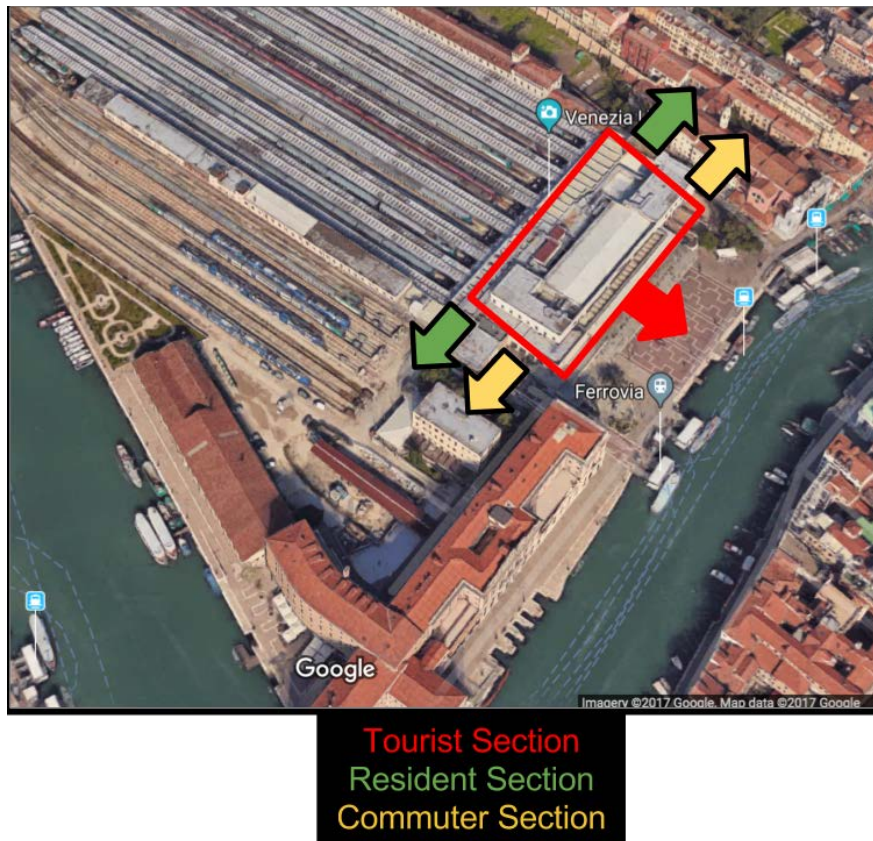


Figure 20: Santa Lucia Station Hub

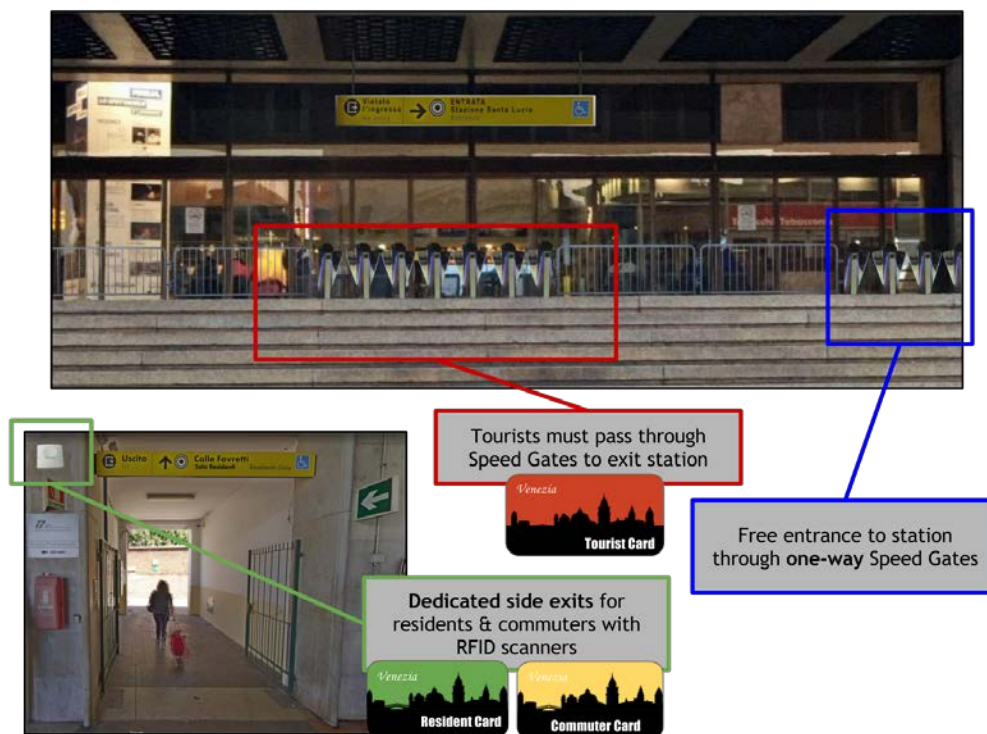


Figure 21: Santa Lucia Station Entrance and Exit Details

2. Marco Polo Airport

This hub will be located at the docks of the airport to control anyone who attempts to reach the old city from the airport. This hub will use turnstiles to ensure that everyone has a pass. Residents and commuters will have a separate line to allow priority access to the docks. The hub will be situated so that all docks will be controlled by these turnstiles.

3. Lido (S.M.E.)

This hub will be located at the Lido (S.M.E.) ACTV station. Passes will be checked before getting on ACTV bus lines that lead to Venice using the existing ACTV infrastructure.

4. Caserma Cornoldi

This hub will adapt the current large dock at Caserma Cornoldi to check passes for private boats not coming from other hubs. Boats carrying tourists, either from cruise ships docked on Porto Marghera or other places around the lagoon, must stop here and let tourists have their passes checked.



Figure 22: Caserma Cornoldi Hub

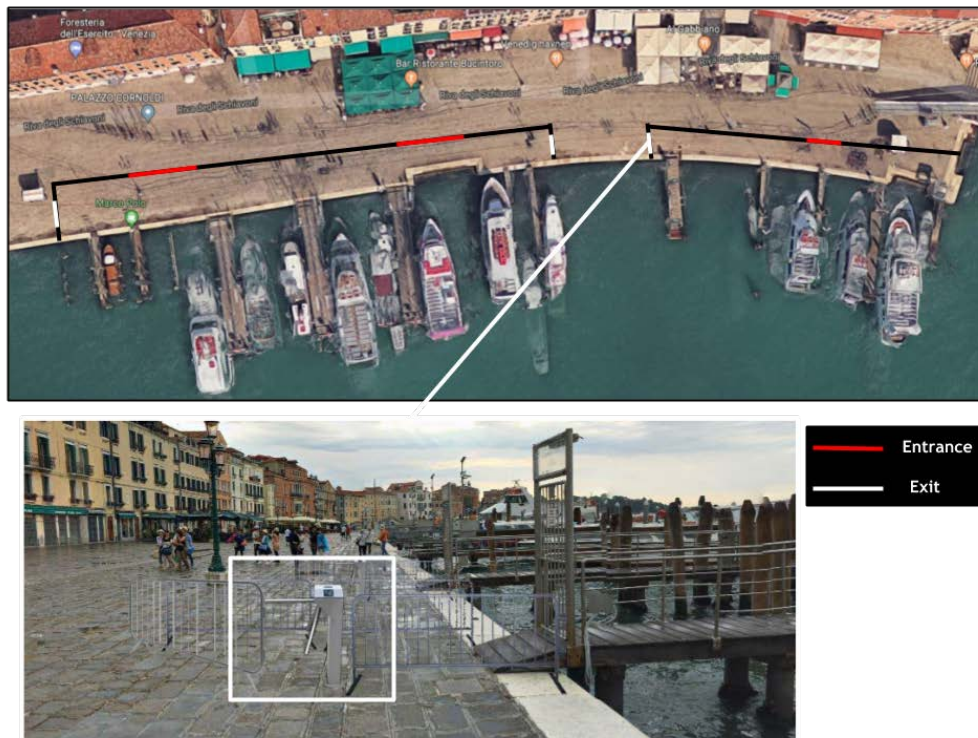


Figure 23: Turnstiles and Gates by Caserma Cornoldi

5. Punta Sabbioni

This hub will be on the peninsula of Punta Sabbioni and will consist of two parts. The first part of the hub will be integrated into the existing ACTV station to check people boarding ACTV boats to the old city. The current ACTV scanners will be repurposed to check for the access pass in addition to the transportation pass. Residents and commuters will not have a separate line for this station, as expected congestion from tourism is much lower than the other hubs. The second part of the hub will be located at the private boat docks located near the ACTV station. These will be implemented with turnstiles, similar to Caserma Cornoldi, and ensure that anyone taking a boat from that hub has an access pass.

6. Ponte della Libertà

This hub will be for all land traffic attempting to enter the city. Tollbooths before the bridge will check cars for tourist passes, with a separate lane for residents and commuters with priority access to the bridge. Infrastructure will have to be designed in such a way that someone without a pass can be turned around and sent away from the bridge. For bus traffic, it will be required that all private bus companies check for Venice access passes when selling tickets, and offer the pass alongside their tickets. Public busses are allowed to pass through unchecked, as public bus passengers are accounted for by the hub at Piazzale Roma.



Figure 24: Tollbooth Before Ponte della Libertà



Figure 25: Tollbooth Lanes

7. Piazzale Roma

This hub is designed to handle all public bus passengers that arrive in Venice, because they are not stopped at the bridge hub. All busses arriving at the city will drop off their passengers at Piazzale Roma, and infrastructure will be created so that the only way people can leave the drop off point for the rest of the city will be via a checkpoint. This will require closing off certain parts of the lot that are currently open, and creating a funnel to the checkpoint (Example in figure 26).



Figure 26: Piazzale Roma Hub

8. Seasonal ACTV Stops

These hubs will be for stations along seasonal ACTV lines that lead to Venice. There are five of these stations, and each one should use the existing infrastructure, adapted to check for both the access pass as well as the transportation pass. The five stations are:

- Treporti
- S. Nicolò
- Lido Casino
- Chioggia
- Fusina

Effect on Tourism

This intervention is intended to directly lower the number of tourists in the old city of Venice, addressing the issues currently caused by tourism.

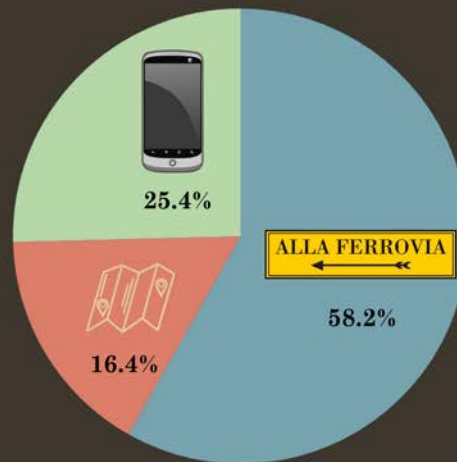
Cost Analysis

The costs for this intervention are much higher than all of the others. Construction costs for installing turnstiles, one-way passages, tollbooths, and proper signage for directing people to the correct areas are very expensive. The ACTV station hubs are already equipped to check for passes using the same infrastructure that checks for the universal city card, but would have to be adapted to actually control access with some additional construction. A similar system proposed by Pass4Venice estimates an initial cost of €600 million for their suggested hubs (*Pass4Venice*).

Appendix B: Signage Proposal



Signs are Primary Means of Navigation in Venice



We observed 5,400 people; 910 used navigational aids.
12:30-13:30, 14:00-15:00

Current Signage is Cluttered



Proposed by Fabio Carrera and Emanuele Dal Carlo

3

The Vision: Simplify Signage



Proposed by Fabio Carrera and Emanuele Dal Carlo

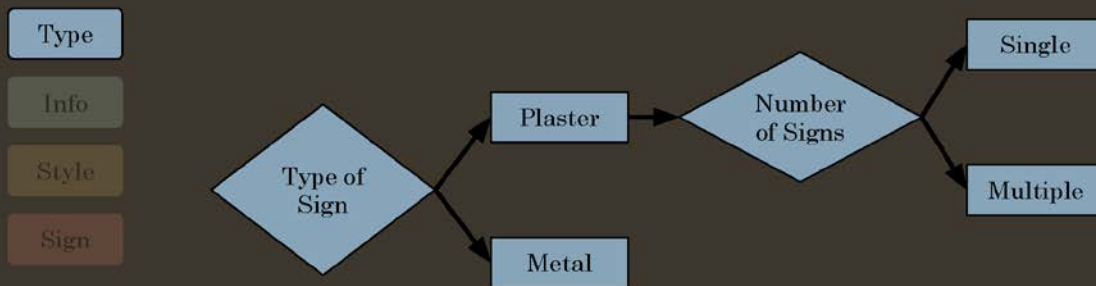
4

Experimental Objectives

- Type** Determine the type of sign to use.
- Info** Determine the information signs should convey.
- Style** Determine what makes signs visually appealing.
- Sign** Create final sign design.

5

Sign Type Decision Tree



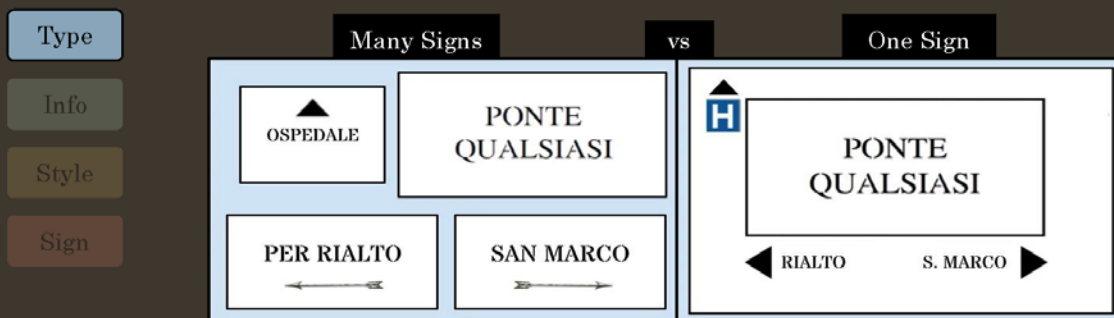
6

Possible Sign Types



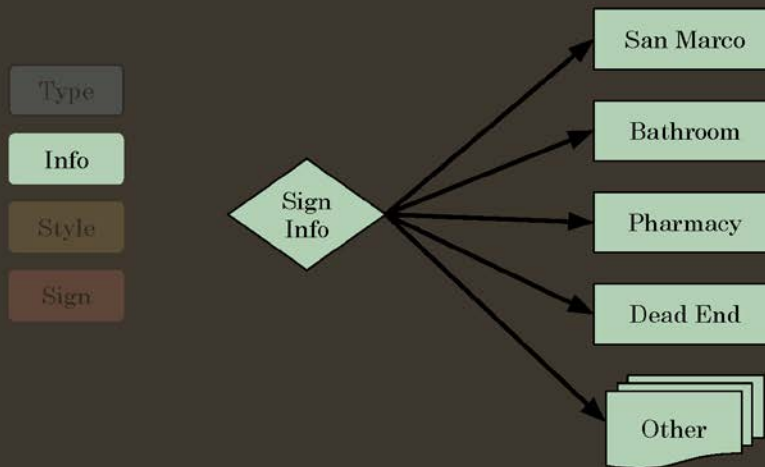
7

Should we simplify all signs into one?



8

Sign Information Decision Tree

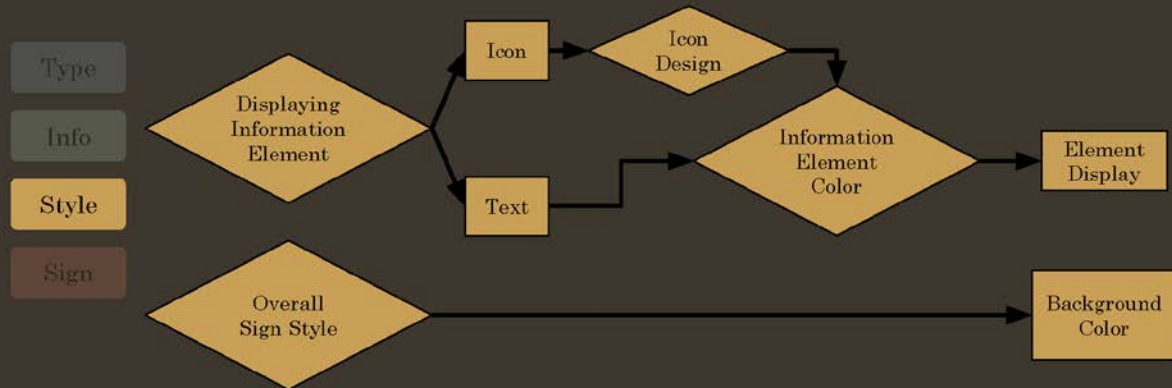


What information should be displayed on signs?

Rank the following icons in terms of importance on signs										OTHER	
Type											
Info											
Style											
Sign											

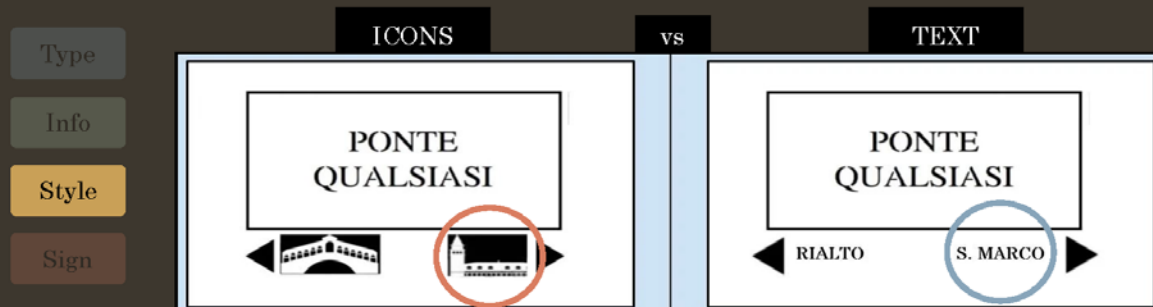
Destinations?					
---------------	--	--	--	--	--

Sign Style Decision Tree



11

Display info using icons or text?



12

Which icons are best?

Type
Info
Style
Sign

 OR  OR ?

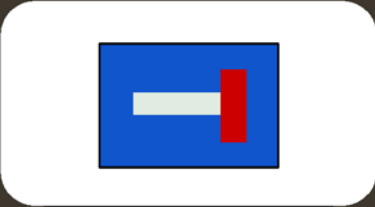
Bathroom icon options

13

Denoting dead end streets

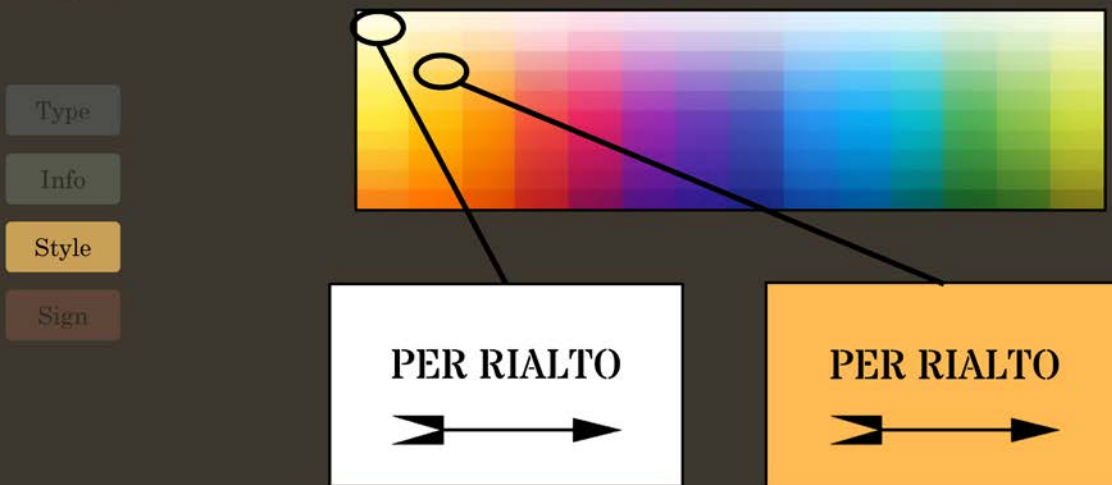
Type
Info
Style
Sign

Normal dead end icon Dead end marking

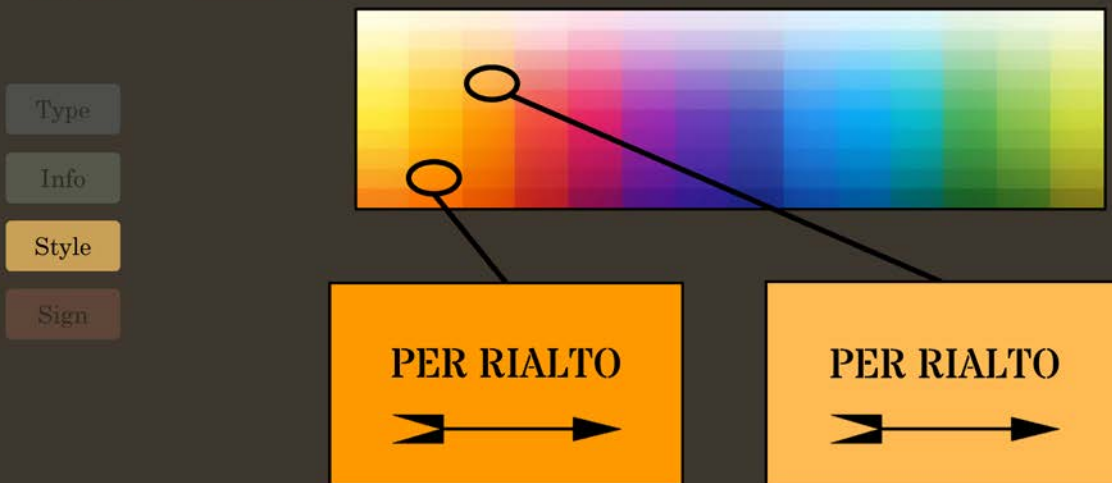
14

Style: Black and White or Colors?



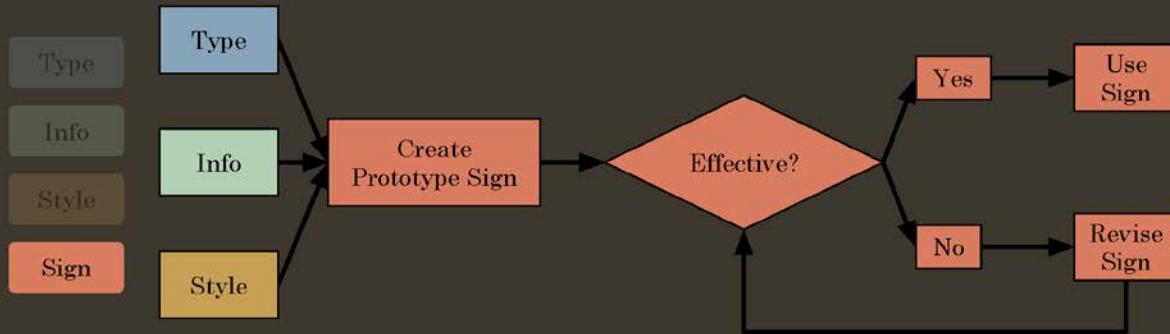
15

Style: Which colors are best?



16

Creation of Prototype Sign



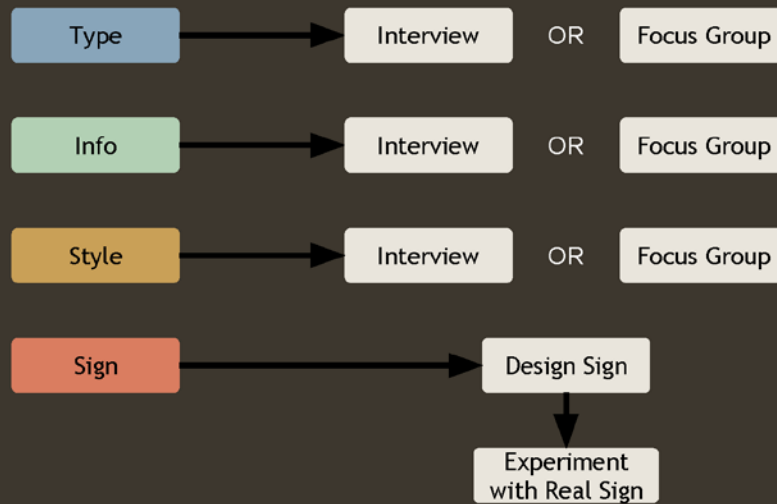
17

What is an effective sign?

	Yes	No
Visible?	✓	
Legible?	✓	
Good placement?	✓	
Conveys important/relevant information?	✓	
Does it send you in the right direction?	✓	

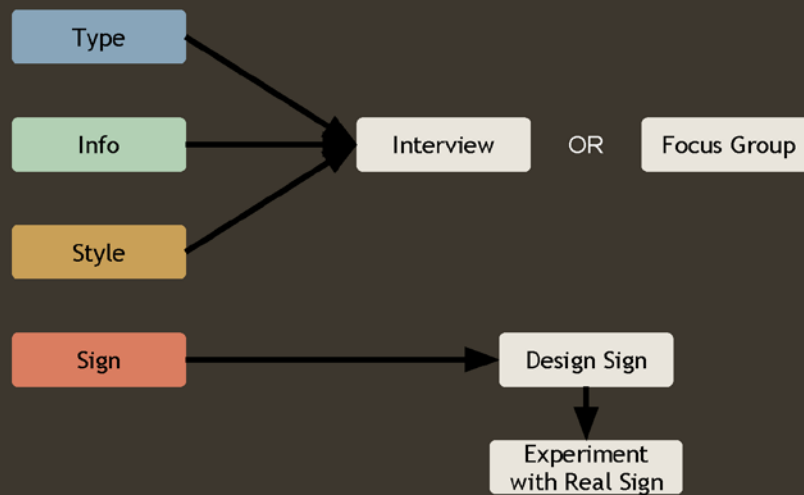
18

Interview Procedure: Option 1



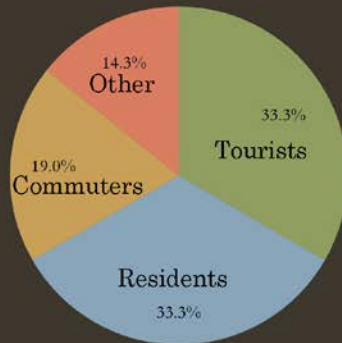
19

Interview Procedure: Option 2



20

Always Collect Demographic Information



Goal: Stratified Sample, ~1% of Population

21

Sources

Carrera, F.C. & Dal Carlo, E. (2015). Nizioeti 2.0: Semplificare la segnaletica cittadina [Slides].

Le Roy, Michael K. (2013). *Research Methods in Political Science*. Boston, MA: Wadsworth.

"Sample Size Calculator." Creative Research Systems. Retrieved 16 November 2017 from <https://www.surveysystem.com/sscalc.htm#two>

22

Appendix C: ZTL Expected Revenue Calculations

Goal: Estimate the annual income from implementing a variant of the small ZTL fees on all vehicle types coming into the historic city of Venice.

The three variations of ZTL we looked at were:

- (1) Charge both day-trippers and overnighers the same fee (€6)
- (2) Charge day-trippers double that of overnighers (€6 and €3, respectively)
- (3) Charge day-trippers double that of overnighers, but give overnighers the option to pre-register and pay nothing (€6, €3, and €0, respectively)

We extrapolated the data from the 2009 COSES tourism report to estimate the number of people coming to Venice by train, bus, car, boat, and cruise ship in 2017. The data extrapolation also allowed us to estimate how many are day-trippers and how many are overnighers.

In 2008, 15,794,000 tourists arrived in Venice. Of them:

Table 7: Tourist Arrivals by Transportation Method (COSES, 2009)

Vehicle	Arrivals	Day-trippers	Overnighers
Train	8,467,000 (53.60%)	7,170,900 (93.99%)	509,000 (6.01%)
Bus	4,219,000 (26.71%)	4,044,000 (95.86%)	175,000 (4.14%)
Boat	2,861,000 (18.11%)	2,861,000	No data
Car	846,000 (5.36%)	751,000 (88.78%)	95,000 (11.25%)
Cruise Ship	674,000 (4.27%)	435,000 (64.54%)	239,000 (35.46%)

The percentage of tourists arriving by a certain method in 2009 by train, bus, car, and cruise ship was applied to 2017. This assumes that the way tourists arrive in Venice currently has not drastically changed since 2009.

Then, we estimated the potential income from each of the three options listed above.

For option (1), we multiplied the number of tourists arriving by each method by the €6 ZTL fee to find annual income from each vehicle type.

Trains:

Thus, option (1) for **trains** generates:

$$(\text{€}6)(0.536 \frac{\text{tourists by train}}{\text{total tourists}})(19,981,587 \text{ total tourists}) \approx \text{€}64,261,000$$

Option (2) sums the product of the number of day-trippers and €6 with the product of the number of overnighers multiplied by €3.

Thus, option (2) for **trains** generates:

$$\begin{aligned} & (\text{€}6)(0.536 \frac{\text{tourists by train}}{\text{total tourists}})(19,981,587 \text{ total tourists})(0.9399 \frac{\text{day-trippers by train}}{\text{tourists by train}}) \\ & + (\text{€}3)(0.536 \frac{\text{tourists by train}}{\text{total tourists}})(19,981,587 \text{ total tourists})(0.0601 \frac{\text{overnighers by train}}{\text{tourists by train}}) \\ & \approx \text{€}62,330,000 \end{aligned}$$

Option (3) sums the product of the number of day-trippers and €6 with the product of half of the number of overnighers multiplied by €3. This assumes that about 50% of all over-nighers will pre-register their visit to Venice and be waived the €3 fee (*ZTL Revolution*).

Thus, option (3) for **trains** generates:

$$\begin{aligned} & (\text{€}6) \times (0.536 \frac{\text{tourists by train}}{\text{total tourists}}) \times (19,981,587 \text{ total tourists}) \\ & \times (0.9399 \frac{\text{day-trippers by train}}{\text{tourists by train}}) + (\text{€}3) \times \left(0.536 \frac{\text{tourists by train}}{\text{total tourists}}\right) \\ & \times (19,981,587 \text{ total tourists}) \times \left(0.0601 \frac{\text{overnighers by train}}{\text{tourists by train}}\right) \\ & \times (0.5 \frac{\text{overnighers pay}}{\text{overnighers by train}}) \approx \text{€}61,364,000 \end{aligned}$$

We performed the same calculations, using the percentages from the table, for bus and cruise ship, yielding the annual incomes:

Buses:

Option (1): €32,022,000

Option (2): €31,360,000

Option (3): €31,028,000

Cars:

Because we propose to enforce the ZTLs by charging cars to park in Piazzale Roma and Tronchetto, we cannot use the number of tourists coming to Venice by car, but rather the number of cars parking in Venice. We assumed the average car contains two tourists.

$$(0.0536 \frac{\text{tourists by car}}{\text{total tourists}})(19,981,587 \text{ total tourists})(0.5 \frac{\text{cars}}{\text{tourist}}) = 535,667 \text{ cars}$$

Then, the percentages from the table were used to estimate potential annual income from **cars**:

Option (1): €3,214,000

Option (2): €3,034,000

Option (3): €2,944,000

Boats:

Since the COSES report contained no data on the number of overnighers arriving in Venice by boat, we assumed the percentage of overnighers and day-trippers arriving by boat is the same as the percentage of overnighers and day-trippers among tourists arriving by all methods to Venice (which is 22.5% and 77.5%, respectively).

Thus, **boats** could generate the following annual income:

Option (1): €21,712,000

Option (2): €19,269,000

Option (3): €18,048,000

Cruise Ships:

The numbers for cruise ships include both people arriving in Venice by cruise ship and boarding them from Venice. Additionally, since the number of cruise ship arrivals and departures from Venice has increased by 166% in the last ten years, a linear extrapolation of the data from the COSES report would be a poor estimate. Thus, data from the 2015 Annuario del Turismo was used for this (1,582,481 tourists boarded or disembarked on 521 ships).

We assumed the percentage of overnighers and day-trippers arriving by cruise ship is the same as the percentage of overnighers and day-trippers among tourists arriving by all methods to Venice (which is 22.5% and 77.5%, respectively) to calculate potential income for options (2) and (3).

Option (1): €9,495,000

Option (2): €8,427,000

Option (3): €7,893,000

Final Values

It was assumed that a number of tourists could evade paying ZTL fees due to the nature of their enforcement and the many ways into Venice. Thus, we assumed an actual income of 75% of the expected income, except for cruise ships, where we assumed 100%. Since we are recommending option (3) be followed, we only did this calculation for that option:

Option (3):

Car: €2,208,000

Bus: €23,271,000

Train: €46,023,000

Cruise Ship: €7,893,000

Boat: €13,536,000

Combined: €92,931,000

Appendix D: Observation Session Procedures

Sessions:

1. Count how many people are using each method of navigation in the city
2. Attempt to follow directional signage through the city
3. Count the number of people in each tour group

Session 1: Count how many people are using each method of navigation in the city

Observation Locations: Calle del Teatro 4663 and Ruggia Vecchia S. Giovanni 48

Length of Observation: 60 Minutes per location

Number of Researchers Required: 4

Categories: Map, Signs, Phones

Criteria for each category:

1. Map - Person is holding a map or a guide/tour book
2. Signs - Person is actively looking towards or at a sign
3. Phones - Person looks at a phone and then up at their surroundings, may also be swiping on their phone

Procedure:

1. Assign each researcher a category, with one counting the total number of people passing through the intersection
2. Begin observation time by starting a timer
3. Each researcher then counts* the number of people** using their assigned method according to the criteria above with handheld counters
4. End observations when the time is up

*People using more than one method of navigation will be counted once for each category they use

**Groups led by one person using a navigational aid all count towards that category.

Session 2: Attempt to follow directional signage through the city

Observation Path: Rialto → San Marco

Number of Researchers Required: 2

Procedure:

1. For the chosen observation paths, navigate to its starting location
2. Identify a directional sign pointing to the destination
3. Record the latitude and longitude of the sign as well as background and text colors, as well as note if the sign is not an official directional sign and take a picture of it

4. Follow that sign's direction until another directional sign pointing to the destination is encountered
5. Repeat step 3
6. Repeat steps 4 and 5 until the destination is reached
7. If the destination is not reached by following the sign, mark the final encountered sign as a "problem sign"
8. Continue searching for the next sign in that direction, when encountered continue to loop steps 4 and 5.

Session 3: Count the number of people in each tour group

Observation Location: St. Mark's Square and outside of the Doge's Palace

Length of Observation: 60 Minutes

Number of Researchers Required: 3

Criteria for definition of tour group:

1. There is an identifiable tour guide for the group
2. Group members may use the same listening technology
3. Group members move together

Procedure:

1. Assign two researchers to count the number of people in each group and one researcher to record the data
2. Begin the observation time by starting a timer
3. When counting the number of people in a group, the counter will identify a feature of the group guide out loud to the other researchers to denote the entire group as already being counted (i.e. "counting group with red umbrella")
4. The other counter will count a different group, if available
5. Both will give their number to the recorder after counting, and look for another group
6. The recorder will track the descriptions, the time the group was counted, and the size of the group on paper
7. End observations when the time is up

Appendix E: Sign Observation Results

Directional Sign Mapping

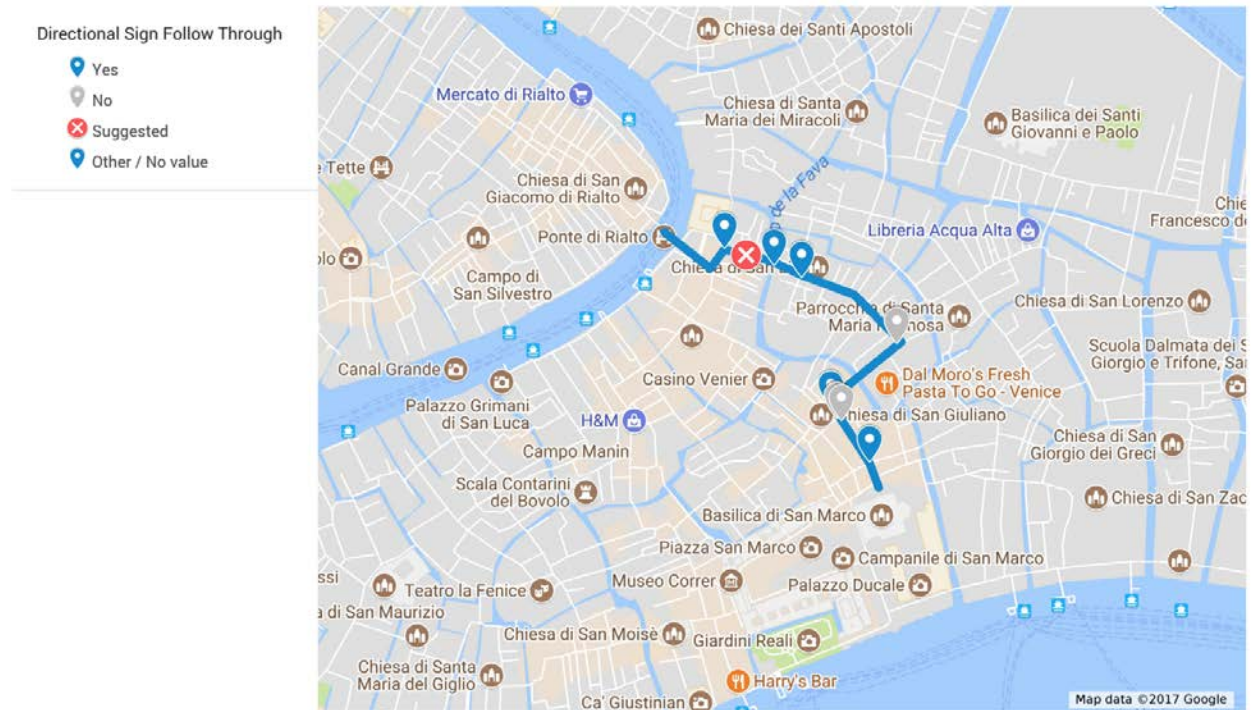


Figure 27: Directional Sign Mapping

This map shows the results of following the procedure shown in **Appendix D, Session 2**, where *Yes* represents official signs, *No* represents unofficial signs, and *Suggested* refers to possible additional sign locations.

Appendix F: San Marco Pass Cost Estimate Calculation

Cost Analysis

Cost of Electro SpeedBlade Speed Lane: €5,600

Width of single pass: $1.08 \text{ m} \times 2 = 2.16 \text{ m}$

+Width of double pass: 1.87 m

= 4.03 m for areas where 2 gates can fit

Width of singles pass: $1.08 \text{ m} \times 2 = 2.16 \text{ m}$ for areas where only 1 gate can fit.

Using widths of roads as measured by Google Earth, divided by correction factor of 1.15, and found how many speed lanes would fit in an area, leaving room to spare.

Given the entrances and exits we chose:

For tourist/resident entrances, there is room for 3 gates for tourists.

For dedicated exits, there is room for 4 exit gates.

For tour group access, there is room for 17 gates.

Total for speed gates: 24 gates x €5,600 each = €134,400

Cost of RFID uPass Reader for resident entrances (5) = €1,700

Total for RFID readers: 5 readers x €1,700 each = €8,500

Grand Total of Costs: €142,900

Additional crowd control barriers can be as cheap as €28 for a 2.5-meter galvanized steel segment, making the cost negligible compared to the other costs. The city also already has a substantial amount of these that have previously been used in cordoning off large areas of the square during Carnevale (S. Marco Pass).

Additional consideration must be given to the cost of installing and powering all tech involved.