Water Taxis in the San Francisco Bay Area

*From travel time to quality time:*
*Is there a viable service concept?*

Delft University of Technology
Jody Verpoort
18-02-2010
Delft, The Netherlands
18 February 2010

Final report for the graduation of
Name Jody Verpoort
Student ID 1097873

University Delft University of Technology (TU Delft)
Faculty Technology, Policy and Management (TPM)
Program System Engineering, Policy Analysis and Management (SEPAM)
Degree Master of Science (MSc)

Graduation Professor (Chair) - Prof. dr. Bert van Wee
First supervisor - Dr. Ir. Caspar Chorus
Second supervisor - Dr. Dap Hartmann
Entrepreneurial advisor - Meinard Sprenger

Email j.verpoort@student.tudelft.nl // Jody.Verpoort@gmail.com
Mobile +31 6 - 519 402 83
Preface

Around May 2008 the idea started to materialize that a vast empty slab of water in combination with congested roads offers potential. This was while I was living in the San Francisco Bay Area for six months and being surrounded by the positively infectious commercial vibe of Silicon Valley. This soon narrowed down to focusing on a wealthy niche market that doesn’t want to be standing around in traffic and might rather use water taxis including water transportation to and from the waterfront.

In that time I was just joking around when talking about using it as a graduation project and perhaps even starting a company. By now the graduation project is finished and the difficult decision about starting up has become real.

In the process I received much guidance and input from a vast range of people, both in the Netherlands and on location. I value this so much that I have even dedicated an entire chapter to this wonderful group of people.

I would particularly like to thank the Velez’ and Laanens for the facilitation of my return to the Bay Area this summer, to do on-site research. Next to them I would like to thank everyone that helped me find quality time in times of stress.

I salute my, by now, former roommates at the most beautiful part of the most beautiful canal in Delft and thank them for putting up with me all this time. Since, maybe not at a wise moment, but not at all a bad decision, I recently moved to The Hague. In March 2009 I never expected to be writing this preface while looking out over the skyline of our political capital.

A special thanks goes out to my graduation committee, for allowing me to graduate on this rather odd, but so fascinating subject, and thus serve as the capstone of my engineering degree. In particular to Caspar for kicking my ass when needed and giving the compliments when deserved (…and needed). Also Meinard deserves extra kudos for opening up many doors and clearing his busy schedule to make the business more real.

The finishing touches wouldn’t have been possible without Johannes Kok from graphical- and product design studio Peerdrops! All visualizations of the business models are composed from pictures especially designed by him for this project.

I would never have reached this point in my life if it wasn’t for my parents. Mom, dad, thank you for the support and trust all these 8.5 years of being in Delft, during the wrong choices, difficult decisions and pure joy!

Now it is time to see where the next 8.5 years will take me…

Jody Verpoort
Delft, February 2010
Executive Summary

There seems to be great business potential for high-speed reliable executive transportation over water. Contrary to the highly subsidized market of public transit in the San Francisco Bay Area this high-end niche market seems to be self-sustaining and even profitable.

This pre-feasibility study for a high-end business water taxi for the San Francisco Bay Area, is executed in collaboration with Delft University of Technology in the Netherlands. Amongst others, this service would provide a solution for the increasing unpredictability in travel times due to congestion and parking problems. The focus is not on reducing congestion, but providing the more wealthy population a more predictable way of transportation. It also aims to convert travel time into quality time, by including a door-to-door service.

Initial market size estimates are based on the wealthy section of the commute flows (18.5% earning >$100k) between San Mateo county and San Francisco county (168,000 daily commuters in 2009). This reveals a potential market size of 31,000 customers. Three scenarios are used to represent a optimistic, intermediate and pessimistic percentage of this potential market size, that would consider using the service. These market interest percentages are set at 9%, 6% and 4.5%, corresponding to 2,800 / 1,900 / 1,400 potential daily customers. A statistically valid survey is designed to estimate market shares within these scenarios, based on Trip duration, Ticket price, Maximum delay and Comfort levels.

The main competitive advantages are predictability of travel time and full door-to-door service. This validates a premium price strategy, for which a high-end service is provided in return. The combination of the survey data with a varying price level, showed an optimum at a high-end commuter service, priced at $80 per single trip. This ticket price is used to forecast that 5% of the mentioned potential customer would actually use the service. On a daily basis (250 workdays), this leads to approximately 49-97 round-trip passengers originating from San Mateo and 24-48 round-trip passengers originating from San Francisco, which are transported in both the three morning and evening rush hours.

The business is predicted to lead to annual revenues between $2.9million - $5.8million. This is expected to be sufficient to pay-off the $3.5million investment in four vessels and to pay for the $2.2million annual operational costs, as well as the $0.5million - $1million annual cab fares for the on-shore taxi rides.

ROI calculations, based on a 15% discount rate over a period of ten years, leads to a ROI of 22% and a break-even point of 5 years in the pessimistic scenario. The intermediate scenario reaches a ROI of 48% and break-even in 3 years. The optimistic scenario has the potential to reach a ROI of 277% and break-even within a year of operating at full capacity.

Before starting this business, additional research is needed by a team of experts in the fields of logistics, vessel operation, local maritime and nautical conditions, Local and State politics and marketing. Partnering with an experienced operator, local or abroad, would allow for a quick start. This team would preferably also be the founding team.

The projected time span between start and a fully operational service is approximately 1.5 years. This time span allows for the additional research and the organizational setup including permitting, testing, marketing, finance and HR issues.

To start this project on the route between Redwood City port - San Francisco Ferry Building, an initial investment of $3.5million in four vessels is needed. 1/3 to be obtained from investors and partners and 2/3 from a bank.

Opportunities for expansion lay in other client segments such as tourists in the off-peak hours and weekends. Also a gradual expansion is foreseen to six short-haul service areas with interconnections by multiple long-haul routes.
This report is written along four phases:

- A research approach phase, which provides an introduction to the subject, a literature study and an elaboration on the methodology;
- A design phase in which the necessary qualitative sources are gathered in a team, the design space is framed and three service concepts are designed;
- A choice phase in which a choice is made for the most suitable service concept through matching the demands from the customer with what a company can supply;
- A wrap-up phase in which conclusions are drawn, recommendations are given and the report is reflected upon.

**Phase 1: Research approach**

The main goal of this pre-feasibility study is to advise a start-up company, based on the business potential, whether or not it should pursue performing a full feasibility study on high-end water taxi services for business travelers in the San Francisco Bay Area.

Triggered in 2008 by personal observations of parking hassles, congestion problems, a focus on the environment and the wish of San Francisco to make better use of their unique waterfront, it seems as though there is indeed potential for water taxis. Encouraged by a speech of Ron Cowan in which he expressed his dream of water taxi cabs criss-crossing the bay, these claims and its accompanying uncertainties warrants in-depth qualitative research.

The choice is made to focus on business travelers, since they are willing to pay more for higher quality travel. This is necessary considering the fact that the current water transportation in the area is highly subsidized.

The specific business opportunity studied in this thesis concerns the following new service:

**Water taxis**

On-demand, long-distance (30-50km), high-speed (>30kts), sustainably powered (solar/electricity/hydrogen), relatively small water taxis;

for business travelers in need of travelling from the South of the Bay to San Francisco and back;

combined with drop off and pick-up at the desired meeting point.

The objectives of this project, as set forth in section 1.3, are:

1. Design several service concepts for
   - water transportation
   - in the San Francisco Bay Area
   - for business travelers.

2. Choose the most suitable concept from a company point of view, based on matching of
   - customer demand,
   - positive financial viability, and
   - practicability.

---

1 Ron Cowan is a prominent local Alameda developer who received a lifetime achievement award at the Bay Area Council annual meeting (April 2008). At the event, he was sharing this dream with the audience of 1,500 business people.
To reach the two main objectives the research is performed along four phases as presented in section 1.5. Phase 1 (Research approach) results in the selection of the Business Model Canvas by Osterwalder (2009) as a tool to represent the service concepts and selection of the Business Model Innovation Cycle by Osterwalder (2006). Both combined, form the basis for the methodology for the Design and Choice phases as shown below (elaboration in chapter 3).

The results of phase 2 (Design) and phase 3 (Choice) correspond to the two objectives as stated above. This chapter (Conclusions), along with the recommendations and reflection, is part of the fourth and last phase (Wrap-up).

**Phase 2: Design**

**Objective 1**
Design several service concepts for:
- water transportation
- in the San Francisco Bay Area
- for business travelers.

**Accompanying sub-goals**
Determine the boundaries of the (technical) design space for water transportation in the SFBA, in terms of:
- trip duration
- comfort and service levels
- sustainably powered or not
- boarding points
- access & egress means
- minimum and maximum ticket prices
- maximum initial investments.

Objective 1 is completed in phase 2: Design.

The three steps within phase 2 are:
1. Building the team
2. Framing the design space
3. Design Business Models

On the next page Figure 47 - and the text below it, completes objective 1. It summarizes the three service concepts of water transportation for business travelers in the San Francisco Bay Area.

Sections 6.1 - 6.3 show the fully visualized versions of the three designed service concepts, represented by business models based on Osterwalders Canvas (2009). The visual representation is one of the strengths of Osterwalders Canvas (Figure 1). These business models are designed within the design space from step 2 (section 5.6), which includes all elements of the sub-goals.

Within the predetermined set of limitations of the design space the combination of the different levels of the attributes within the nine building blocks (section 5.6), results in three unique Business Models:
- High-end Business
- High-end Commute
- General Business

Findings in each of the steps will shortly be elaborated on below.
Step 1 Building the team
The goal of this step is to gather input from a highly diverse group of people (team), which leads to in-depth and applied information for the design space, in addition to desk research.

The team consists of 34 people from large companies to small startups, from government officials to entrepreneurs and both from the Netherlands and the San Francisco Bay Area. Much information was gathered from the Dutch ferry- and water taxi companies in Rotterdam, Gorinchem and Dordrecht. These companies have many years of experience in passenger transportation over water. Also the new governmental ferry operator WETA in the San Francisco Bay Area has provided much useful input.

Step 2 Framing the design space
Framing the design space is done through the use of Osterwalders Business Model Canvas. It allows for a highly visual representation of all the information, in a condensed set of nine building blocks, covering the who, how, what and money issues of business.

The Canvas has worked as an proper tool to discuss all important elements of a business model, summarized in Table 9 on page 52. It can also be used in future steps, when a business plan and strategy are written. The canvas also allows for an overlay of other known business analysis tools, such as Porter’s Five Forces or SWOT analyses.

Step 3 Design Business Models
The boundaries of the design space, the identification of three client segments and the preconditions of mutually exclusiveness, realism and relevance for implementation, allow for the design of three service concepts, represented by business models.

Result objective 1
The result of objective 1 is an overview of the three service concepts, represented by business models. The grey-shaded area in the middle of Figure 1 is the building block: Value proposition. This combined with the other eight building blocks shown, forms the canvas to represent business models as proposed by Osterwalder (2009).

Figure 1 Blank Business Model Canvas (Based on: Osterwalder et al. 2009)

The value propositions of the three concepts are represented below in Figure 2 - Figure 4.
High-end Business - allows for private transportation in large comfortable water taxis with on-demand departures at comfort levels comparable to airline business class settings.

High-end Commute - allows for transportation in the large comfortable water taxis with mostly scheduled departures at comfort levels comparable to BART, CalTrain and/or AMTRAK;

General Business - allows for transportation in the small 12 passenger water taxis with regular departures at comfort levels comparable to the local AC Transit bus.
Phase 3: Choice

Objective 2
Choose the most suitable concept from a company point of view, based on matching of:
- customer demand,
- financial viability, and
- practicability.

Accompanying sub-goals
Forecast if the high end business market
- consisting of businessmen and women
- earning over $100,000 per year
is willing to use water transportation instead of their current means,
- based on to be determined decision elements (attributes)
- in quantities and for a price which is sufficient to build and sustain a company

Objective 2 is completed in phase 3: Choice
The two steps within phase 2 are:
4. Forecasting the demand
5. Supplying the demand
Figure 7 on page xiii, completes objective 2. It shows the visual representations of the most suitable service concept of water transportation for business travelers in the San Francisco Bay Area; based on the matching of customer demand, financial viability and practicability. This figure from section 8.3
shows the service concept: High-end Commute, represented by a business model based on Osterwalders Canvas (2009).

The concept i.e. business model is selected based on financial calculations in step 5 (chapter 8) with input of market shares calculated from a local survey in step 4 (chapter 7). The financial constraints led to the exclusion of the High-end Business and the practicability constraint led to exclusion of the General Business, only for the proposed route, in section 8.2.1. This leaves the High-end Commute service, which is profitable with a ticket price adjustment to $80, as presented below.

Findings in each of the two steps will shortly be elaborated on below.

**Step 4 Forecasting the demand**

The demand research is done through discrete choice analysis, with data from an online stated preference survey. The aim of the experiment was perfectly described in one of the remarks by a respondent:

“I found myself comparing this directly to taking my own car; and in particular the cost (and hassle) of parking. When it’s cheaper to take mass transit than to park; it’s a no brainer (BART). When price gets over $20 or $30; you have to start asking how much your time and flexibility is really worth.”

Performing this analysis is based on collecting choices people make. In this case a variation of 18 different services (profiles) were proposed and asked whether or not it would be a means they would use. The choices can be used to estimate a model. This model allows for making predictions on what choices people would make at certain levels of the attributes, such as a high versus low price.

56 useful responses out of 1,500 invitations means a response rate of 4.5%, taking into consideration 275 bounced emails. The response led to 972 observations, since 18 profiles are asked. The five attributes varied in the profiles are Trip duration, Ticket price, Maximum delay, Comfort and Number of passengers. Out of 11 estimated parameters all but Number of passengers, have at least one significant estimator, allowing for determination of utility functions for each attribute.
The variation of the utilities based on the different attribute levels is calculated in section 7.2.2. The accompanying graphs are repeated below in Figure 5.

The different attribute levels have a certain use (utility) for the population. The utilities found in the research are:

- Value of time (VOT) $47/hour [valid between 40-60 minutes]
- Value of reduction of maximum delay $242/hour [valid between 15-25 minutes]
- Comfort level upgrades $8 [ACbus upgrade to BART or BART upgrade to Business class]

This data allows for estimation of the market shares in as calculated in section 7.2.4. The accompanying graph is repeated in Figure 6 below.

![Figure 5 Utility graphs](image)

![Figure 6 Market shares](image)
Step 5 Supplying the demand

The financial viability calculations are aimed at finding the business with the largest Return on Investment (ROI), at an investment of no more than $15 million. The main financial elements that are used in the calculations are revenues, investments and operational costs in relation to the potential demand.

The market shares calculations for the three service concepts can be used to make estimates on the number of passengers per day, the amount of vessels needed and the accompanying costs and revenues. For more detail see the calculation framework in Figure 37 on page 94.

To increase the market insights these calculations are made for 3 scenarios: optimistic, intermediate and pessimistic. These scenarios indicate what percentage of the wealthy daily commuters (18.5%) might be interested in the service, i.e. the initial potential market size.

The financial constraints led to the exclusion of the High-end Business and the practicability constraint led to exclusion of the General Business, only for the proposed route, in section 8.2.1. This leaves the High-end Commute service, which appears to be profitable as presented below.

The main competitive advantages are predictability of travel time and full door-to-door service. This validates a premium price strategy, for which a high-end service is provided in return. Based on the ROI, needed initial investments and a high-end sales strategy the one-way ticket price is chosen. The combination of the survey data with a varying price level, showed an optimum at a high-end commuter service, priced at $80 per single trip.

This ticket price is used to forecast that 5% of the mentioned potential customer would actually use the service. On a daily basis (250 workdays), this leads to approximately 49-97 round-trip passengers originating from San Mateo and 24-48 round-trip passengers originating from San Francisco, which are transported in both the three morning and evening rush hours.

The business is predicted to lead to annual revenues between $2.9 million - $5.8 million. This is expected to be sufficient to pay-off the $3.5 million investment in four vessels and to pay for the $2.2 million annual operational costs, as well as the $0.5 million - $1 million annual cab fares for the on-shore taxi rides.

ROI calculations, based on a 15% discount rate over a period of ten years, leads to a ROI of 22% and a break-even point of 5 years in the pessimistic scenario. The intermediate scenario reaches a ROI of 48% and break-even in 3 years. The optimistic scenario has the potential to reach a ROI of 277% and break-even within a year of operating at full capacity.

Result objective 2

The next page Figure 7, shows the final service concept i.e. business model: High-end Commute.

The High-end Commute oriented business model is designed through approaching the high standards of the High-end Business model, but making it accessible to a larger audience. The customer has access to a service that has a maximum wait time of 25 minutes, combined with the pick-up at the office and drop-off at the desired doorstep with group transportation.

The vessel is a stable catamaran with 30 seats. It can be partially propelled by electricity which means it is clean, silent and fast. The speed of 30 knots allows for a trip from Redwood City port to the San Francisco Ferry Building in 45 minutes (excl. access egress ~15 min.).

The on-board bar provides the customer with a small selection of snacks and drinks, always fresh and of high quality. The relation towards the customer is low touch but marketing is personal.

This final version of the business model has a ticket price of $80. This pays for a one-way trip between Redwood City Port and San Francisco Ferry Building, including the pick-up at the office and drop-off at the desired doorstep with group transportation.
Phase 4: Wrap-up

Conclusion
The main goal of this pre-feasibility study is to advise a start-up company, based on the business potential, whether or not it should pursue performing a full feasibility study on high-end water taxi services for business travelers in the San Francisco Bay Area.

Based on the positive preliminary economic criteria as found in step 5 above, given the conservative approach for the estimates in the project and clear view on the underlying assumptions (next chapter), it seems worth it to proceed to performing a full feasibility study.

The advice is to accept the proposed business model for High-end Commute as a potentially viable service and to proceed into a next step of research, by an experienced team.

The service concept, depending on the scenario, consists of 3 or 4 vessels. Two high-end crewmembers operate each vessels on 45 minute trips a total of 6 hours during morning- and evening commute. Maintenance is mainly outsourced and annual costs are set at 5% of the vessel price of $700,000. In calculations a occupancy rate of 60% is used. In the first few months this rate is likely to be lower.

The advice to continue research is based on the amount of assumptions which needed to be made in this study. The underlying assumptions with the most impact, which need further research, as elaborated in section 10.1, are:

- Full market sizes are based on the numbers found for the commuter market, not on business trips during the day. Data on these types of trips was not found.
- The vessel type is selected based on trusted advice and quick multi criteria analysis. This needs more attention to verify suitability for the local situation. The currently selected vessels are the ShuttleCat120 by FontainePajot (France) and the Water taxi by TRANZ (Netherlands).
- Permits for operation are assumed to be obtained.
- All berthing locations are assumed to be available for usage, but all need individual negotiations.
- The vessels would need testing, to see if they actually perform up to par in comfort and travel times.

A suggested timeline if the decision would be made to perform a full feasibility study and after a dedicated team is gathered, could be:

<table>
<thead>
<tr>
<th>Year 1</th>
<th></th>
<th>Year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
</tr>
<tr>
<td>Research</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Funding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Letter of intent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operational setup</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchase</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shipping</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Further recommendations
The five underlying assumptions above are Go / No-go items from a prioritized summary of the full overview of assumptions. These are presented in the recommendations chapter of the report. Also a useful list of additional contacts for the steps following the full feasibility study, is provided.

A glance on the first steps towards starting the business is added to the timeline above. In combination with a number of fields with the potential for expansion of the company and its services in a later stage, this completes the future outlook. The opportunities for expansion for the company lay in the areas of routes, customer segments, supply chain, technology and geographical locations.
Index

Preface ........................................................................................................................................ iii

Executive Summary ..................................................................................................................... v

Report Summary ........................................................................................................................ vi

Phase 1: Research approach ........................................................................................................ vi

Phase 2: Design ........................................................................................................................... vii

Phase 4: Wrap-up .......................................................................................................................... xiv

Appendices ................................................................................................................................... xix

List of Figures .............................................................................................................................. xx

List of Tables ............................................................................................................................... xxi

Phase 1 Research approach
1 Introduction ............................................................................................................................... 2

1.1 Current situation & opportunities .................................................................................. 3

1.1.1 Parking problems ........................................................................................................ 3

1.1.2 Congestion .................................................................................................................... 3

1.1.3 Earthquake threats ...................................................................................................... 4

1.1.4 More water transportation envisioned ...................................................................... 4

1.1.5 Focus on green and sustainable .................................................................................. 5

1.1.6 Lack of quality alternatives ....................................................................................... 5

1.2 Opportunity area ............................................................................................................... 6

1.3 Project objective ................................................................................................................ 7

1.4 Scope of the design project ............................................................................................. 8

1.5 Structure of the research .................................................................................................. 10

2 Literature study ...................................................................................................................... 12

2.1 Passenger transportation over water .......................................................................... 12

2.1.1 Introduction ............................................................................................................... 12

2.1.2 Summary of important aspects ................................................................................. 13

2.1.3 Lessons for the San Francisco Bay Area .................................................................. 14

2.2 Service concepts represented by business models .................................................... 15

2.2.1 Business models & Innovation ................................................................................ 15

2.2.2 Development of the concept .................................................................................... 16

2.2.3 Difference between Business Models, -Strategies and -Plans .............................. 17

2.2.4 Elements in a Business Model ................................................................................ 19

2.2.5 Using Business Models ........................................................................................... 21

2.2.6 Selected tool .............................................................................................................. 23

2.3 Design proces .................................................................................................................... 23

2.4 Conclusion ........................................................................................................................ 25

3 Methodology ........................................................................................................................... 27

3.1 Design methodology ......................................................................................................... 29

3.2 Detailed structure of the research .................................................................................... 32
Appendices

Appendix A  Graduation committee ........................................................................................................... 137
Persons .................................................................................................................................................. 137
Roles .................................................................................................................................................. 137

Appendix B  Annotation Entrepreneurship ................................................................................................. 138
Learning objectives ........................................................................................................................... 138
Entrepreneurship supervisor ........................................................................................................... 138
Assessment ....................................................................................................................................... 139

Appendix C  Longlist relevant in passenger transport over water .............................................................. 140

Appendix D  Business Model Frameworks ............................................................................................... 143
Components of a business model 2003 .......................................................................................... 143
Components of a business model 2004 ........................................................................................ 144
Dynamics of business ..................................................................................................................... 145
Six questions that underly a business model .............................................................................. 146
IBMs Component business model ............................................................................................... 147
The Business Model Framework .................................................................................................. 148

Appendix E  Local analysis ..................................................................................................................... 150
Visual comparison Ijssel-/Markermeer, SouthWest Holland and San Francisco Bay Area .............. 150
Visual overview ............................................................................................................................. 151
Daily Inter-County commuters ...................................................................................................... 152
Current Public Transportation ....................................................................................................... 153
Boarding points ............................................................................................................................ 154
Water depths (feet) .......................................................................................................................... 155
30 Day Traffic on the bay ................................................................................................................ 156
Bay Area Freeway locations with most delay during commute hours ......................................... 157

Appendix F  Cost Structure ..................................................................................................................... 158

Appendix G  Permits & regulation ........................................................................................................... 160
Permits ............................................................................................................................................... 160
Regulation ....................................................................................................................................... 161

Appendix H  Vessel specifics .................................................................................................................. 165
Vessel inventory ............................................................................................................................... 165
Vessel acceleration .......................................................................................................................... 166
Propulsion systems .......................................................................................................................... 167

Appendix I  Travel time .......................................................................................................................... 168
Travel times for new WETA routes ............................................................................................... 168
Service zones and travel times ........................................................................................................ 169
Example comparison travel time car versus boat ...................................................................... 170

Appendix J  Stakeholders analysis ......................................................................................................... 172
Stakeholder overview ...................................................................................................................... 172
Stakeholders and their resources ................................................................................................. 173

Appendix K  Experiment elements ......................................................................................................... 175
Items included/excluded from survey ............................................................................................. 175
Attributes, attribute levels & encoding ............................................................................................ 176
Profile construction .......................................................................................................................... 177
Survey profiles .................................................................................................................................. 178
Survey profile variation .................................................................................................................... 181
Biogeme model .................................................................................................................................. 182
Email invitation & reminder ............................................................................................................. 183
Online survey screenshots ................................................................................................................ 185
Individual comments (online) .......................................................................................................... 187
Individual comments (private email) .............................................................................................. 189

Appendix L  High-end Business graphs .................................................................................................. 191

Appendix M  General Business graphs .................................................................................................. 192
List of Figures

Figure 1 Blank Business Model Canvas (Based on: Osterwalder et al. 2009) .................................................... viii
Figure 2 Value proposition High-end Commute ................................................................................................. ix
Figure 3 Value proposition High-end Commute ................................................................................................. ix
Figure 4 Value proposition General Business .................................................................................................... ix
Figure 5 Utility graphs .......................................................................................................................................... xi
Figure 6 Market shares .......................................................................................................................................... xi
Figure 7 High-end Commute - Final .................................................................................................................... xiii
Figure 8 Vehicle hours of delay vs. employment ................................................................................................. 3
Figure 9 Study area on Regional Map (Source: ABAG) .......................................................................................... 9
Figure 10 The business model mediates between the technical and economic domain ..................................... 16
Figure 11 The occurrences of the term business model (Source: Osterwalder 2004) ........................................... 16
Figure 12 The relationship between the concepts ‘business model’ and ‘strategy’ (Source: Seddon and Lewis 2003) 18
Figure 13 Business model components framework – for eBusiness (Source: Pateli 2003) ................................. 20
Figure 14 Business Model Canvas (Source: Osterwalder et al. 2009) ................................................................. 20
Figure 15 Business Model Canvas basic shape (Based on: Osterwalder et al. 2009) ........................................... 21
Figure 16 Telco’s business model based on SMBO (Source: Samavi et al. 2009) ................................................ 22
Figure 17 Sellaband business model drawn on Canvas (Source: Osterwalder et al. 2009) ................................. 22
Figure 18 Business Model Canvas (Source: Osterwalder et al. 2009) ............................................................... 23
Figure 19 Business Model Innovation Cycle (Based on: Osterwalder 2006) ..................................................... 25
Figure 20 Design phases .................................................................................................................................... 27
Figure 21 Business Model Innovation Cycle (Based on: Osterwalder 2006) – remaining steps .................... 28
Figure 22 Design- and Choice phase .................................................................................................................. 28
Figure 23 Business Model Canvas and 9 Building Blocks (Source: Osterwalder et al. 2009) .......................... 30
Figure 24 Project design steps ............................................................................................................................. 32
Figure 25 Limousine prices (Datasource: Sanfranciscocolimo.com 16-09-2009) ............................................... 41
Figure 26 San Francisco Bay boating facilities (Source: Briconm) .................................................................. 47
Figure 27 Service zones ...................................................................................................................................... 1
Figure 28 Value proposition High-end Commute ............................................................................................. 62
Figure 29 Value proposition High-end Commute ............................................................................................. 62
Figure 30 Value proposition General Business ................................................................................................. 62
Figure 31 Conceptual model .............................................................................................................................. 77
Figure 32 Visual representation of significant results ......................................................................................... 79
Figure 33 Number of passengers - stated importance ....................................................................................... 80
Figure 34 Market shares at different ticket prices ............................................................................................. 83
Figure 35 Which service would you choose to use - forced choice ................................................................. 83
Figure 36 Market sizes and scenarios ................................................................................................................ 90
Figure 37 Calculation framework ..................................................................................................................... 94
Figure 38 High-end Business profit scheme (SM-SF) ....................................................................................... 96
Figure 39 General Business profit scheme (SM-SF) ......................................................................................... 97
Figure 40a Number of passengers (HC / SF-SM) ............................................................................................. 99
Figure 41a Number of passengers (HC / SM-SF) ............................................................................................. 99
Figure 42 Break-even ticket prices & positive ROIs .......................................................................................... 101
Figure 43 Break-even analysis .......................................................................................................................... 102
Figure 44 Return on Investment: High-end Commute - Route: SM =>SF ....................................................... 104
Figure 45 Break-even analysis: High-end Commute - Route: SM <= SF ............................................................ 104
Figure 46 High-end Commute - Final .................................................................................................................. 105
Figure 47 Value proposition - High-end Commute ........................................................................................... 110
Figure 48 Value proposition – High-end Commute .......................................................................................... 110
Figure 49 Value proposition - General Business ............................................................................................... 110
Figure 50 High-end Commute - Final ................................................................................................................ 112
Figure 51 Ijssel-/Markermeer, SouthWest Holland and San Francisco Bay Area (Google Earth, satellite altitude 50 miles) ........................................................................................................................... 1
Figure 52 Visual overview of the San Francisco Bay Area .................................................................................. 151
Figure 53 Daily Inter-County commuters (x1000) – only >25,000 showed .................................................... 152
Figure 54 Current Public Transportation (Source: ABAG) ................................................................................ 153
Figure 55 Boarding points ................................................................................................................................. 154
Figure 56 Nautical map of the San Francisco Bay Area .................................................................................... 1
List of Tables

Table 1 Average weekday daily person miles of travel ........................................... 4
Table 2 Mean Household Income (2007 dollars) .................................................. 5
Table 3 List of advisors ......................................................................................... 36
Table 4 WETA Five year Financial Plan .................................................................. 42
Table 5 Vessel type characteristics (Based on: Piet 2008) ....................................... 43
Table 6 Minimum number of required crew ....................................................... 45
Table 7 Access and egress ................................................................................... 48
Table 8 Stakeholders ............................................................................................ 49
Table 9 Design Space ......................................................................................... 52
Table 10 Items in transportation research on surveys - overview ........................... 69
Table 11 Attributes & attribute levels ..................................................................... 71
Table 12 Example effects coding .......................................................................... 71
Table 13 Response rate ......................................................................................... 75
Table 14 Response group characteristics .............................................................. 75
Table 15 Response distribution ............................................................................. 75
Table 16 Missing values ....................................................................................... 76
Table 17 Biogeme data file - partial ................................................................. 76
Table 18 Estimation results .................................................................................... 78
Table 19 Utilities per attribute level ....................................................................... 79
Table 20 Willingness to pay .................................................................................. 81
Table 21 Business model utility & choice probability ............................................ 81
Table 22 Congestion on route 101 ......................................................................... 89
Table 23 Scenario overview .................................................................................. 91
Table 24 Items in calculation per Business Model ................................................ 93
Table 25 Ticket prices with positive ROI indicated for all scenarios ....................... 95
Table 26 Break-even points ................................................................................... 101
Table 27 Top 3 ROI generating ticket prices ....................................................... 102
Table 28 Cost Structure ....................................................................................... 102
Table 29 Uninspected / Small Passenger Vessel .................................................. 159
Table 30 Vessel inventory .................................................................................... 161
Table 31 Engine types ......................................................................................... 165
Table 32 Travel times for new WETA routes (expected by 2025) ......................... 167
Table 33 Stakeholders and their resources ............................................................ 173
Phase 1

Research approach
1 Introduction

Triggered in 2008 by personal observations of parking hassles, congestion problems, a focus on the environment and the wish of San Francisco to make better use of their unique waterfront, it seems as though there is potential for water transportation. Encouraged by a speech of Ron Cowan\(^2\) in which he expressed his dream of water taxi cabs criss-crossing the San Francisco Bay, these claims and its accompanying uncertainties warrants in-depth qualitative research.

The chosen angle is the business perspective in which is searched for an answer to questions like: how can we make money out of the discomfort people perceive? Can you solve their headache?

Which opportunities does the San Francisco Bay Area in California, USA have related to water transportation? This urban area is "A metropolitan region that surrounds the San Francisco and San Pablo bays in Northern California. It consists of nine counties, 101 cities, and comprises 7,000 square miles. All of the region's nine counties share the San Francisco Bay. With 7.1 million residents, the San Francisco Bay Area is the fifth most populous metropolitan area in the United States" (Droettboom 2009).

The region is highly troubled by congestion. "the region experienced 161,700 vehicle hours of delay during the morning and afternoon commute periods on an average weekday during 2007." (MTC 2008)

The Bay Area houses many people with money. Silicon Valley\(^3\) houses a multitude of high-tech companies and over 600 investors swarm around that. It houses the largest venture capital community in the world and it is in the top ten of the largest economies in the world.

The Bay is an estuary of over 1,000km\(^2\), situated lengthwise over 80km parallel to major traffic arteries and in width varying between 5 and 20 km. This makes it ideal an ideal alternative route for high-speed water transportation between major financial centers.

So basically the San Francisco is an area which has congestion and its accompanying hassles, a way to get around them and other arguments, to start offering a service to a select group of people with money. That said, discomfort is usually not equally distributed over different market segments, so why create a midway solution available to anyone?

This is a pre-feasibility study on the business potential of high-end water taxi\(^4\) services for business travelers in the San Francisco Bay Area. This study will advise a startup company on whether or not to pursue the next steps of performing a full feasibility study, creating a business plan and a full financing structure for this type of service.

The specific business opportunity studied in this thesis concerns the following new service:

<table>
<thead>
<tr>
<th>Water taxis</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-demand, long-distance (30-50km), high-speed (&gt;30kts), sustainably powered (solar/electricity/hydrogen), relatively small water taxis; for business travelers in need of travelling from the South of the Bay to San Francisco and back; combined with drop off and pick-up at the desired meeting point.</td>
</tr>
</tbody>
</table>

A project objective will be formulated in section 1.3. But first the current situation and the opportunities they might bring, will give further support to pursuing this startup potential for water transportation in the San Francisco Bay Area.

\(^2\) Ron Cowan is a prominent local Alameda developer who received a lifetime achievement award at the Bay Area Council annual meeting (April 2008). At the event, he was sharing this dream with the audience of 1,500 business people.

\(^3\) It is the area below San Francisco, creating a hockey stick shape by adding San Jose and leading up to the Diablo mountain range and down to Santa Cruz. It is about big as the province of Zuid-Holland in the Netherlands.

\(^4\) According to the Transportation Research Board (TRB) a water taxi by definition provides on-demand service to a variety of destinations. However, the term is commonly applied to small watercraft serving multiple-stop routes. TRB. (2004). "Transit Capacity and Quality of Service Manual, 2nd Edition."
1.1 Current situation & opportunities

The introduction mentioned a number of items relevant to warrant more research on the subject of high-end water taxis. This section discusses multiple situations, which all lead to an opportunity.

1.1.1 Parking problems

NPR Radio states that “in addition to high gas prices San Francisco has some of the worst traffic in the nation. The city says one major contributing factor is drivers cruising for the few available parking spaces. By double parking and blocking traffic waiting for spots to open, this creates tense drivers, slow public transit and clogged streets”. (NPR 2008)

Adam Stein writes on the Terrapass website that “Professor Donald Shoup, the godfather of parking reform, has conducted research showing that drivers cruising for parking are responsible for up to 30% of traffic in central business districts. In one small area studied, cruising burned an additional 47,000 gallons of gasoline per year.” (Stein 2008)

The City Parker newsletter states that “Downtown parking rates in San Francisco continue to creep upwards reaching $400 per month, with daily rates of over $30 for all day parking” (Leonoudakis 2007). Dutch government pays its abroad employees according to the local cost of living. San Francisco lies at 136% of the benchmark in Washington DC (100%), making it the highest in the country. If Washington DC parking rates can be taken as benchmark for future developments as well, a rate of “18USD per hour after the first two hours” is a shocking prospect.

An extensive overview of the (political) difficulties on the parking problems in San Francisco has been published by Jason Henderson in Antipode (2009a).

By using the water transportation from the south, towards San Francisco, those extra cars would not enter the city at all. This would eliminate the need for downtown parking on this trip.  

1.1.2 Congestion

The Metropolitan Transportation Commission (MTC) and Caltrans, two leading traffic related institutions in the San Francisco Bay Area, report that region wide congestion reached its highest level since 2000. This is contradictory to the declined delays along Bay Area’s most congested freeway corridors. It is caused by “several years of steady job growth and measured with greater precision in 2007 thanks to an expanded data-gathering effort”. The report further states that “While this year’s congestion numbers may drop under the weight of $4-a-gallon gasoline, rising carpool and transit use, a weak real estate market and other factors, the region experienced 161,700 vehicle hours of delay during the morning and afternoon commute periods on an average weekday during 2007.” (MTC 2008)

![Figure 8 Vehicle hours of delay vs. employment](image)

Sources: California Employment Development Department, Caltrans, Metropolitan Transportation Commission

Figure 8 Vehicle hours of delay vs. employment

---

5 To deliver the same door to door trip, the access and egress should still be done by an added service such as a standard taxi, not eliminating the need for minor downtown car travel.
The same MTC research (MTC 2007) shows as below that the average miles travelled per day is likely to increase up to 40% in the next 25 years and thus worsening the traffic situation.

<table>
<thead>
<tr>
<th>2006 Base Year</th>
<th>2035 Baseline</th>
<th>% Change, 2006 to 2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>144,330,807</td>
<td>202,302,636</td>
<td>40.2%</td>
</tr>
</tbody>
</table>

An initial analyses for the main corridor to the south of San Francisco (Highway 101) shows that congestion creates over 11,000 vehicle hours of delay per weekday (MTC 2007). See Appendix D for an overview of the number of commuters per day between the different counties.

The water taxi would simply bypass the congested road over the parallel water.

### 1.1.3 Earthquake threats

The Bay Area Water Emergency Transportation Authority (WETA) celebrated on October 15, 2007 Governor Schwarzenegger’s signature of Bay Area Council-sponsored Senate Bill 976 (Torlakson, D-Antioch). According to their website the bill (SB 976) "creates the Bay Area’s first new transportation authority of the 21st Century. WETA's mission is to plan and build an emergency response and disaster recovery water transportation system for the region to be able to respond to an earthquake or other disaster.” (BayAreaCouncil 2007).

Currently the WETA is completing the Emergency Water Transportation System Management Plan (BayAreaCouncil 2009). By achieving this a milestone is reached by consolidating all current public ferry operators, except Golden Gate Transit.

This means an excellent time to enter discussions since all cards are on the table and up for discussion. With that comes the benefit of a rapid decrease of the amount of actors involved.

### 1.1.4 More water transportation envisioned

There is a growing interest in water transportation in the San Francisco Bay Area. The San Francisco Chronicle website reported in 2002 the blue-ribbon plans to add seven routes of ferries with non polluting ships. It further states that the WTA authority (currently WETA) has scaled back its plans by eliminating routes that would have light ridership or would be too costly to operate. Reasons for this are ridership, feasibility and cost studies (Cabanatuan 2002). All seven lines of the 2002 plans for more ferry routes are still on the WETA website (watertransit.org). One line would lead to the south, to Redwood City.

Large companies such as Yahoo, Google and Oracle already have their private car-based shuttle services. The build of this new ferry terminal on or close to their premises would decrease or eliminate the use of their cars (WETA 2009c). Inside information revealed that Google has recently been researching the use of water transportation. The reason for discontinuation of the efforts is the conflicting interest between the environment and the maximum access and egress distance. Another way Google is considering to decrease the amount of passengers transported on the road, is to build an extra office in San Francisco.

More explicit new information states that multimillion dollar water taxi piers are in place since December 2007, yet no water taxis are in operation (Harris 2007; SanFranciscoPlanningDepartment 2009).

Apparently the idea to use the water is not new. WETA mentions in their Spring 2009 news letter Full Speed Ahead that all funds for the south bound plans are frozen: “The South San Francisco Ferry service, is now delayed until 2011. In addition, we have stopped all environmental work and preliminary investigations on Hercules, Richmond, Antioch, Martinez, and Redwood City ferry projects.” (Johnson 2009). Reason for this was a sudden bankruptcy of the State, due to the credit crunch. UPDATE “A groundbreaking ceremony was held at Oyster Point on October 19, 2009 to celebrate the start of construction on the South San Francisco ferry terminal” (WETA 2009e).
indicates that financial support for any new projects like this is not realistic. This does however create an opportunity for non-public initiatives.

The difference however is the target group: businessmen instead of average Joe. Personal, on-demand transportation on different infrastructure might be a winner, just as easy as calling a cab but of higher quality.

1.1.5 Focus on green and sustainable
Mayor Gavin Newsome has presented a “9-point strategy to standardize the efforts to become the capital of electric vehicles in the US”. At this high-profile press conference (BetterPlace 2008) in 2008, several public and private partners from the Bay Area joined hands in acting on the zero emissions vehicle program of Governor Schwarzenegger (Mayor’s Office 2008).

In a practical sense this means that in the entire Bay Area the infrastructure for electric cars will be installed. Shai Agassi, founder and CEO of Better Place said at the same conference that the total value of the charging spots, battery switching stations, etcetera run up to $1bln.

The reason for this vast project is global warming. There is an enormous growth in vehicle miles traveled: “it grows twice as fast as the population.” according to Senator Mark Leno and the accompanying “worst air quality in the country causes an economic cost of $28bln”. The effect of tackling this problem is urgent and effective since 54% of the emissions in the city comes from cars and small trucks, compared to 40% elsewhere.

This project is in line with the local policy. Czeers Solarboats has developed the world’s first solar powered speedboat. Due to its electric propulsion and solar power charging it’s silent and clean. It’s top speed is 30knots; double the speed of the average ferry according to a 2006 study (Roberto 2006) and in line with all ferries in the San Francisco Bay Area, which have a operating speed between 25-35knots (WETA 2009b). The design philosophy is fit for the high ranked businessman. However the current design is leisure based and has to change for business travel to be possible.

Another type of impact on the environment is due to damage to the wetlands and its fragile habitat. High speeds usually come with large wash. New vessel types are being developed by innovative companies, that might be the solution for minimize the creation of waves, such as Trimarans and Axe Bow-shaped hulls.

1.1.6 Lack of quality alternatives
The first important element that usually comes to mind with most people when travelling is the travel time (see also section 7.1.2). Current research however shows equal or at least significant important effects from the elements travel time reliability, equipped time and comfort cq. luxury.

Research based on rational economic behavior, specifically on value of travel time has shown an inverted relation between travel time and value. This means a reduction in travel time is worth money. The value of time estimates in the San Francisco in 1990 ranged between $0.23 for Home-based high school trips up to $9.65 for Home-based high school trips up to $9.65 for Home-based work trips (MTC 1997).

People with higher income usually have an even higher value of time. This is especially the case for business men. Research shows, even when controlled for both influences, that their higher wage and the bosses make, them the group with the largest value for time (Fosgerau 2006; Hess et al. 2005). As indicated before, the San Francisco Bay Area is an expensive region; with that has come a high average income per capita as shown in Table 2. The smaller font relates to counties of less interest to this research.

Table 2 Mean Household Income (2007 dollars)

<table>
<thead>
<tr>
<th>County</th>
<th>Year 2006</th>
<th>Year 2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alameda</td>
<td>$94,588</td>
<td>$120,291</td>
</tr>
<tr>
<td>Contra Costa</td>
<td>$106,707</td>
<td>$139,327</td>
</tr>
<tr>
<td>Marin</td>
<td>$130,149</td>
<td>$171,248</td>
</tr>
</tbody>
</table>
Napa $96,051 $126,344
San Francisco $103,796 $132,857
San Mateo $128,817 $165,308
Santa Clara $101,703 $129,829
Solano $82,478 $125,023
Sonoma $89,741 $115,238
Bay Area $103,031 $133,072
Source: (MTC 2007)

Initial analysis of the envisioned service shows however that reduction of travel time would require extraordinary speeds, which are not likely to be accompanied with comfort. See also Appendix I.

Since travel time is hard to compete on other competitive factors are needed. Improving reliability (Brownstone and Small 2005) and predictability (Chorus et al. 2007; Chorus et al. 2009) is as influential on the perceived value of time, as a reduction in travel time savings itself (Brownstone and Small 2005).

Jain and Lyons (2008) discovered that many people see their journey as a part of everyday activities and work-related tasks. Being able to call family and friends or finally have time to read a magazine, switching off when going home or switching on by preparing for the upcoming meeting are all examples equipped time, or at least not necessarily lost-time.

By creating the opportunity for people to turn their travel time into equipped time by improving the quality of the trip or by creating the opportunity to combine it with work, the value gained can be transferred into revenues.

Bay Area businesspeople are not scared of enjoying their achievements. It does not mean however that they like to show off. A good meal, a nice car and a proper house are often part of a well designed image of success but not overdone (Verpoort 2008). Some however would prefer not to travel by public transport. From this perspective it can be expected that a new service would require a certain level of distinction with comfort or luxury, aside from existing means of transport.

The largest opportunity seems to lie in the overall transformation of travel time into quality time. Be it by improving travel time reliability, by creating options for equipped time or by offering comfort cq. luxury.

All in all this means that with the amount of business present in the region, there is huge potential for a niche market with money to be made on well-paid business travelers, not the general commuter.

1.2 Opportunity area

In the previous section six topics have been discussed elaborately, all leading to assumptions on business opportunities. It’s only a matter of combining them in the right way: business opportunities galore for anyone that keeps an eye out for them. Take another look at the six topics below:

- Parking in city centers, especially the Financial District in San Francisco, is a hassle and parking rates are increasing rapidly; also the environmental impact is considerable.
- Congestion in the San Francisco Bay Area creates over 160,000 vehicle hours of delay per weekday.
- The Bay Area is working on more waterborne solutions to deal with the threat of the next major earthquake.
- Based on San Francisco policy, water taxi piers are in place since December 2007. Yet no water taxis are in operation.
- The Mayor of San Francisco wants to make the City cleaner, more environmentally friendly and making better use of its unique waterfront location. Innovations on vessel shapes and electric propulsion can create added benefit.
- Business travelers are willing to pay for higher quality travel, either by decreasing travel time, improving travel time reliability, creating options for equipped time or offering comfort cq. luxury.
A combination of all these issues, provides potential for a new service:

**Water taxis**

On-demand, long-distance (30-50km), high-speed (>30kts), sustainably powered (solar/electricity/hydrogen), relatively small water taxis; for business travelers in need of travelling from the South of the Bay to San Francisco and back; combined with drop off and pick-up at the desired meeting point.

The project has three core issues to address: which concepts can be designed for this type of service, what would be the utilization thereof by the customer, and is one of the concepts at those utilization levels good enough to start a business on.

### 1.3 Project objective

The purpose of this study is to facilitate a startup company in project identification for investment. A pre-feasibility study may form the basis of an important investment decision (SMEDA 2003). A preliminary feasibility study, or pre-feasibility study, is the precursor to a feasibility and design study (AUSaid 2005). In large (and usually joint venture or multinational) projects, such a preliminary study is undertaken to determine if it would be worthwhile to proceed to the feasibility study (BusinessDictionary.com 2010). In other words, it tries to answer the question whether or not the project seems to have business potential.

In general a pre-feasibility study will analyze and determine the financial viability, i.e., its ability to be self supporting (Hall et al. 2003). According to the Organization of American States (OAS) it is defined as a “preliminary assessment of the technical and economic viability of a proposed project. Alternative approaches to various elements of the project are compared, and the most suitable alternative for each element is recommended for further analysis. Costs of development and operations are estimated. Anticipated benefits are assessed so that some preliminary economic criteria for evaluation can be calculated.” (OAS 2010)

The specific project in this study is a high-end water taxi service for business travelers in the San Francisco Bay Area.

The main goal of this pre-feasibility study is thus to:

*Advise a start-up company, based on the business potential, whether or not it should pursue performing a full feasibility study on high-end water taxi services for business travelers in the San Francisco Bay Area.*

The objectives of this project are:

1. Design several service concepts for
   - water transportation
   - in the San Francisco Bay Area
   - for business travelers.

2. Choose the most suitable concept from a company point of view, based on matching of
   - customer demand,
   - positive financial viability, and
   - practicability.

These objectives lead to the determination of the most suitable concept, accompanied with anticipated benefits, which allow for calculation of some preliminary economic criteria. Generally speaking, negative economic criteria would mainly indicate negative financial results, and thus no financially viable business, i.e. no business potential in the proposed form. Positive criteria analogously, could indicate a potentially viable business.

This end result, in combination with other arguments gathered in this study, allows for advice on pursuit of a full feasibility study.
Sub-goals
Determine the boundaries of the (technical) design space for water transportation in the SFBA, in terms of
- trip duration
- comfort and service levels
- sustainably powered or not
- boarding points
- access & egress means
- minimum and maximum ticket prices
- maximum initial investments.

Forecast if the high end business market
- consisting of businessmen and -women
- earning over $100,000 per year
is willing to use water transportation instead of their current means,
- based on to be determined decision elements (attributes)
- in quantities and for a price
which is sufficient to build and sustain a company

1.4 Scope of the design project

Problem owner
The viewpoint, or actor perspective, is that of a startup company that might decide to invest in this service.

School of thought
This design project will focus on the interaction between utility based demand analysis and supply analysis from a service perspective. Only a limited amount of technology will be introduced.

Geography
The geographic scope is limited to the San Francisco Bay thus only touching the following counties, as indicated in Figure 9:
- Alameda
- Contra Costa
- San Francisco
- San Mateo
- Santa Clara
- Marin

Reasons for this being the multitude of businesses in the Silicon Valley region as indicated in black, the presence of the San Francisco financial district and two airports. For the area more north there are not as many boarding points nor many densely populated areas. Also there are already ferry services in place as indicated in Appendix E.
Figure 9 Study area on Regional Map (Source: ABAG)

Limitations
This project does not aim to contribute to the discussion on how to solve general congestion. It aims to help the more financially fortunate in a specific region to bypass them.

This design project is limited to water transportation as a means of transportation for the business traveler, not all means of transportation are compared.

It is aimed at finding the best business model for the company, based on the preferences of the users. It is not aimed at comparing business models for water transportation, rather applying the one that seems to fit to this project.

The actual implementation of the results falls outside the scope. The aspect of implementation and related milestones is part of a business plan and not of a business model, as will be explained in section 2.2.3. Specific attention is given to data analysis tools for market demand forecasting. Limited attention is given to logistics and environmental impact. No attention is given to technical design such as jetties.

New vessel development is not a priority. Insights at this point in the report suggest a positive influence on marketing benefits, but also a lack of directly implementable technological developments in sustainable propulsion on a large scale.
The service concepts should be practically achievable and not exceeding the following boundaries:

- Door-to-door travel times: 39 – 90 minutes. Determined by fastest vessel ~55 knots & longest congested time +50%. See also Appendix I.
- Boarding locations: Currently available or possible to be created with minimal environmental impact.
- Ticket prices: up to $375. Determined by comparing to limo prices: maximum +50%. See also section 5.1.
- Total initial investment not exceeding $15 mio. This is the amount spend on the latest purchase of two 149pax-ferries for the San Francisco Bay Area, which are the most environmentally friendly in the entire US.

These boundaries are initial estimates of factors that will be elaborated on in chapter 5 Step 2 - Framing the design space.

### 1.5 Structure of the research

This report is written along four phases:

- A research approach phase, which provides an introduction to the subject, a literature study and an elaboration on the methodology;
- A design phase in which the necessary qualitative sources are gathered in a team, the design space is framed and three service concepts are designed;
- A matching phase in which a choice is made for the most suitable service concept through matching the demands from the customer with what a company can supply;
- A wrap-up phase in which conclusions are drawn, recommendations are given and the report is reflected upon.

The design and choice phase for this project are based on the Business Model Innovation Cycle by Osterwalder (2004) and will be introduced in chapter 2 and elaborated on in chapter 3.
2 Literature study

Designing service concepts for water taxis, or more in general passenger transportation over water, requires prior knowledge on the relevant aspects involved. In section 2.1 a compilation of six reports published on the Dutch ferry systems in the past 17 years, provides an extensive overview of key elements.

Designing also implies that there is the need for a tool or framework for representation of the service concepts and a design process. Section 2.2 introduces business models as the appropriate framework for representation of the service concepts that will be designed. It will also select one specific tool that will be used.

Thirdly, in section 2.3, a short elaboration is given on design processes and the integration with business models. This leads to the introduction to the basis of the design process for this study: the Business Model Innovation Cycle (Osterwalder 2006).

The chapter is written with both an aim for educating those unfamiliar with business models and for the support of the decision for the tool and process used in the rest of this project.

2.1 Passenger transportation over water

This section is largely based on unpublished work from the same author: “Waterborne passenger transport: what can 15 years of Dutch experience teach us?” by J. Verpoort – TU Delft (January 2009). It is a literature study based on a selection of reports published on the Dutch ferry systems in the past 15 years to gather the data.

2.1.1 Introduction

Transportation of passengers over water is often becoming an alternative for more common modes of transportation, often inspired by congestion and otherwise costly infrastructure.(TRB 2004) The reason for using a different modality is: added value.

Large diversity of situations makes it hard to identify a preferred system design. To overcome this problem an extensive overview of key elements should be available.

A literature study is done on a selection of reports published on the Dutch ferry systems in the past 17 years to gather the data. Publication of a government policy advice in 1993 is the starting point. This compilation will provide insight in the factors that are important. The compilation consists of data from 6 reports with different objectives:

<table>
<thead>
<tr>
<th>Title</th>
<th>Year</th>
<th>Objective</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passagiersvervoer over water: een mogelijke alternatieve vorm van openbaar vervoer</td>
<td>1993</td>
<td>Government policy advice</td>
<td>(Zoutendijk 1993)</td>
</tr>
<tr>
<td>Personentransport over binnenwateren: een onderzoek naar de haalbaarheid van personentransport over bestaande waterwegen in Vlaanderen</td>
<td>2000</td>
<td>Practical applicable lessons</td>
<td>(Schrijver and Willems 2000)</td>
</tr>
<tr>
<td>Succes- en Faalfactoren en de toekomst van OV water</td>
<td>2002</td>
<td>Reviewing Dutch projects</td>
<td>(Veenma and Linden 2002)</td>
</tr>
<tr>
<td>Openbaar vervoer over water: reizigersonderzoek op vijf trajecten.</td>
<td>2005</td>
<td>Travelers opinion Dutch projects</td>
<td>(Werff and Veenma 2005)</td>
</tr>
<tr>
<td>Verkenning openbaar vervoer over water</td>
<td>2006</td>
<td>Preliminary research for Rotterdam</td>
<td>(dS+V 2006)</td>
</tr>
<tr>
<td>Vervoer over water in Rotterdam: Een verkenning van voorwaarden voor een succesvolle ontwikkeling van een OV-waternetwerk</td>
<td>2008</td>
<td>Application for Rotterdam</td>
<td>(Berg and Mingardo 2008)</td>
</tr>
</tbody>
</table>
There are many shapes and forms of passenger transportation over water. On one end there are small deteriorated private boats can be your taxi in less developed water-rich cities. On the other end there are huge systems such as Hong Kong which consists of 23 terminals and 8 professional operators or Sydney and Boston. (Ceder 2006) The systems considered in this paper are ferries in the Netherlands, which have 100-250 seats.

In the researched period six companies started transporting people over water:

<table>
<thead>
<tr>
<th>Company</th>
<th>From - To</th>
<th>Year in operation</th>
<th>Current status</th>
<th># travellers 2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast Flying Ferries</td>
<td>Velsen-Zuid - Amsterdam Centrum</td>
<td>1998</td>
<td>Active</td>
<td>250.000</td>
</tr>
<tr>
<td>Flevo Ferries</td>
<td>Lelystad-Almere-Amsterdam</td>
<td>1999</td>
<td>Out of order</td>
<td>operational only a few months</td>
</tr>
<tr>
<td>Waterbus</td>
<td>Drechtsteden - Hollandse Biesbosch</td>
<td>1999</td>
<td>Active</td>
<td>1.820.000</td>
</tr>
<tr>
<td>Fast Ferry</td>
<td>Rotterdam - Dordrecht</td>
<td>1999</td>
<td>Active</td>
<td></td>
</tr>
<tr>
<td>Aqualiner</td>
<td>Almere-Haven - Huizen</td>
<td>2000</td>
<td>Active</td>
<td>60.000</td>
</tr>
<tr>
<td>BBA Fast ferries</td>
<td>Vlissingen - Breskens</td>
<td>2003</td>
<td>Active</td>
<td>800.000</td>
</tr>
</tbody>
</table>


Section 2.1.2 provides the findings of the researched literature, ordered according to the five important elements for projects with societal impact:

- Financial and economic aspects
- Technical aspects
- legal aspects
- Governance and organizational aspects
- Socio- and psychological aspects

By using these elements new developers are forced to look from different viewpoints, or it can be a guideline to split up responsibilities among partners. Part of the elements will be overlapping; this is exactly what often makes these multi-actor projects so complex and hard to manage.

Section 2.1.3 is a reflection on the lessons from the Dutch cases studied and the general research for the San Francisco Bay Area.

2.1.2 Summary of important aspects

As mentioned six reports are combined. The fact that the objectives of each report are different makes it more extensive than a one-dimensional analysis. Also the multiple viewpoints caused by the different actors, makes it an elaborate set of factors. The main lessons that can be drawn from the table are provided in this section. An overview of all the key elements mentioned in the reports can be found Appendix C, structured according to the following five elements:

- Financial and economic aspects
- Technical aspects
- legal aspects
- Governance and organizational aspects
- Socio- and psychological aspects

Technical aspects

The factor comfort is clearly interpreted differently among the reports. In 1993 the smooth ride in a comfy chair to sufficiently ‘survive’ the trip. In later stages there are discussions about ambiance, amenities and the ‘feeling’ of safety.

The early reports seem to be focused on the location of the dock from the boats perspective, while the latter focus on accessibility from several modalities.

Wash problems are seen as a problem in most reports. Only in the user oriented report 2005, this is actually turned around in being able to gain support for the system through addressing the issue.

Bikes have almost become a precondition in construction of the system. It is seen as an added benefit over other transport modes.
It is quite remarkable to see that the 2006 report is the only one to explicitly mention to, for example, not plan a ferry parallel to other PT systems. An advice that would have had added value in all other reports as well. It is perhaps caused by a more in-depth analysis of the location also resulting in explicit mentioning of the need for high population density in proximity to stops and a potential challenge when those areas have less prosperity.

**Judicial aspects**
The most important find on this aspect is that it has only been addressed to some depth in 1993. Not counting the general remark in 2000 that government has a role in law and finance.

**Financial and economic aspects**
Multiple target groups are clearly an issue, since all reports mention this. The basic reason is the lack of a consistent flow of commute passengers over the day, which leads to a low cost coverage. On average for the Netherlands this is 37%. Often market research has been done lightly, wrong or even left out while this should be the main driver for implementing a system. Expected reason is the wish from the government to do so. The last three reports don’t explicitly mention it to be an issue.
Reliability is always a trade of in which finance is involved. Higher reliability will cost more. The 2000 report will even go as far as requesting an extra vessel to secure this reliability. This issue returns in the socio- and psychological aspects as punctuality since it has a huge impact on the trust and with that usage of the system.

Fuel is becoming more of an issue lately, since it comprises about 50% of the operating costs. Prices have skyrocketed and plummeted again. By now they are expected to rise again towards the high of USD150/barrel.

Only in the first and last report subsidies are practically mentioned. 1993 states there should be a clear recognition of the impact of pilot versus long-term subsidies, while 2008 states that the systems are just not feasible without it.

**Socio- and psychological aspects**
Getting used to water transportation should be considered a gradual process. Making it trustworthy, punctual, safe including visually and having extensive periods of trial; gives people the chance to get used to it.

**Governance and organizational aspects**
Including the government is a must, since they will be involved in many aspects, such as permits, subsidies and the assignment itself. An important warning comes in 2002 by mentioning that often the ships cause problems, either in purchase, maintenance or operational speeds.

Very explicitly the 1993 report states that the key factor for success is travel time competing with the current modality, often the car.

### 2.1.3 Lessons for the San Francisco Bay Area

Different approaches adopted in Europe as opposed to the United States with respect to transport policy and, in particular, public transport provision has created different systems (Button 1997). Next to geographic and natural differences, origin and development of the transport markets was different. Europe later changed in number of members and policy. Both had a liberalization streak. Urban sprawl, high-speed rail and innovative ways of financing created different forms and incentives of transport systems. Another major difference is in the way environment is compensated. While there are a number of geographical and economic reasons why different policy approaches can be expected between Europe and the US, there is also often a different philosophical attitude in among the European countries themselves. That is why for example the water transportation systems in Hamburg and Goteborg are different (Berg and Mingardo 2008). Al-in-all European experiences not rosy, but lessons can be learned for the US.

The Netherlands has high density urbanization. This can be somewhat compared to the San Francisco Bay Area. This region is of particular interest due to recent plans to expand the ferry system. (Cabanatuan 2002; WETA 2009c)

The San Francisco Bay Area has a large focus on sustainability (SFEnvironment 2009) and is proud of the rich ecology in the Bay. This is why the wash problems could be a key issue.
San Francisco is one of the few American cities with a lot of bike riders. Therefore all public transportation modes are adjusted to bringing the bike onboard, including busses. This is something in which they are ahead of the Netherlands. A ferry system should definitely have this option.

There are tourists and inhabitants in San Francisco who would like to go out somewhere else at night, for example in San Jose or Sausalito. Driving takes a long time and there needs to be a designated driver. Public transportation doesn’t ride at night. The advice to use multiple target groups could also be implemented through providing a party charter.

Not doing market research, but implementing a project based on what you have, not what you need is not the smartest thing to do. The Mixed Logit stated choice model has been designed to predict one of the newer local modes of public transportation: BART, sort of a subway. This has a very high accuracy in predicting for a heterogeneous group of users.

Trustworthiness, punctuality and safety including visually, are issues that need to be solved for the Americans. Lawsuits are around the corner, when something does happen that has not strictly been forbidden. (Verpoort 2008) Remarkably these are big issues America while this combination of the judicial and socio- and psychological aspects are hardly mentioned in the Netherlands.

Travel time is apparently very important. This would mean that the vessels should at least be able to compete with congested road travel.

Comfort during travel, shorter travel times and possibilities for intermodality are user requirements. To estimate the usage by multiple target groups, market research should be done extensively, considering the above issues and their relation to congestion, reliability and getting used to waterborne transit.

There should be a technical solution for the wash problems, a logistic decision on parallel versus cross-water routes and a sound financial estimate, based on, among others, the influence of the oil prices (50% OpEx) and subsidies for pilot versus long-term programs.

2.2 Service concepts represented by business models

This project aims to advise a startup company on whether or not to follow-up on a proposed service. This creates the need to frame the concepts in a manner known to these companies. Even though it is often unclear what exactly a business model is and its relation to business plans and business strategy (Linder and Cantrell 2000), it usually creates a understanding at a higher-level of what the business is about (Alt and Zimmermann 2001).

Business models themselves can be innovative, for example at Dell, but also the business models can create continuous innovation, for example at Google. (section 2.2.1)
One of the earlier writings on business models comes from Drucker (1954). The boom in research and attention however took until the rise of e-business around 2000. Much literature on business models is still focused on this type of business, but there are also more general frameworks. (section 2.2.2)
To many users however there is still much unclarity on the difference between business models, - plans and -strategies. (section 2.2.3)
This accompanied with the fact that there is much discussion on the actual elements that a business model should contain, creates the need for a clear choice on what will be used in the rest of this project. (section 2.2.4).
Discussion of these subjects combined with arguments on usability (section 2.2.5), this section builds towards the choice for use of one specific tool: Osterwalders Business Canvas (section 2.2.6).

2.2.1 Business models & Innovation

One theory that allow for a continuous innovation is Open Innovation. In the concept of Open Innovation (Chesbrough and Appleyard 2007) innovation is often seen from the perspective of existing companies in which startups can play a role as outsourced change or development (Chesbrough 2009).
This project focuses more on an innovation of the business model itself. Supplying a well known service (taxi’s) on a less standard infrastructure (water) to a small niche client segment (high-end) instead of to everyone along the streets.

Figure 10 The business model mediates between the technical and economic domain

Chesbrough and Rosenbloom (2002) state that as depicted in Figure 10, the business model mediates between the technical and economic domains. The richness and complexity of each domain, usually leads to companies specializing their personnel to focus within each domain, while business model conception and execution is aided when individuals can learn to span those domains. Spanning the domains creates interaction in the most unexpected areas, usually leading to innovative ideas. Even though the Open Innovation concept is not adhered to in the classical sense, it will be a multidisciplinary approach: open to all input to stimulate creativity. Osterwalder and Pigneur (2009) have incorporated this same view in their business model ideation process.

2.2.2 Development of the concept

The development of the concept of business models is discussed in this section on the attention it has received in science and on the definitions that researchers have given it.

Scientific attention

(Chesbrough and Rosenbloom 2002) discuss the presence of business models in the academic realms. Around the year 2000 the discussion on business models started to rise, due to the rise of e-commerce, but it was not as prominent in academic discourse. As can also be seen in Figure 11 by Osterwalder.

Figure 11 Occurrences of the term business model (Source: Osterwalder 2004)

Porter concurs in 2001 that the scientific foundation of business models is not yet fully developed. “The definition of a business model is murky at best. Most often, it seems to refer to a loose conception of how a company does business and generates revenue.” (Porter 2001).

One reason coined for the non-focus was the fact that it is an integration of academic and functional disciplines, gaining prominence in none. Academic applications were emerging in management curricula, rather than in scholarly disciplines. Porter himself is also more industry then business focused (Porter 1985; Stähler 2002).

Chesbrough and Rosenbloom (2002) refer to a search on the term ‘business model’ in the year 2000, in which a Google search turned up 107,000 references. (Morris et al. 2005) did a search on the term
in 2005 which indicated 1,326,000 hits. Almost ten years later, December 2009, this same search provides 9,270,000 hits.

On Osterwalders website a reason can be found why over the past decade so many more hits arose. “Before, it used to be sufficient to say in what industry you were in, for somebody to understand what your company was doing. All players had more or less the same business model. Today it is not sufficient to choose a lucrative industry, but you must also design a competitive business model. In addition, increased competition and rapid copying of successful business models forces all players to continuously innovate and adapt their business model to gain and/or sustain a competitive edge.” (Osterwalder 2005)

Definitions

Exact definitions found, vary over time and per researcher. This section intends to provide insight and a feel for what business models imply rather than explicitly define and classify them. For this is referred to Timmers (1998) or Pateli (2003). Well and Vitale (2001) “define a business model as a description of the roles and relationships among a firm’s consumers, customers, allies and suppliers and it identifies the major flows of product, information, and money, as well as the major benefits to participants.” (Osterwalder 2004)

Shafer, Smith et al “define a business model as a representation of a firm’s underlying core logic and strategic choices for creating and capturing value within a value network.” (Shafer et al. 2004)

According to (Morris et al. 2005) “A business model is a concise representation of how an interrelated set of decision variables in the areas of venture strategy, architecture, and economics are addressed to create sustainable competitive advantage in defined markets.”

“...we can define a business model as a simplified description of how a company does business and makes money without having to go into the complex details of all its strategy, processes, units, rules, hierarchies, workflows, and systems.” (Osterwalder 2005) Which is later redefined into:
“A business model describes the rationale of how an organization creates, delivers, and captures value.” (Osterwalder et al. 2009)

In the end the definitions stay a variation on the way a company does business and how it generates revenue, as Porter already stated in 2001.

The definition used in the project is Osterwalders quote: “A business model describes the rationale of how an organization creates, delivers, and captures value.”

2.2.3 Difference between Business Models, -Strategies and -Plans

There is a difference between business models, business strategies and business plans. A distinction that is not clear to all and often confusing.

The term Business modeling is the activity of modeling processes; not business models. This was more common around 1975 (Aguilar-Savén 2004; Duersch 1975; Gordijn et al. 2000).

Business strategy

There is a difference between strategy and business model (Stähler 2002). Seddon and Lewis (2003) “use the term ‘business model’ to mean an abstraction, not specific to any one firm, and ‘strategy’ to mean a particular firm’s plan for making superior return on investment.”. Which is also depicted in Figure 12.
The concept of business models differs from strategy in at least the following three ways, according to (Chesbrough and Rosenbloom 2002). Firstly the business model starts with value creation for the customer, where in the realm of strategy the focus is more on value capture and sustainability. Secondly, financing issues do not figure prominently in the business model, since it is focused on creating value for the company and not so much for the shareholders. The third difference lies in the fact that strategy generally requires careful, analytic calculation and choice based on reliable information based on former successes of the company. Whereas business model consciously assumes that this information is cognitively limited and actually biased by the earlier performances.

“The initial business model is more of a proto-strategy, an initial hypothesis for how to deliver value to the customer, than it is a fully elaborated and defined plan for action.” (Chesbrough and Rosenbloom 2002)

Magretta agrees that “a business model isn’t the same thing as a strategy, even though many people use the terms interchangeably today.” (Magretta 2002) “Business models describe, as a system, how the pieces fit together. But they don’t factor in one critical dimension of performance: competition. … A competitive strategy explains how you will do better than your rivals.”

Shafer, Smith et al. (2004) “While a business model does facilitate analysis, testing, and validation of a firm’s strategic choices, it is not in itself a strategy… the common elements regards making choices. Business models reflect these choices and their operating implications.”

“Instead of talking about strategy and competitive advantage, dot-coms and other internet players talk about ‘business models’… Generating revenue is a far cry from creating economic value, and no business model can be evaluated independently from industry structure. The business model approach to management becomes an invitation for faulty thinking and self-delusion.” (Porter 2001) It seems like Porter is agitated by the lack of actual value in the 2001 internet hype. He seems to predict a non-sustainable situation, which later becomes the bubble burst.

The focus on the value creation for the customer, the demarcation just before the detailed organizational design and only a limited analysis of the overall industry, including competitors, makes this project clearly about business models.

**Business plan**

The Business Model is also not the same as a Business Plan. “The business model is related to a number of other managerial concepts. It captures key components of a business plan, but the plan deals with a number of start-up and operational issues that transcend the model. It is not a strategy but includes a number of strategy elements. Similarly, it is not an activity set, although activity sets support each element of a model.” (Morris et al. 2005)

A BlogQuote from Osterwalder shows: “A business model is a representation of the business logic of an organization. The business plan is the translation of a business model into a planning document for implementation (usually including more details, milestones etc. for implementation...” (Osterwalder 2008).
The latter quote captures the core difference between a business model and business plan quite well and will be used as guiding throughout this thesis/report. As mentioned in the previous chapter, the entire business plan is not part of his research, only the business model.

2.2.4 Elements in a Business Model

Next to elaborate variations on the definition of a business model, the elements that comprise such a model are a discussion in itself.

Hedman and Kalling (2003) provide a generic business model based on a meta-search among eight researches. Six causally related components that span the supply chain are customers, competitors offering, activities and organization, resources and supply of factor & production. Added to that is a seventh element: a longitudinal process. See also Appendix D.

(Shafer et al. 2004) divide the components of the Business model in Strategic choices (value proposition, Target market, etc), Value network (suppliers, customer information, etc), Create value (Assets & activities) and Capture Value (cost, profit & financial aspects). See also Appendix D.

Based on a meta-search in 18 articles Morris, Schindehutte et al (2005) span their framework along the foundation level, the proprietary level and a rules level. The foundation level addresses basic decisions that all entrepreneurs must make, and is thus further divided into six components and accompanying questions that underlie a business model:

- Factors related to the offering - How do we create value?
- Market factors - Who do we create value for?
- Internal capability factors - What is our source of competence?
- Competitive strategy factor - How do we competitively position ourselves?
- Economic factor - How do we make money?
- Personal/investor factor - What are our time, scope, and size ambitions?

This article extends its efforts by providing a for each of the six components a number of bullets that should at least be discussed when defining the business model. See also Appendix D.

(Weil 2006) found many dynamics “which interact over time to turn innovation into value” within the following three levels:

- Organizational level
- Market level
- Contextual level

At the organizational level some dynamics received particular emphasis in the literature: the development, location, migration, and obsolescence of capabilities, including the effects of outsourcing, are key. See for a full overview of the dynamics Appendix D.

Chesbrough and Rosenbloom (2007; 2002) define the following detailed and operational functions of a business model:

- “Articulate the value proposition
- Identify a market segment
- Define the structure of the value chain
- Specify the revenue generation mechanism(s) for the firm, and estimate the cost structure and profit potential
- Describe the position of the firm within the value network
- Formulate the competitive strategy”

Pateli (2003) states in a meta-study that “the prevalent approaches followed for defining BM components are:

- Decomposing a business initiative into levels of analysis, from the more general to the more concrete, and identifying primary components for each analysis level.
- Identifying ways to represent a business and defining key information required for each representation way.

---

• Decomposing a Business Model into sub-models that link together to build a Business Model.
• Identifying principal issues or major components of a BM and decomposing them to sub-components.
• Defining vertical and horizontal dimensions of Business Models.”

Pateli integrates this into the Business model components framework, as shown in Figure 13. This model is designed mainly to be applied to eBusiness.

![Figure 13 Business model components framework – for eBusiness (Source: Pateli 2003)](image)

The aim in this project is to be able to decompose the principal issues of the business model. In this way all elements can be researched further. As Pateli (2003) states in the fourth bullet: *Identifying principal issues or major components of a BM and decomposing them to sub-components.*

This bullet is referred to be coming from the earlier works of Osterwalder and Pigneur (2002). This decomposition, also referred to as ontology, is called the Business Model Canvas (Osterwalder et al. 2009), as shown in Figure 14. This is elaborated on in chapter 3 and chapter 5.

![Figure 14 Business Model Canvas (Source: Osterwalder et al. 2009)](image)

Osterwalders systematic approach to business model innovation by using the Canvas, appears to be perceived as valuable by others as well. Companies and more have applied his tools as well. This is particularly remarkable for IBM, since, as explained before, they have been an early leader in the development of mapping tools for businesses.

According to (Chesbrough 2009) IBM has published white papers on the approach, and is even filing patents on their method of ‘component business modelling’, see Appendix D. Osterwalder, Pigneur et
al. (2009) reports that IBM, and many other companies such as Deloitte, Ericsson, Telenor, have now also applied their tool: the Business Model Canvas.

2.2.5 Using Business Models
This section briefly describes what can Business Models be used for. Explicitly mapping what the thoughts behind the business is a means to a goal: being able to convey the message.

Storyline
Magretta likes to portray business models as stories that explain how enterprises work. “Because a business model tells a good story, it can be used to get everyone in the organization around the kind of value the company want to create. Stories are easy to grasp and easy to remember.” (Magretta 2002) Shafer and Smith concur in a sense when they say: “Business models provide a powerful way for executives to analyze and communicate their strategic choices.” (Shafer et al. 2004)

These stories should answer questions as Who is the customer? and What is value to the customer?. As well as from a managerial perspective What is our business?, What will our business be? and What should it be? (Drucker 1954; Webster Jr 2009)

Peter Drucker (1954) is one of the first and few that has addressed these fundamentals of a business (Stähler 2002).

Markides (1999) follows the lines of Drucker by looking at the "who" the "what" and the "how" of a business.

Figure 15 shows the basic shape of the business model canvas, without it’s nine building blocks. Again the same How what and who elements appear, but now accompanied by a financial component.

![Figure 15 Business Model Canvas basic shape (Based on: Osterwalder et al. 2009)](image)

Visualization
According to Chesbrough (2009) business models also have “the great virtue of explicitly visualizing the processes underlying a business model. Thus, theoretical considerations of configuring elements of a business model here can become far more concrete.”

One example of a visualization comes from Samavi and Yu (2009), see Figure 16. A diagram that most likely contains all elements and relations important to Telco. But is this the type of great visualized virtue that Chesbrough applaudes? And next to that can it convey the message of the uniqueness and strengths of the company’s business are?

It is certainly quite suitable to predict changes in the rest of the company when an element changes. But only when the concept of causal diagrams are known and mastered. The general public (customers/partners/investors) wouldn’t know where to start.
Osterwalders Canvas (2009) in comparison explicitly incorporates the How, What, Who and Money issues and does so in a highly visual, storytelling manner. Figure 17 is an example of the Canvas applied to startup company Sellaband.
2.2.6 Selected tool

The Canvas by Osterwalder has been chosen as a leading tool because of its integration of three disciplines: describing, analyzing and designing business models. It is one of the few tools that can communicate the highly complex subject of business models with a limited set of elements. The high level of visualization, and the limitation of the number of elements involved (9 building blocks), also make it a great tool for interaction/discussion in a This will allow it to be tool to quickly explain involved actors what the research is about. It incorporates most elements, discussed in literature on the subject, including meta-studies thereof. And it is integrated with a design cycle, discussed in the next section. On top of that it is the most recently published tool both in scientific literature as management books, thus constructed from and building on the growing body of knowledge.

![Figure 18 Business Model Canvas (Source: Osterwalder et al. 2009)](image)

2.3 Design process

"The function of what I call design science is to solve problems by introducing into the environment new artifacts, the availability of which will induce their spontaneous employment by humans and thus, coincidentally, cause humans to abandon their previous problem-producing behaviors and devices. For example, when humans have a vital need to cross the roaring rapids of a river, as a design scientist I would design them a bridge, causing them, I am sure, to abandon spontaneously and forever the risking of their lives by trying to swim to the other shore" (adjuvant-Kuromiya and Fuller 1992)

- R. Buckminster Fuller (1895-1983)

Design engineering

Facilitation of design can be found in the design sciences. At Delft University of Technology three faculties are labeled as design studies: Architecture, Design School and Technology, Policy & Management. Engineering design has evolved into a more fussy iterative process then empirical scientific research (Buijs 2003; Eekels and Roozenburg 1991; Saren 1984). Also “Whereas natural science tries to understand reality, design science attempts to create things that serve human purposes” (Au 2001; March and Smith 1995).

The Buckminster Fuller Institute, named after inventor, architect, engineer, mathematician, poet and cosmologist R. Buckminster Fuller, states: “Design Science is a problem solving approach which entails a rigorous, systematic study of the deliberate ordering of the components in our Universe.” (BFI 2010)

Engineering design is thus more oriented to problem solving or opportunity grasping in a creative, but nonetheless structured, manner, than it is oriented on understanding the fundamentals of the things around us.
This report follows the engineering design approach. This can, at some points lead to a wealth of information that fits in a framework, but does not directly seem to contribute to the fundamentals. However in hindsight all these elements will show to be relevant to the insight and decisions during the creative process to reach the final design.

**Business model design**

“The business model unlocks latent value from a technology, but its logic constrains the subsequent search for new, alternative models for other technologies later on – an implicit cognitive dimension overlooked in most discourse on the topic.” (Chesbrough and Rosenbloom 2002)

In other words, there is the danger of getting stuck in one model. Therefore the business model should be an organic part of the business and if preferred should be able to change when situations change. Six types of Business Models describe the stage a company is in, in (Chesbrough 2007) Business Model Framework. It varies from very basic and not very valuable models to very valuable more advanced ones. The current line of business under investigation in the project would be a type 1 business. “A business using the undifferentiated model competes on price and availability, and serves customers who buy on those criteria.” It however has the potential to be put forward as a Type 3 “The company now can compete in different segments simultaneously. More of the market is thus served, and more profit is extracted from the market as well.” or even a Type 4 business “Company has an externally aware business model. Relationships with outsiders help identify external projects that fulfill some of their needs. This reduces the cost of serving the business, reduces the time it takes to get new offerings to market, and shares the risks of new products and processes with external parties.”

(Magretta 2002) describes the process of business modeling as being “the managerial equivalent of the scientific method – you start with a hypothesis, which you then test and revise when necessary.”

Alexander Osterwalder has devoted his Phd research to the subject of designing business models at l’Université de Lausanne in 2004 (Osterwalder 2004). Osterwalder has created a generic process of designing innovative business models tying together all concepts, techniques, and tools, for an overarching range of businesses. This aggregate design process gives it an added benefit over the other frameworks mentioned.

**Business Model Innovation Cycle**

Osterwalders Business Model Innovation Cycle (Osterwalder 2006) covers this pattern of continuous improvement. The process of business model innovation is chosen for the combination of both a stepwise and continuous approach. This allows for clear set of steps to follow, for this study and future analysis.

Also the interactive approach, by involving a very diverse team, is extremely useful in a situation like this research is in: a non-existing, highly ambitious plan of implementing a service abroad. This needs educated analogies, estimates and assumptions in which books and articles can do only so-much. Experience is then the ultimate source to utilize.

Osterwalders academic background has resulted in thorough research on the matter, next to that his book Business Model Generation (Osterwalder et al. 2009), based on his research, is co-created with over 400 followers: breaking the format of conventional strategy and management books, and stepping out of the ivory tower, thus creating a product based on the academic approach of peer-to-peer reviewing.

In the academic realms Osterwalders efforts are appreciated as well. In March 2009 Dr. Osterwalder was a guest lecturer at the Open Innovation Series by Henry Chesbrough at UC Berkeley’s Center for Open Innovation at the Haas School of Business (Henderson 2009b).

Osterwalder identifies four main steps in his Business Model Innovation Cycle. They are, as also shown in Figure 19:

1. Environmental framing
2. Business model innovation
3. Organizational design
4. Business model implementation
2.4 Conclusion

This literature study was written with both an aim for educating those unfamiliar with business models and for the support of the decision for the tool and process used in the rest of this project.

Section 2.1 elaborated on passenger transportation over water. It provides an extensive overview, or checklist, of key elements in setting up such a system. Of particular interest is section 2.1.3 on the lessons for San Francisco.

In section 2.2 business models have been identified as the appropriate framework for representation of the service concepts that will be designed. Osterwalders Business Model Canvas (Osterwalder et al. 2009) is selected as the tool for this study.

Section 2.3, shortly introduced the basis of the design process for this study: the Business Model Innovation Cycle (Osterwalder 2006).

The next chapter elaborates on the design process, including the use of the Canvas-tool.
3 Methodology

This chapter elaborates on the integration of four phases of the study with Osterwalders design cycle (2006). It interprets the process to fit the project at hand.

The objectives of this project, as set forth in section 1.3, are:

1. Design several service concepts for
   - water transportation
   - in the San Francisco Bay Area
   - for business travelers.

2. Choose the most suitable concept from a company point of view, based on matching of
   - customer demand,
   - financial viability and
   - practicability.

This is the reason to dedicate a full phase of the study to each of these objectives. The results of phase 2 (Design) and phase 3 (Choice) correspond to the two objectives as stated above. These receive input from the research approach phase and concluded by a wrap-up phase, as shown in Figure 20.

![Figure 20 Design phases](image)

The contents of phase 2 and phase 3 is based on the 5 steps remaining from the Business Model Innovation Cycle, as shown in Figure 21:

- **Step 1 - Building the team**
- **Step 2 - Framing the design space**
- **Step 3 - Designing three business models**
- **Step 4 - Forecasting the demand**
- **Step 5 - Supplying the demand**
The combination of phase 2 and phase 3 with the 5 remaining steps leads to the methodology for the Design and Choice phases as shown below in Figure 22.

Figure 22 Design- and Choice phase

The four phases now consist of:

- A research approach phase, which provides an introduction to the subject, a literature study and an elaboration on the methodology;
- A design phase in which the necessary qualitative sources are gathered in a team, the design space is framed and three service concepts are designed;
- A matching phase in which a choice is made for the most suitable service concept through matching the demands from the customer with what a company can supply;
- A wrap-up phase in which conclusions are drawn, recommendations are given and the report is reflected upon.
Subsequently each of the 5 sub-step in the design cycle are explained more in-depth and expanded with the needed tools and resources.

### 3.1 Design methodology

The subdivided design parts as shown in Figure 22 were renamed from Osterwalders original definitions, see Figure 21, to allow for continuous use of the same terms throughout the report:

- **Step 1 - Building the team**
- **Step 2 - Framing the design space**
- **Step 3 - Designing three business models**
- **Step 4 - Forecasting the demand**
- **Step 5 - Supplying the demand**

Each step in the design cycle is explained more in-depth and expanded with the needed tools and resources

**Step 1 - Building the team**

Originally this step is called “Build multi-disciplinary business model innovation team”. Step one in creating the business model is the creation of a highly divers team. The thought behind building a business model innovation team, is to get a holistic view of the company and all the business logic involved. Different people have different perceptions and wishes. For existing companies this usually involves mainly internal experts. This research needs input from people with knowledge and experience in the various fields of work involved.

In this case it involves the fields of water transportation, water taxis, starting a (high-tech) company, policy management and development, innovation management, potential users: businessmen and – women, demand forecasting, maritime engineering, funding and local situations, regulations, conditions, etc.

These people are able to give practical insight in the needed developments and potential pitfalls, far more applied and faster than any desk research can deliver.

**Resources**

The team consist of experts throughout Delft University of Technology (DUT) and beyond. A DUT coach on consumer demand forecasting is part of the graduation committee. As well as a DUT Professor in Transport Policy and Logistics, an DUT Assistant professor in Technology, Strategy & Entrepreneurship and the former director of a ferry system in Rotterdam, the Netherlands. Details on the graduation committee and their roles can be found in Appendix A.

These people in combination with a personal network in the Netherlands and San Francisco and high quality referrals will create a great team.

**Step 2 - Framing the design space**

Originally this step is called “Understand Business model environment and frame business model design space”. For this step the information that the team and desk research provides, is put to use in the 9-block Canvas. By describing the scope of the 9 blocks, the design space is framed. Within that design space several business models can be designed in the next step.

**Tool**

Osterwalder has “based on an extensive literature research and real-world experience defined a business model as consisting of 9 building blocks that constitute the business model canvas” (Osterwalder 2005). This Canvas addresses all relevant items and relations in the business model. Figure 23 shows the canvas.
Figure 23 Business Model Canvas and 9 Building Blocks (Source: Osterwalder et al. 2009)

As mentioned earlier this Canvas is part of Osterwalder’s book that is launched in October 2009. A draft version of the book was already partly available in the form of an elaborate 10 page manual for describing each block (Osterwalder 2007):

1. The value proposition of what is offered to the market;
2. The segment(s) of clients that are addressed by the value proposition;
3. The communication and distribution channels to reach clients and offer them the value proposition;
4. The relationships established with clients;
5. The key resources needed to make the business model possible;
6. The key activities necessary to implement the business model;
7. The key partners and their motivations to participate in the business model;
8. The revenue streams generated by the business model (constituting the revenue model);
9. The cost structure resulting from the business model.

Limitations

Time and financial constraints unfortunately don’t allow for a full analysis of all 9 blocks. All blocks do however need at least some attention, since it is an interrelated framework. The nine blocks are grouped in How, What, Who and Money as shown on the right. This figure is an abstracted copy of the previous one, with the nine blocks in it.

The sections that will get full attention are white: What and Money and most of the How. Resulting in the elaboration on:

- Cost structure
- Revenue flows
- Key resources
- Partner network

Costs and revenues are the core of a financially sound business. Without the key resources no service can be delivered. Without the partner network the key resources cannot be obtained.

The value proposition (What) is a very important element of the canvas. It is basically the outcome of what can be done with the available elements of the rest of the canvas. The value propositions will be introduced as results of the business model designs in Step 3 - Designing three business models.

That leaves the sections that receive less attention: Who and part of How, the grey areas which correspond with the underlying blocks of Figure 23, containing:
The key activity within this ‘old industry’ is mainly transporting people. This research sticks to this core. The client relationships and distribution channels are of high importance, however this type of portfolio management better suits a thesis from a business school. The expected main elements thereof will be mentioned but not much elaborated on. The client segment has already been identified in the goal of the research, namely: well paid business men and women. And will thus not be elaborately discussed.

Resources

Mapping the environment and design space will be based on the input of the previously mentioned team, literature study and on-site research. Preferably interaction with the team would be done with everyone in the same brainstorm session. However the size of the project at hand and the diversity and geographical distribution of the team make this impossible.

The literature study is possible due to public research data such as “Transportation 2035: Change in Motion” (Dodd 2008). Therein both public transportation and car use is analyzed to see what can and needs to be done from a governmental point of view on the transportation system in the San Francisco Bay Area.

One month of the project will be done on-site in the San Francisco Bay Area. This allows for initial scouting of respondents for later survey efforts, direct feedback from third parties, searching for added business opportunities and identification of local conditions.

Step 3 - Designing three business models

Originally this step is called “Generate a wealth of business model prototypes”. In step 1 the right people are involved and through step 2 the business environment is known resulting in a framed design space. Within this design space a range of business models can be implemented. The overall goal of step 3 is to design a set of three different service concepts, represented by business models, containing the value propositions.

Resources
This is a creative design step in the project. This means that not necessarily new data is needed, only input from the previous steps.

Step 4 - Forecasting the demand

Originally this step is called “Select most promising & realistic business models”. Testing the potential usage will be done for the different concepts, created for the portfolio during the previous step of the Design Cycle.

Tool
The method chosen to forecast the demand is an experiment in which a stated choice survey supplies the data for a discrete choice analysis. Stated choice can measure preferences, willingness to pay and the impact of varying attribute levels. Logit analysis has been chosen, amongst others, due to the fact that it is the first closed form solution for discrete choices analysis. The method is proposed by Daniel McFadden (McFadden 1974) and reported by Kenneth Train. It leads to a choice probability which is interpreted as market shares, based on a choice probability function. In full: the chance that an alternative is chosen is equal to the exponent of the individuals perceived utility of that service divided by the sum of the exponent of the utilities of all alternatives in the choice set.

This data analysis tool requires the concepts to be written into an equal number of scenarios expressed in a limited number of indicators, such as Travel time, Travel cost and Reliability.
potential users choose between these scenario’s, after which the tool can provide the before mentioned elements.

**Resources**

Resources used in this step are the concepts designed in the previous step and responses of the potential users through a survey, which has to be designed.

**Step 5 - Supplying the demand**

Originally this step is called “Choose one or several prototypes to test in a business model portfolio”. This step will take the market demand of the customer of the services and check its business viability. This element is the effectuation of the objectives stated in Annotation Entrepreneurship.

The main elements that will be looked at are revenues, investments and operational costs in relation to the potential demand. If no profits can be made this could mean that the service will be altered or additional activities should be developed.

**Resources**

Resources needed are cost structures of operating and buying/leasing high speed vessels, nautical fee’s, general cost of business, willingness to pay, number of customers etcetera.

### 3.2 Detailed structure of the research

Throughout the report Figure 22 will guide you through all the steps that have just been explained in more detail.

The full study overview is found in Figure 24.
Phase 2

Design
4 Step 1 - Building the team

Even before the kickoff of the project, the quest for experts started. Over time the list has expanded to 34 people of which the majority has been interviewed as can be seen in Table 3. This team could be seen as part of the reference list.

This highly diverse groups of people has brought knowledge and experience in the various fields of work involved into this research, providing practical insight in the needed developments and potential pitfalls. Their input is used throughout the research. The team consists of people from large companies to small startups, from government officials to entrepreneurs and both from the Netherlands and the San Francisco Bay Area.

The input includes a day-on-the-job at the Rotterdam water taxi company, meetings with experts on vessel design and construction, meetings with high level experienced people in ferry operations both in the Netherlands and the San Francisco Bay Area and also meetings with potential users and government officials in the Bay Area.

Much information was gathered from the Dutch ferry- and water taxi companies in Rotterdam, Gorinchem and Dordrecht. These companies have many years of experience in passenger transportation over water. Also the new governmental ferry operator WETA in the San Francisco Bay Area has provided much useful input.

From a scientific standpoint the following overview, which is granted its own chapter, might seem out of place. However, it is part of the steps suggested by Osterwalder and it is crucial in the gathering of unique data and information.
Table 3 List of advisors

<table>
<thead>
<tr>
<th><strong>Delft University of Technology</strong></th>
<th><strong>Company</strong></th>
<th><strong>Expertise</strong></th>
<th><strong>Meeting</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Caspar Chorus</td>
<td>TU Delft - Assistant Professor Transport Policy and Logistics</td>
<td>development and testing of travel choice models that combine behavioral realism with econometric tractability</td>
<td>Regularly</td>
</tr>
<tr>
<td>Meinard Sprenger</td>
<td>ThyssenKrupp Veerhaven - Vice President / Former director Fast Ferry BV and Waterbus BV</td>
<td>Operational experiences in setting up and running ferry systems</td>
<td>Regularly</td>
</tr>
<tr>
<td>Dap Hartmann</td>
<td>TU Delft - Assistant professor Technology, Strategy &amp; Entrepreneurship</td>
<td>innovation management and entrepreneurship</td>
<td>14-4-2009</td>
</tr>
<tr>
<td>Bert van Wee</td>
<td>TU Delft - Professor in Transport Policy and Logistics</td>
<td>long-term developments in transport, environment, safety, accessibility, policy analyses</td>
<td>26-5-2009</td>
</tr>
<tr>
<td>Robert Hekkenberg</td>
<td>TU Delft - Assistant Professor</td>
<td>Ship Design, Production &amp; Operation</td>
<td>3-6-2009</td>
</tr>
<tr>
<td>Job Nijs</td>
<td>TU Delft / YES!Delft - Manager Growth Center</td>
<td>Start up companies</td>
<td>8-9-2009</td>
</tr>
<tr>
<td>Cees van Stiphout</td>
<td>Tourboats Maastricht - Former owner &amp; director</td>
<td>Operational expertise</td>
<td>10-2-2009</td>
</tr>
<tr>
<td>Maira van Helvoirt</td>
<td>Centraal Bureau voor de Rijn- en Binnenvaart - Manager</td>
<td>Dutch policy and developments on inland waterway transportation</td>
<td>10-2-2009</td>
</tr>
<tr>
<td>Hans Heijmen</td>
<td>H2O participaties</td>
<td>Operational expertise &amp; investment opportunities</td>
<td>26-3-2009</td>
</tr>
<tr>
<td>Jaap Gelling</td>
<td>Damen Shipyards -Product Director High Speed Craft</td>
<td>High speed sea going vessels</td>
<td>19-5-2009</td>
</tr>
<tr>
<td>Jos van Woerkum</td>
<td>Damen Shipyards -Director</td>
<td>Company overview</td>
<td>22-5-2009</td>
</tr>
<tr>
<td>Johan Hania</td>
<td>Veerdienst/Watertaxi Gorinchem - Director</td>
<td>Operational expertise</td>
<td>22-5-2009</td>
</tr>
<tr>
<td>Minnemijn Smit</td>
<td>BoArt - Founder / Family history in shipbuilding</td>
<td>Top-end luxury yachts with a stylish integrated art collection</td>
<td>28-5-2009</td>
</tr>
<tr>
<td>Robert Luth</td>
<td>Damen Shipyards - Manager Project Department Fast Ferries</td>
<td>Top-expert on ferry design and construction (1-400 passengers)</td>
<td>2-6-2009</td>
</tr>
<tr>
<td>Han Verhagen</td>
<td>Water Taxi Rotterdam - CEO</td>
<td>All-round knowledge on water taxis</td>
<td>9-6-2009</td>
</tr>
<tr>
<td>Gerbrand Schutten</td>
<td>Aqualiner - Ferry Rotterdam - CEO</td>
<td>All-round knowledge on ferry services and small vessels</td>
<td>12-6-2009</td>
</tr>
<tr>
<td>Johan Tuk</td>
<td>Doeksen Transport Groep - CFO</td>
<td>All round knowledge on ferry services, specifically tendering and cost structures</td>
<td>24-11-2009</td>
</tr>
</tbody>
</table>
### Table 3 List of advisors (continued)

<table>
<thead>
<tr>
<th><strong>Startup companies</strong></th>
<th><strong>Company</strong></th>
<th><strong>Expertise</strong></th>
<th><strong>Meeting</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Arthur Tolsma</td>
<td>Greeting - CEO &amp; Founder</td>
<td>Personal coaching and shared enthusiasm</td>
<td>Regularly</td>
</tr>
<tr>
<td>Stefaan Ghijs</td>
<td>Aeolus Aviation - CEO &amp; Founder</td>
<td>Business taxi by airjet</td>
<td>14-5-2009</td>
</tr>
<tr>
<td>Nils Beers</td>
<td>Czeers Solarboats - Founder</td>
<td>Design and construction sustainably powered luxury boats</td>
<td>15-6-2009</td>
</tr>
<tr>
<td>Joek van Voorbergen</td>
<td>Entrepreneur</td>
<td>International experience</td>
<td>5-7-2009</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>USA based contacts</strong></th>
<th><strong>Company</strong></th>
<th><strong>Expertise</strong></th>
<th><strong>Meeting</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Peter Laanen</td>
<td>NBSO - International Trade director / Former CEO of Expressions College for Digital Arts</td>
<td>Internationalization, local knowledge, network, coach</td>
<td>Regularly</td>
</tr>
<tr>
<td>Deborah Acosta</td>
<td>International Trade, Project Manager City of Oakland / Business Development</td>
<td>urban redevelopment &amp; local governance</td>
<td>23-6-2009</td>
</tr>
<tr>
<td>Ella van Gool</td>
<td>Silicon Valley Regional Manager of the Venture Pipeline group (DLA Piper)</td>
<td>focused on enhancing the funding prospects of early stage</td>
<td>3-7-2009</td>
</tr>
<tr>
<td>Beth Altschuler</td>
<td>UC Berkeley - Student</td>
<td>GIS &amp; SF Bay Area public transportation</td>
<td>8-7-2009</td>
</tr>
<tr>
<td>Jasper van der Bruggen</td>
<td>Netherlands Consulate San Francisco - Employee</td>
<td>Local knowledge</td>
<td>14-7-2009</td>
</tr>
<tr>
<td>Frans van Gosliga</td>
<td>Netherlands Business Support Office - Employee</td>
<td>Local knowledge</td>
<td>14-7-2009</td>
</tr>
<tr>
<td>Keith Stahnke</td>
<td>Operations Manager WETA</td>
<td>Current developments on ferries and accompanying issues and regulations</td>
<td>15-7-2009</td>
</tr>
<tr>
<td>Rich Taylor</td>
<td>Port of Oakland - Wharfinger</td>
<td>Local issues, permits and developments</td>
<td>15-7-2009</td>
</tr>
<tr>
<td>Aaron Golbus</td>
<td>Port of San Francisco - Wharfinger</td>
<td>San Francisco Water Taxi Service feasibility study</td>
<td>email</td>
</tr>
<tr>
<td>Antwan van der Stap</td>
<td>Oracle - Senior Engineer</td>
<td>Internal transportation arrangements</td>
<td>email</td>
</tr>
<tr>
<td>Paul Kamen</td>
<td>Surface Propulsion Analysis - Naval architect</td>
<td>Berkeley Urban ferry system design</td>
<td>email</td>
</tr>
<tr>
<td>Jerry Sanders</td>
<td>San Francisco Science - Founder</td>
<td>Investor</td>
<td>email</td>
</tr>
<tr>
<td>Barry Bergman</td>
<td>City of Alameda Public Works Dept. - Transportation Coordinator</td>
<td>Oakland-Alameda water shuttle plans</td>
<td>email</td>
</tr>
</tbody>
</table>
5 Step 2 - Framing the design space

The information the team provides, is put to use in the 9-block Business Model Canvas (Canvas in short). By describing the scope of the 9 blocks, the design space is framed/mapped out. The difficulty of finding the right input for this non-existing service is finding accurate data. This is often not available, thus creative analogies are used to find approximations for the needed information. That is why the information in this chapter at some points might seem a bit confusing or unrelated.

The result of this chapter is an overview of 28 items and the accompanying range of values. These values form the basis of the design space in which several business models can be designed, which will be done in the next chapter.

Time and financial constraints unfortunately don’t allow for a full analysis of all 9 blocks of Osterwalders Canvas. As explained before, four blocks receive extra attention:

- Cost structure
- Revenue flows
- Key resources
- Partner network

The value proposition is a very important element of the canvas. It is basically the outcome of what can be done with the available elements of the rest of the canvas. The value propositions will be introduced as the business model designs in the next design step.

That leaves the following blocks, that will be briefly discussed in section 5.5:

- Key activities
- Client relationships
- Distribution channels
- Client segments
Each section ends with an overview of its design space. In some instances the tables mention 'indifferent'. This does not mean that it is unimportant, but that it will not differ among the business models. In the other cases it indicates a range values. This range does not relate to the business models yet and is merely an overview of possible values.

5.1 Cost structure

The costs of operating a water taxi service are built up from three elements (SFPort 2009):

- Construction & procurement
- Vessel Operation & maintenance costs
- Land-based costs

Construction & procurement involves long term investments. This concerns mainly the vessels and the landings. A preferred format, according to M. Sprenger, is that local government installs the landings and the operator is only responsible for operating the service: a Public Private Partnership. This reduces the initial investments significantly since the cost of a single landing varies between $0.8-$4.3 million. It also guarantees the local government the possibility of selecting a different operator when performance lacks. The cost per vessel ranges between $0.3-$4.5 million. More on the vessels in section 5.3.1.

The two cost drivers in vessel operation & maintenance costs are fuel and personnel. Totaling up to $500,000-$700,000 per vessel per year. Reducing fuel consumption through speed adjustments, weight or engine selection and limiting the number of crewmembers has a significant impact on the operational expenses.

The Land-based costs mainly consist of office space, staff and marketing expenses. Which could go up to $500,000 per year.

In Appendix F a full cost structure spreadsheet can be found. Which is proposed by R. Luth and after alterations to fit this project, confirmed by J. Tuk.

5.1.1 Overview

<table>
<thead>
<tr>
<th>Cost structure §4.1</th>
<th>Ranges between</th>
</tr>
</thead>
<tbody>
<tr>
<td>construction &amp; procurement</td>
<td>$0.35 million initial - $6.1 million initial</td>
</tr>
<tr>
<td>vessel operation &amp; maintenance</td>
<td>$0.28 million per year - $0.49 million per year</td>
</tr>
<tr>
<td>land-based costs</td>
<td>Indifferent to business models</td>
</tr>
</tbody>
</table>

5.2 Revenue flows

The next block from the Canvas is Revenue flows. Sources of revenue are ticket sales, leasing out the vessels and/or external funding.

5.2.1 Ticket sales

An initial estimate for ticket prices can be found through comparison. Limousine taxis often serve, next to festive occasions, a high-end market. Prices for luxury transport, not the average yellow cab, start at about $50 per 15 minutes for a sedan. When selecting a full size limousine in the San Francisco Bay Area, an hour ride would set you back approximately $250 (SanFranciscoLimo 2009), see also Figure 25.

---

7 The cost estimates in this chapter are based on interviews with M. Sprenger, J. Tuk, R. Luth, H. Heijmen, H. Verhagen, G. Shutten and J. van Woerkum.
Figure 25 Limousine prices (Datasource: Sanfranciscolimo.com 16-09-2009)

Ticket prices have been a subject in many meetings. The general comments from the team where that it should be more expensive than public transport, to create the impression of higher quality. The impression of public transport is often that of relatively low quality and somewhat shabby. Also amounts of $25 as a maximum per one-way ticket have been mentioned.

5.2.2 Leasing

Being dependent on the number of passengers will always stay part of operating a water transportation system. Part of the risk however can shift from the company to others. In Rotterdam, the water taxi service works with a crew that are on obligated leave from ocean shipping. They lease a vessel from the company and pay that from the ticket fares they collect that day. If there are not enough passengers they receive less wages, but the company still gets the full lease price. Added benefit is that at the end of the day the average hourly wages are ~$20 (€15). Much less than the $80-$120 indicated in the estimates the Alameda water taxi (Multiple 2009). These prices seem high altogether. According to J. Tuk hourly wages for captain and crew are around $50. It has been proven viable in the Netherlands. Better yet the shipmen are standing in line to get selected.

5.2.3 External funding

There are several sources for funding/subsidies by governments and other institutions in California, just as in the Netherlands. The section stakeholders elaborates further on the different actors present. Rich Taylor at the Port of Oakland indicated that almost always funding will be found for port related activities. There are also several regional and local funding programs that redirect toll and taxes towards public transit and clean transport development. A new federal funding program called TARP stimulates sustainable energy, both in production and usage, such as hybrid cars and fuel cell development (Sarni 2008).

If WETA ferry lines are taken as an example, much subsidy can be obtained. The lines are subsidized for 63% on average, totaling $92million for five years. Table 4 shows that some lines are even subsidized up to 71% (WETA 2009b).
Table 4 WETA Five year Financial Plan

<table>
<thead>
<tr>
<th>WETA Five year Financial Plan</th>
<th>Systemwide ('08-'14)</th>
<th>USD (x 1million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating expenses</td>
<td></td>
<td>147</td>
</tr>
<tr>
<td>Operating revenues - Fares</td>
<td></td>
<td>55 37%</td>
</tr>
<tr>
<td>Operating revenues - Subsidies</td>
<td></td>
<td>92 63%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ferry lines</th>
<th>Annual operating budget</th>
<th>Subsidized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alameda / Oakland</td>
<td>4</td>
<td>25%</td>
</tr>
<tr>
<td>Alameda Harbor Bay</td>
<td>2</td>
<td>27%</td>
</tr>
<tr>
<td>Vallejo Ballink</td>
<td>15</td>
<td>53%</td>
</tr>
<tr>
<td>South San Francisco</td>
<td>3</td>
<td>71%</td>
</tr>
<tr>
<td>Berkeley</td>
<td>5</td>
<td>71%</td>
</tr>
</tbody>
</table>

For this project however the choice is made to research the viability based solely on commercial activities, without subsidies. This is partially based on the current financial situation in which the State of California is bankrupt and funding for many projects is stopped, and is likely to continue in 2010.

**Additional sources of funding**

An employee at Heineken has mentioned that is not unlikely that a large company like themselves or Coca Cola for example, would be interested to consider a sponsorship, considering the many millions of annual tourists who, for the largest part, will visit the waterfront (Pier39, baseball, stadium, etc) at least once.

The WaterTaxi service in Rotterdam receives almost $100,000 annually from a sponsor on the hull of the vessel. Their sponsoring covers all marketing costs.

According to 2001 conference proceedings on Coastal zones and advertising “The San Francisco ordinance prohibits only those vessels whose “sole intent” is advertising.” (McCarthy and Professor Nixon 2001). So it appears to be allowed, but for now will not be pursued.

**5.2.4 Overview**

<table>
<thead>
<tr>
<th>Revenue flows §4.2</th>
<th>Ranges between</th>
</tr>
</thead>
<tbody>
<tr>
<td>ticket fares (one-way)</td>
<td>low = $30</td>
</tr>
<tr>
<td></td>
<td>medium = $50</td>
</tr>
<tr>
<td></td>
<td>high = $70</td>
</tr>
<tr>
<td>external funding</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>no</td>
</tr>
<tr>
<td>leasing-out vessels</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>no</td>
</tr>
</tbody>
</table>

**5.3 Key resources**

The next block is Key resources. Key resources are both tangible and intangible assets which the business model needs to function. Only a limited number of key resources will be elaborated on due to time and financial constraints.

As shown earlier in the section 5.1, the vessels and manning are make or break items on costs. On top of that, vessels determine travel times, comfort levels and environmental impact. These both will be discussed here.

Boarding points are a geographical constraint, they will determine the areas that can be served, and is the third item in this section.

For readability purposes an elaboration on permits and regulation is moved to Appendix G.

**5.3.1 Vessels**

A wise purchase of the vessels makes all the difference in the long run. This was mentioned in three separate interviews (G. Schutten, H. Heijmen, H. Verhagen). A financially sound investment should include the size to be adjusted to the expected ridership, maintenance should be easy, fast and cheap and fuel consumption should be kept to a minimum.
For identification of the sizes and number of the vessels fairly accurate data on ridership is needed. This will be estimated in step 4. Easy, fast and cheap maintenance is dependent both on the accessibility of the equipment on the vessel and the technology and materials used. Fuel consumption is based on the speed and weight of the vessel, as well as its hull shape and engine type.

Table 5 below shows an overview of ship type characteristics compiled by Alexander Piet (2008). It has been updated and adjusted where needed, based on among others expert insights from Damen Shipyards (R. Luth, J. Gelling) and it is expanded with multi-criteria scoring. This shows the preference for the Catamaran, Trimaran and Monohulls.

<table>
<thead>
<tr>
<th>Table 5 Vessel type characteristics (Based on: Piet 2008)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
</tr>
<tr>
<td>Surface Effect Ship (SES)</td>
</tr>
<tr>
<td>Operational Speed (knots)</td>
</tr>
<tr>
<td>Speed capability in bad weather</td>
</tr>
<tr>
<td>Comfort</td>
</tr>
<tr>
<td>Deck space</td>
</tr>
<tr>
<td>Purchase price</td>
</tr>
<tr>
<td>Operational cost</td>
</tr>
<tr>
<td>Required power</td>
</tr>
<tr>
<td>Draft</td>
</tr>
<tr>
<td>Wash</td>
</tr>
<tr>
<td>Newest types already standardized</td>
</tr>
<tr>
<td>Score</td>
</tr>
</tbody>
</table>

Legend
- **Best**: 3
- **Medium**: 2
- **Lowest**: 1

Appendix H shows an overview of a pre-selection of potential vessels.

Customer preferences and regulation however do not necessarily align with those requirements. Key items that are influenced by customer preferences are:

- **Speed**
- **Comfort**
- **Environmental impact**

**Speed**

Speed determines travel time. It also influences fuel consumption, comfort and wash. To compete with uncongested travel times by car the vessel should be able to go over 60 knots (~110 km/h), see Appendix I. There are vessels available that reach these speeds, but it is usually accompanied by an unflattering helmet, headset, racing seats and four-point seatbelts. This makes it less likely that business travelers would use such type of service on a (semi-)regular basis.

The average high speed craft would reach around 25-35 knots. Unfortunately reaching these kinds of speeds is not very fuel efficient since the installed power, and thus fuel consumption, increases exponentially with the increase of speed. Also the vertical ship motions, depending on the (meeting-) frequency, may tend to increase strongly with the vessel speed. See also Appendix H.

Another side effect is that wash waves increase at higher speeds. This increases the impact on other vessels, marine life and shorelines (Multiple 2007).

There are no direct speed limits in the San Francisco Bay, see Appendix D for more regulatory information on speeds.

**Comfort**

Comfort aboard a vessel is dependent on the sea keeping performances. Items influencing the human performance and the chance of seasickness are vertical acceleration, lateral acceleration, roll angle and slamming. Different users have different levels of acceptance, with transient passengers having
the lowest levels. Also see Appendix H. The level of comfort desired by the customer determines the vessel choice, since all the items can be influenced by vessel design (Frouws 2000).

The most important parameter that influences the sea keeping performance is the length of the vessel (Frouws 2000). Research on adding length to vessels, without increasing deck space or adding much weight and research on different bow-shapes, by Damen Shipyards in cooperation with Delft University of Technology, has resulted in the Axe-bow concept (TUDelft-3mE 2009). This elongated bow concept chops through the waves, significantly improving performance.

WETA has found for their newest vessels, the cleanest in the United States, that passengers like a high level of comfort and convenience. This is understandable for higher segment as well, for example business class sections on airplanes.

**Environmental impact**

The earlier mentioned wash waves have an impact on the environment. This can be limited by vessel design and speed. Noise is restricted by law. To alter its impact on the environment choices can be made on engine types and insulation. Air pollution can be limited by filters, the use of the proper engines and alternative fuel types.

Ideally the entire voyage would be on an alternative, and more important silent propulsion method, such as electricity, to increase the comfort. Both in noise and vibration. The ShuttleCat 120, a 12 meter Catamaran with originally 250kw of engine power, would require (according to ‘napkin’-estimates June 2009 by Czeers Solarboats) an extra investment of approximately 0.75 million euro per vessel. The reason for the shift would not be savings on the fuel costs, but the silence, the sustainable image, the speed and the fun.

It is highly likely that full electric propulsion is still too young in its development to apply to this type of high usage vessels. Dave Courtois, Maintenance Supt. at Golden Gate Ferry (WETA 2002), mentions extra concerns. The cost of operation might go up, since it is expected that the USCG will require licensed electricians on-board to oversee the propulsion system. These technicians have a higher educational bar and wages and on top of that are in more competitive demand.

Tests in Rotterdam for 150pax vessels with hydrogen as alternative fuel, required a full 40foot container aboard the vessel, which at this stage makes it an unlikely source (M. Sprenger).

Preferably diesel engines always run at their optimal RPM (~80% of maximum) to minimize wear and tear (M. Sprenger). This is unfortunately impossible because of the range of speeds needed. In that case multiple engines would be needed for different moments during the voyage. That is why hybrids are becoming more popular. The docking procedures often require 25-50% of all fuel. Operating this part electrically significantly reduces fuel consumption and exhaust fumes (N. Beers).

Not all engines are alike, selection of the engine that fits the vessel and has the best fuel economy are preferred, but hybrids should definitely be kept under close observation.

Another choice related to the environment is on the propulsion system. Water jets and propellers are the most common forms. Water jets have a bad efficiency (N. Beers), but are less sensitive to large debris, can reach higher speeds and have better maneuverability than propellers (H. Heijmen). Another reason to choose water jets over propeller propulsion is the shaft connection, which breaks fairly easy (H. Verhagen). The water jets tend to have a larger impact on the bottom conditions (J. Gelling). See Appendix H for an overview pro’s and con’s of propulsion systems.

**Wait time**

The number of vessels in the system determine the head times, which result in an expected wait time for the passenger. The logistics of the fleet can be designed to always have at least one vessel at the main boarding points. In that case the wait time is zero and would indicate an on-demand service.

This is however not the case when the access and egress is provided as well. There will always be a certain wait time for the car when a last-minute call is made for pick-up at an office. The system can be designed in such a way that there still is no wait time in between modes without continuously having a vessel at each boarding point, unless there is group transportation.

A proper reservation systems decreases the difficulties with and overall wait times.
The number of passengers on a vessel depends on the size of the vessel and the number of customers per departure. When using an on-demand system it is virtually impossible to top off the entire vessel, unless the customer is a group of people.

When decreasing the number of departures per hour, the number of passengers per departure can increase. This is only up until a certain wait time at which the customer would decide to use a different mode of transportation. A maximum wait time is assumed of 20 minutes for commuters, but they would normally know their departure times. A maximum wait time of 10 minutes is assumed for business pick-ups.

### 5.3.2 Manning requirements

The minimum number of qualified personnel aboard a commercial vessel, can rapidly change the profitability of passenger transportation. Research initiated by the city of Alameda (Multiple 2009) shows an hourly wage of $80 for ship mates and up to $120 for Masters. J. Tuk suggest using a wage rate of $50. These manning requirements vary per country. The United States has set forth computation rules in U.S. Code of Federal Regulations Title 46: Shipping – Part 15 Manning Requirements (GPOAccess 2009b).

Every vessel obviously needs a Master, but it is the amount of Mates needed that can add up on personnel costs. The requirements for Mates are usually based on gross tonnage of the vessel and number of hours or miles of the voyage.

#### Table 6 Minimum number of required crew

<table>
<thead>
<tr>
<th>Gross Tonnage</th>
<th>&lt;100</th>
<th>100-200</th>
<th>100-1000</th>
<th>&gt;1000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hours</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;12</td>
<td>0*</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>12 - 24</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>&gt;24</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td><strong>Miles</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;400</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>&gt;400</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

* if the Officer in Charge, Marine inspection (OCMI) determines it to be safe

The Commandant of the USCG will also consider reductions to the number of mates required by this section when special circumstances, allowing a vessel to be safely operated, can be demonstrated.

This indicates that theoretically a vessel can be operated by a single person. A draft summary for research issued by the Port of San Francisco on Water Taxis however reported a minimum crew of two (SFPort 2009).

Further research in a later stage is needed to determine the final number of crew for a specified vessel mainly through contacting the U.S. Coast Guard.

#### Quality personnel

In section 5.2.2 the option to lease to shipmen has been discussed. This has an effect on the quality of your personnel. Toughened ocean shipmen, sea dogs, might not have the sophistication business men and women look for in their high-end transportation modes.

On the other hand, they are the most experienced vessel handlers, which in turn could impose trust. This impact should be researched further.

#### 5.3.3 Boarding points

The number and location of the boarding points, in combination with access and egress modes, determine the amount of customers that can be reached and served. A quick comparison, see Appendix D, between the San Francisco Bay and the Ijssel- and Markermeer in the Netherlands
shows a body of water of comparable size, but the Dutch lakes are not as much surrounded by high density residential and business areas. Thus there are only two ferry lines on those Dutch waters, Enkhuizen-Stavoren and Urk-Enkhuizen with three stops, while the San Francisco Bay has ten stops and lines, with more underway. These lines are currently operated from ten ferry stops, as indicated in green in Figure 26.

Next to these stops there are also many recreational docks. Assuming the appropriateness of using these 18 existing recreational facilities for the water taxi service, boarding locations would be as indicated in red below, in Figure 26. A full overview of all docks in the San Francisco Bay Area can be found in Appendix D.

All locations need individual agreements for landing rights. Before going into negotiation each individual location needs to be analyzed concerning the possible delays when multiple flows of transportation (yachts, cargo vessels, water taxis) start to mix. For example the Port of Oakland (right-hand side) has enormous blockage in the estuary waterway. Their turning basins are very tight and in the middle of the estuary, even creating a significant increase in water level at one side when a large vessel turns. This full blockage can take up to 10 minutes.

New locations

Figure 26 also shows thirteen locations that are currently being redeveloped by the cities or have been indicated by other current research on ferries and water taxis (SFPort 2009; WETA 2007; WETA 2009b) as being good locations to service. These include an airport, conference centers, business parks and new residential areas. Appropriateness is also based on the commute flows as indicated in Appendix D.

Limited water depths and nature preserves limit the possibilities to develop access over water to the lower right corner of Figure 26, below San Leandro down until Alviso.

Integrating ferry and water taxi

Interviewing the Water Emergency Transportation Authority (K. Stahnke - WETA) revealed that they are indeed responsible for developing transit expansion over water, but will not start with water taxi services. This for two main reasons. First, they focus on transporting scheduled large numbers, mainly commuters, which is a different line of work than on-demand small numbers. And second the land-side infrastructure for both systems are supposedly different. Water taxis are by definition smaller and usually need a different height between the passenger loading platform and the vessel (freeboard), compared to >149pax vessels. Water taxis are expected to use very low recreational style berths.

This would not necessarily be a problem, but there are strict ADA regulations on the maximum barriers allowed, including the ramp angles. This is concurred by the 2004 Transit Capacity and Quality of Service Manual (TRB 2004).

This would significantly reduce the possibilities of integration with the existing and/or developing ferry services. Surprisingly however, current research on the feasibility of a water taxi service by the Port of San Francisco provides a different view. A new pier (Pier 1½) constructed by the end of 2007, specifically for recreational use and future water taxi services is indicated to be of medium float freeboard.

Meinard Sprenger explicitly mentions the benefit if the integration could be achieved: synergy benefits on technical and nautical services, HR and planning.
In the 2009 research (SFPort 2009) other piers in the area, including those for ferries, are indicated to be equal, lower or of variable height. This theoretically makes them all accessible to small water taxis. A contradiction arose through personal observations, since they have shown that the special water taxi pier has a freeboard of approximately 1 foot. This indicates an unclear definition of heights and compatibility, creating the need for reevaluation in a later stage.

Figure 26 San Francisco Bay boating facilities (Source: Bricomm)

5.3.4 Overview

<table>
<thead>
<tr>
<th>Key resources §4.3</th>
<th>Ranges between</th>
</tr>
</thead>
<tbody>
<tr>
<td>vessels</td>
<td></td>
</tr>
<tr>
<td>speed (influences travel time)</td>
<td>25knots</td>
</tr>
<tr>
<td>comfort (vessel stability)</td>
<td>low</td>
</tr>
<tr>
<td>Comfort (luxury / seating)</td>
<td>low</td>
</tr>
<tr>
<td>propulsion</td>
<td>sustainable</td>
</tr>
<tr>
<td># pax</td>
<td>1+</td>
</tr>
<tr>
<td>Maximum delay</td>
<td>5min.</td>
</tr>
<tr>
<td>Manning</td>
<td>#</td>
</tr>
<tr>
<td>Quality</td>
<td>sea dog</td>
</tr>
<tr>
<td>Boarding points</td>
<td>many</td>
</tr>
</tbody>
</table>
5.4 Partner network (Stakeholders)

5.4.1 Access & egress
In order to transport the customer over water, the customer needs to reach the waterfront and its final location, the so-called access and egress. This can be achieved either through their own efforts, an outsourced transportation service, expansion of the key activities or a mix thereof. For strength and weaknesses see Table 7.

Table 7 Access and egress

<table>
<thead>
<tr>
<th></th>
<th>Strength</th>
<th>Weakness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own efforts</td>
<td>no efforts needed by company</td>
<td>less predictable arrival time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>egress is harder when the car is at the access point</td>
</tr>
<tr>
<td></td>
<td></td>
<td>hassle of transfers is one of the key reasons public transport is avoided</td>
</tr>
<tr>
<td></td>
<td></td>
<td>it would not necessarily reduce the downtown parking problem</td>
</tr>
<tr>
<td>Outsourced service</td>
<td>mean and lean company</td>
<td>less control on service level (car/driver/travel times), potential higher overall costs</td>
</tr>
<tr>
<td></td>
<td>partial investment risk outsourced</td>
<td></td>
</tr>
<tr>
<td>Expansion of key activities</td>
<td>full control on service level</td>
<td>added investments needed, less focus on core activity, more planning</td>
</tr>
<tr>
<td></td>
<td>one fare with one profit margin</td>
<td></td>
</tr>
<tr>
<td>Mix</td>
<td>each customer preference satisfied</td>
<td>broader range of planning tools needed</td>
</tr>
<tr>
<td></td>
<td>base-load in-house but arrangements when crowded</td>
<td></td>
</tr>
</tbody>
</table>

The existing and the envisioned ferry terminals are perfectly integrated with the other modes of transportation: plenty of parking space and connected to one or more public transportation lines (WETA 2009a). To be able to use the recreational docks as boarding points more effort from the company is needed, since not much parking nor public transport is available, see Appendix D.

Several limousine services and general taxi suppliers are available to provide the outsourced service. The San Francisco Bay Area houses Tesla Motors, which might be a great opportunity to provide the base-load access and egress services with fully electric vehicles.

5.4.2 Cooperation
As mentioned earlier, the San Francisco Bay Area consists of nine counties, all having their own jurisdiction on top of the city’s regulation. Next to that the State and federal governments have made laws and regulation which are just as valid in the region of this operation. These need to be enforced. This is done by a mixture of institutions that are directly controlled by their respective governments and that are a cooperation among different departments and/or regions.

Appendix J shows an overview of the relevant stakeholders and their relations, being hierarchical, cooperative, dependent on, consists of or initiated by. Not only governments or government institutions are involved. Also current operators, port authorities, marina’s, businesses and developers influence the area.

The same Appendix J shows an overview of the relevant resources all stakeholders have. Not everyone and everything is as important. See Table 8. Critical stakeholders have something the company needs and cannot do without. If these stakeholders share the same vision and are as dedicated to the developments, it will not be too difficult to make use of their resources. For the water taxi development this group consists of four ports in the region (San Francisco, Oakland, Redwood City and Richmond) that are seriously involved in developments on water taxis. The main difference between the ports is that the Port authority of San Francisco is not only responsible for the movements of the goods, but also for the entire waterfront developments of the city. And the San Francisco city government wants to invest heavily in utilizing its unique waterfront location.
Table 8 Stakeholders

<table>
<thead>
<tr>
<th>Critical</th>
<th>Non-critical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port of San Francisco</td>
<td>California Transportation Commission</td>
</tr>
<tr>
<td>Port of Oakland</td>
<td>Department of Transportation</td>
</tr>
<tr>
<td>Port of Redwood City</td>
<td>Cruise/Tourist/Fishing operators</td>
</tr>
<tr>
<td>Port of Richmond</td>
<td>Ferries</td>
</tr>
<tr>
<td>City Government</td>
<td>Marine Services</td>
</tr>
<tr>
<td>Port of Sacramento</td>
<td>Federal Government</td>
</tr>
<tr>
<td>County Government</td>
<td>Department of Boating and Waterways</td>
</tr>
<tr>
<td>City Government</td>
<td>SFRA Water Emergency Authority</td>
</tr>
<tr>
<td>Marina's</td>
<td>Passenger Vessel Association</td>
</tr>
<tr>
<td>Port of Sacramento</td>
<td>California State Government</td>
</tr>
<tr>
<td>California Bay Area Rapid Transit Commission</td>
<td>Business, Transportation &amp; Housing Agency</td>
</tr>
<tr>
<td>US Coast Guard</td>
<td>Metropolitan Transportation Commission</td>
</tr>
</tbody>
</table>

Not everyone shares the same vision or goals of growing a profitable business. This can cause much delay or even cancellation of the start of operations. In this case permits and (financial) support are key elements. The EPA, ACE, USCG, CPUC, BCDC and ABAG are the main providers thereof, and are dedicated to the environment, safe water way usage and passenger transportation and fair competition.

This might seem contradictory to what a company might want. But in the long run however cooperating with these stakeholders and/or adjusting the business to their vision makes sense as well. Saving the environment creates a great image, especially in San Francisco Bay Area. Not operating safely will quickly lead to accidents and demise of the business, when known as especially unfair and not running an honest business will not give the credibility the original ideas deserve.

So even though they are not the first group that pops into mind to please, doing so increases the chances of success.

The group of non-dedicated but critical stakeholders is the hardest to get on-board. They have no immediate reason to participate, either because they like the status quo or don’t see the need for water taxis. This group also contains critical stakeholders.

Especially the marina’s can play a significant role in the business. Being able to use their mooring facilities increases the amount of boarding points without added investments.

This leaves the range of non-critical stakeholders. Non-critical indicates that there is a large number of the same resources present, for example partners in operation and funding. They do become critical when they all decide to be against you instead of at least one being interested in a partnership. This group also contains the overarching governments and support groups. This is mainly because pleasing the lowest hierarchical level, often means that higher up the decision is supported. And these lower level actors have already been indicated as more critical.

The non-critical and non-dedicated group contains BART metro, AMTRAK train and the AC Transit bus operator. They do not necessarily feel a hard impact from the water taxis, they could and should however be at least in favor of the operations since they are a supply line to the waterfront.

5.4.3 Overview

<table>
<thead>
<tr>
<th>Partner network §4.4</th>
<th>Ranges between access / egress arranged</th>
<th>cooperation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private group</td>
<td>Indifferent to business models</td>
<td></td>
</tr>
</tbody>
</table>
5.5 Remaining blocks

Time and financial constraints unfortunately don’t allow for a full analysis of all 9 blocks. This section quickly refers to the four blocks that have not been addressed yet (the block value proposition is incorporated in the next chapter).

5.5.1 Key activities

The basic key activities are vessel operation, planning, maintenance, scheduling, reservations and marketing. If the choice is made to provide a high-end service, also extensive portfolio management and extra personnel training might be needed.

It is likely that maintenance can be outsourced. WETA has currently written a request for qualification and the design of a Maintenance and operations facility (WETA 2009d). Also Alameda has a Ferry Maintenance Center operated by Bay Ship. This is why 5% of the vessel price is reserved for maintenance. Options for emergency repair could be having qualified crew on-board, service contracts with part suppliers, and/or extra high speed vessels to still deliver the customer on-time. But that will not be elaborated on further.

Optional activities include access and egress operations, catering services, reservation services for restaurants, wineries or events.

<table>
<thead>
<tr>
<th>Key activities §4.5</th>
<th>Ranges between</th>
</tr>
</thead>
<tbody>
<tr>
<td>operating</td>
<td>Indifferent to business models</td>
</tr>
<tr>
<td>planning</td>
<td>Indifferent to business models</td>
</tr>
<tr>
<td>maintenance</td>
<td>Indifferent to business models</td>
</tr>
<tr>
<td>scheduling</td>
<td>Indifferent to business models</td>
</tr>
<tr>
<td>reservations</td>
<td>Indifferent to business models</td>
</tr>
<tr>
<td>marketing</td>
<td>high</td>
</tr>
<tr>
<td>on-board service</td>
<td>low</td>
</tr>
</tbody>
</table>

5.5.2 Client relationships

Customers paying a high price will expect a high touch relationship. (K.P. Morse) This would require extra knowledge on the specific customers and keeping track of their preferences. It is however highly costly. This could include presentations at the potential customers, increasing the quality of the staff the customer meets aboard the vessel or even a personalized website.

When serving a less demanding group it is wise to adjust the level of intensity of the client relationship.

<table>
<thead>
<tr>
<th>Client relationships §4.5</th>
<th>Ranges between</th>
</tr>
</thead>
<tbody>
<tr>
<td>high touch</td>
<td>low touch</td>
</tr>
</tbody>
</table>

5.5.3 Distribution channels

The distribution channels are the channels through which we communicate with our customers and through which we offer our value propositions. The distribution channels can be either through individuals or groups, such a company’s transportation department. Just like the client relationship a clear strategy is needed on the message that is broadcasted, as well as the audience that it should reach. Since it is not uncommon that the buyer is not the user. Some options are waterfront purchase, service desk and online purchase.

<table>
<thead>
<tr>
<th>Distribution channels §4.5</th>
<th>Ranges between</th>
</tr>
</thead>
<tbody>
<tr>
<td>individual</td>
<td>group</td>
</tr>
</tbody>
</table>
5.5.4 Client segments

Client segmentation is one of the first elements of Osterwalders Canvas to be determined. It is also the basis for the three business models to be designed in the next chapter. Despite these two important properties it has been decided, to discuss it lastly and not extensively.

Strange? Yes, but for a good reason. Deep psychological insights in a whole range of client segments at this stage would take too much time and is not the focus of this research. A basic knowledge or expectation of their needs, in combination with a limited range of attributes and attribute levels, is at this stage the level of detail needed.

Based on their high value of time the focus on the business environment has already been set in section 1.2. It was also already indicated that the largest opportunity seems to lie in transforming travel time into quality time. Be it by improving travel time reliability, creating options for equipped time or offering comfort cq. luxury.

More knowledge beforehand would not provide better market share estimates, since there are limitations to the number of attributes that can be entered into the survey, as will be discussed later. The number of elements in a profit calculation, do not include how they feel and what they value more than ticket prices in combination with a certain service. This is more important in a later stage, for marketing and sales.

No further elaborate section will be devoted to client segment selection. For completeness a short list of the holy trinity of client segments that would be ideally serviced, according to the experts, due to their group size and/or willingness to pay:

- Tourism
- Commute
- Business

For all three, a general and high-end section can be chosen. Below the three segments that are chosen for further usage in the next chapters. They are also typified by a user type from which a general understanding of their needs and the accompanying service concepts can be derived.

- High-end Business – Mr. Boss
- High-end Commute – Mr. Better
- General business – Mr. Busy

<table>
<thead>
<tr>
<th>Client segments §4.5</th>
<th>Ranges between</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>general</td>
</tr>
<tr>
<td>tourism</td>
<td>no</td>
</tr>
<tr>
<td>commuters</td>
<td>no</td>
</tr>
<tr>
<td>business</td>
<td>yes</td>
</tr>
</tbody>
</table>
5.6 Results

In this chapter step 2 – Framing the design space, eight of the 9-block Canvas by Dr. Osterwalder have been discussed. The ninth, being the value proposition, is elaborated on in the next chapter.

Each block in the current chapter concluded with a short overview of its design space. The conclusion is thus a complete overview of the entire design space (Table 9), within which three business models have to be designed (Step3).

Table 9 Design Space

<table>
<thead>
<tr>
<th>Cost structure §4.1</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>construction &amp; procurement</td>
<td>$0.35mio</td>
<td>$6.1mio</td>
</tr>
<tr>
<td>vessel operation &amp; maintenance</td>
<td>$0.28mio</td>
<td>$0.49mio</td>
</tr>
<tr>
<td>land-based costs</td>
<td>Indifferent to business models</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Revenue flows §4.2</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ticket fares (one-way)</td>
<td>low = $30</td>
<td>medium = $50</td>
<td>high = $70</td>
</tr>
<tr>
<td>external funding</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>leasing-out vessels</td>
<td>yes</td>
<td>no</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key resources §4.3</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>speed (influences travel time)</td>
<td>25knots</td>
<td>35knots</td>
<td></td>
</tr>
<tr>
<td>comfort (vessel stability)</td>
<td>low</td>
<td>medium</td>
<td>high</td>
</tr>
<tr>
<td>Comfort (luxury / seating)</td>
<td>low</td>
<td>medium</td>
<td>high</td>
</tr>
<tr>
<td>propulsion</td>
<td>sustainable</td>
<td>standard</td>
<td>hybrid</td>
</tr>
<tr>
<td># pax</td>
<td>1+</td>
<td>&lt;12</td>
<td>&lt;30</td>
</tr>
<tr>
<td>Maximum delay</td>
<td>5min.</td>
<td>15min.</td>
<td>25min.</td>
</tr>
<tr>
<td>manning</td>
<td>1</td>
<td>more</td>
<td></td>
</tr>
<tr>
<td>quality</td>
<td>sea dog</td>
<td>high-end</td>
<td></td>
</tr>
<tr>
<td>boarding points</td>
<td>many</td>
<td>few</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Partner network §4.4</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>access / egress arranged</td>
<td>Private</td>
<td>group</td>
</tr>
<tr>
<td>cooperation</td>
<td>Indifferent to business models</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key activities §4.5</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>operating</td>
<td>Indifferent to business models</td>
<td></td>
<td></td>
</tr>
<tr>
<td>planning</td>
<td>Indifferent to business models</td>
<td></td>
<td></td>
</tr>
<tr>
<td>maintenance</td>
<td>Indifferent to business models</td>
<td></td>
<td></td>
</tr>
<tr>
<td>scheduling</td>
<td>Indifferent to business models</td>
<td></td>
<td></td>
</tr>
<tr>
<td>reservations</td>
<td>Indifferent to business models</td>
<td></td>
<td></td>
</tr>
<tr>
<td>marketing</td>
<td>high</td>
<td>low</td>
<td></td>
</tr>
<tr>
<td>on-board service</td>
<td>low</td>
<td>medium</td>
<td>high</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Client relationships §4.5</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>high touch</td>
<td>low touch</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Distribution channels §4.5</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>individual</td>
<td>group</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Client segments §4.5</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>general</td>
<td>high end</td>
</tr>
<tr>
<td>tourism</td>
<td>no</td>
</tr>
<tr>
<td>commuters</td>
<td>no</td>
</tr>
<tr>
<td>business</td>
<td>yes</td>
</tr>
</tbody>
</table>
6 Step 3 - Designing three business models

The end result of Step 2 / chapter 5 is an overview of the design space. All nine blocks are interrelated, but eventually the value proposition should trigger the potential customer. In this chapter the factors within the design space, will be varied and combined into three business models. These business models are formulated as value propositions to the customer (the last remaining building block of the Canvas). The three business models are based on the three client segments identified in section 5.5.4:

- High-end business
- High-end commute
- General business

Again it is pointed out that the three client segments are identified on a level of detail which is sufficient for further development of the experiment and for calculation of the impact on the business.

The next chapter will use these three business models to forecast the usage and preferences. This builds up to the final step to check if these preferences with that intensity provides the needed value for a new company.

The following elements have been leading in the combination process:

- trip duration
- comfort and service levels
- sustainably powered or not
- boarding points
- access & egress means
- minimum and maximum ticket prices
- maximum initial investments

The three Business Models are designed to be mutually exclusive, they are realistic and relevant for implementation.

For clarity purposes no diversification is applied for distances travelled. Figure 27 shows six service zones that should have individual fare structures and differences in costs between zones. This will not be elaborated on within this project. Approximate travel times between the zones can be found in Appendix I.
It is expected that the third business model – general business will be used mainly for shorter distances.

The second and third business model have access and egress on a non-individual basis. This is mainly to keep costs low. Expectation is that for the high-end commute parts of the trip are indeed achievable through group transportation, since some companies already use this type of transportation.

The needs for the individual general business trip might be too diverse to group together, without excessive delays.
6.1 Business Model 1: High-end Business

This high-end business oriented business model contains the most luxurious options in the design space, which comes with a price.

The customer has access to a private on-demand service in which he/she will be picked up at the office and dropped off at the desired doorstep.

The on-board service has all the customer could wish for: meals, drinks and of course all newspapers they might desire. Served by a high standard qualified crew and staff.

The vessel is a stable catamaran refitted to suit 12 luxury boardroom seats where originally 30 seats were installed. It is propelled by electricity which means it is clean, silent and fast.

The speed of 35 knots allows for a trip from Redwood City port to the San Francisco Ferry Building in 45 minutes (excl. access egress).

The relation towards the customer is high touch and marketing is personal.

This requires the one-way ticket price to be $70, to pay-off the high investment and high annual operation costs. Subsidies will be needed to fund the changeover to electric propulsion.
6.2 Business Model 2: High-end Commute

The high-end commute oriented business model is designed through approaching the high standards of the previous business model, but making it accessible to a larger audience.

The customer has access to a service that has a maximum wait time of 20 minutes, combined with the pick-up at the office and drop-off at the desired doorstep with group transportation.

The on-board bar provides the customer with a small selection of snacks and drinks, always fresh and of high quality.

The vessel is a stable catamaran with 30 seats. It is partially propelled by electricity which means it is more clean and silent.

The speed of 35knots allows for a trip from Redwood City port to the San Francisco Ferry Building in 45 minutes (excl. access egress).

The relation towards the customer is low touch but marketing is personal.

This requires the one-way ticket price to be $50, to pay-off the medium high investment and pay for the medium annual operation costs. Subsidies will be needed to fund the changeover to electric propulsion. Since it is a commute operation subsidies might also be available.
6.3 Business Model 3: General Business

The general business oriented business model is designed to make it accessible to the average business traveler. Although somewhat slower it is highly flexible for a reasonable price.

The customer has access to a service that has a maximum wait time of 10 minutes, combined with the pick-up at the office and drop-off at the desired doorstep with group transportation.

There is no on-board bar service, however just as on the other vessels Wi-Fi and 110V power outlets.

The vessel is a (planning) monohull with a maximum of 12 passengers. It has bio-diesel water jet propulsion.

The speed of 25knots allows for a trip from Berkeley Marina to the San Francisco Ferry Building in 22 minutes (excl. access egress).

The relation towards the customer is low touch and marketing is mainly through the companies logistics departments.

This requires the one-way ticket price to be $30, to pay-off the relatively low investment and low annual operation costs.

Risk is reduced by leasing out the vessels to shipmen that are on their obligated leave from sea. They are paid through the ticket fares, are happy to have a change of scenery and are cheaper than full-time employees.

<table>
<thead>
<tr>
<th>Cost structure §4.1</th>
<th>General Business</th>
</tr>
</thead>
<tbody>
<tr>
<td>construction &amp; procurement</td>
<td>$0.35 mio per vessel</td>
</tr>
<tr>
<td>vessel operation &amp; maintenance</td>
<td>$0.28 mio per vessel</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Revenue flows §4.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>ticket fares (one-way)</td>
</tr>
<tr>
<td>external funding</td>
</tr>
<tr>
<td>leasing-out vessels</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key resources §4.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>vessels</td>
</tr>
<tr>
<td>speed (influences travel time)</td>
</tr>
<tr>
<td>comfort (vessel stability)</td>
</tr>
<tr>
<td>Comfort (luxury / seating)</td>
</tr>
<tr>
<td>propulsion</td>
</tr>
<tr>
<td># pax</td>
</tr>
<tr>
<td>maximum delay</td>
</tr>
<tr>
<td>manning</td>
</tr>
<tr>
<td>#</td>
</tr>
<tr>
<td>quality sea dog</td>
</tr>
<tr>
<td>boarding points</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Partner network §4.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>access / egress arranged</td>
</tr>
<tr>
<td>cooperation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key activities §4.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>operating</td>
</tr>
<tr>
<td>planning</td>
</tr>
<tr>
<td>maintenance</td>
</tr>
<tr>
<td>scheduling</td>
</tr>
<tr>
<td>reservations</td>
</tr>
<tr>
<td>marketing</td>
</tr>
<tr>
<td>on-board service</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Client relationships §4.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>low touch</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Distribution channels §4.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>group</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Client segments §4.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>tourism</td>
</tr>
<tr>
<td>commuters</td>
</tr>
<tr>
<td>business</td>
</tr>
</tbody>
</table>
6.4 Results

This chapter is the result of step 3 – Designing three business models. The three models serve three different client segments:

- High-end business
- High-end commute
- General business

The result of this chapter, and simultaneously of objective 1, is are the three service concepts, represented by business models. In summary, the building block ‘Value proposition’ of all three concepts are presented below in Figure 28 - Figure 30.

**Figure 28 Value proposition High-end Business**

High-end Business - allows for private transportation in large comfortable water taxis with on-demand departures at comfort levels comparable to airline business class settings.

**Figure 29 Value proposition High-end Commute**

High-end Commute - allows for transportation in the large comfortable water taxis with mostly scheduled departures at comfort levels comparable to BART, CalTrain and/or AMTRAK;

**Figure 30 Value proposition General Business**

General Business - allows for transportation in the small 12 passenger water taxis with regular departures at comfort levels comparable to the local AC Transit bus.
Phase 3

Choice
7 Step 4 - Forecasting the demand

The three business models of Step 3 fit the design space. Now they need to be tested. The future customer should let the company know what the best model is, not the other way around. According to Osterwalder “adopting the customer perspective is a guiding principle for the entire business model design process” (Osterwalder et al. 2009). Once the preferences are clear the final step can be made to determine how and if this demand can be met (Step 5).

7.1 Forecasting methodology

The forecasting methodology is elaborated on in three sections:

- Method of analysis
- Experiment design
- Experiment

The demand research is done through discrete choice analysis, with data from an online stated preference survey. Performing this analysis is based on collecting choices people make. In this case a variation of 18 different services (profiles) were proposed and asked whether or not it would be a means they would use. The choices can be used to estimate a model. After inspection and interpretation of the parameters, this model allows for making predictions on what choices people would make at certain levels of the attributes, such as a high versus low price.

7.1.1 Method of analysis

Data collection

A great multitude of methods exist to gather data on customer preferences, ranging from interviews and role playing to prototyping and modeling. The aim however to get the preferences on an unknown product (no water taxis yet) from a specific (business) and rather large group of users (entire San Francisco Bay Area) which are located at significant distance (the other side of the globe), rapidly reduces the options.

Subjective perceptions about a product affect consumer choice. Accordingly, acquiring the underlying demand characteristics that consumers find desirable is vital for firms planning future marketing strategies. However, the extent to which product-specific perceptions affect consumer choice is poorly understood. (Managi et al. 2008)

According to van Wee and Dijst (2002) collecting data on individual behavior regarding choices in transportation can be done either through revealed- or stated preference. The fact that the service does not exist yet, makes revealed preference research not an option. The hypothetical situation of the proposed services and the need for speedy and inexpensive data collection are characteristics that fit the profile of Stated Preference research.

Kenneth Train (2003) explains Stated Preference as: “respondents are often asked a series of hypothetical choice questions, called “stated preference” experiments. For each experiment, a set of alternative products with different attributes is described, and the respondent is asked to state which product he would choose. A series of such questions is asked, with the attributes of the products varying so as to determine how the respondent’s choice changes when the attributes change.”
Within Stated Preference there are three different types of tasks for the respondent. Rating-based tasks require an answer in the form of a grade, ranking-based tasks require multiple services to be put in order of appeal, the third is a choice task between two or more alternatives. In every-day life choices are not made by giving options an actual grade, more an estimate of expected utility for different aspects of the proposition. This is the main reason to discard both the rating- and ranking based tasks. Next to that, an investor would not be interested in an alternative which the population prefers most, but still is not good enough to actually be chosen and used.

A preferred task is to cut this into piecemeal bits and compare it to something known to the respondent. This is done in the third type: choice tasks. One (or more) services are presented in conjunction with preferably a known alternative. Each time a simple answer is asked: which one would you choose to use? This is called Stated Choice (SC).

When collecting data for SC research two aspects need attention, the choice model to do the discrete choice analysis and the experimental design to systematically vary the attributes.

Discrete choice analysis
As derived above, in this case the usefulness of services to the customer (utility) is examined through Stated Choice (SC). Basically one indicator dependant on a list on independent predictors, being the different elements in the business models. The underlying assumption is that the travelers decision is based on the concept of utility maximization. He or she compares all known travel alternatives and chooses the one with the highest utility (McFadden 1974).

SC can measure preferences, willingness to pay and the importance of characteristics. The method is proposed by Daniel McFadden (McFadden 1974) and reported by Kenneth Train. Train states that “Logit is by far the most widely used discrete choice model.”

Hair ea provides a decision tree, which points to either Multiple Discriminant Analysis (MDA) or Linear Probability Models (MNL), based on the characteristics above. MDA however is used to understand group differences and to see if an entity belongs to a particular class. Logit analysis is a combination between these MDA models and multiple regression analysis, which is used to “predict the changes in the dependent variable in response to changes in the independent variables” (Hair J.F. 1995). The nonmetric nature of the dependent variable requires this specific combination found in logit models, over simply multiple regression.

Theory
Logit analysis has been chosen, amongst others, due to the fact that it is the first closed form solution for discrete choices analysis. McFadden’s concept of utility estimation with logit analysis (McFadden 1974), as reported by (Molin 2009), works as follows:

- The customer \( i \) conceives alternatives \( j \) as bundles of \( k \) attributes.
- Each attribute can have a certain value (attribute level) \( X_{ijk} \) for which every customer \( i \) can have a different (perceived) value, such as the travel time to the final destination.
- Each attribute level has a certain amount of utility \( V_{ijk} \) to the customer (part worth utility), which is defined by the attribute level \( X_{ijk} \) times a population specific value \( \beta_k \), which indicates a ‘level of taste’ for each attribute:
  \[
  V_{ijk} = \beta_k X_{ijk}
  \]
- Part worth utilities can be combined in the overall utility for each profile:
  \[
  V_{ij} = \sum_{k} \beta_k X_{ijk}
  \]
“The econometrician cannot observe or control all the factors influencing behavior” (McFadden 1974)

That is why, to estimate the overall utility $U_{ij}$, a random non-measured utility component $\epsilon_{ij}$ needs to be added:

$$U_{ij} = V_{ij} + \epsilon_{ij}$$

$\epsilon_{ij}$ is independently, identically distributed extreme value for all $i$ and $j$. The critical part of the assumption is that the unobserved factors are uncorrelated over alternatives and individuals, as well as having the same variance for all alternatives (Train 2003).

- The choice probability $p_{ij}$, given the sum of all probabilities $y_{ij} = 1 \iff U_{ij} > U_{im} \forall m$ is:

$$p_{ij} = \Pr\{U_{ij} > U_{im}\} = \frac{e^{V_{ij}}}{\sum_{m \neq i} e^{V_{im}}}$$

Where $m$ stands for any alternative but $j$.

This reads: the chance that an alternative is chosen is equal to the exponent of the individuals perceived utility of that service divided by the sum of the exponent of the utilities of all alternatives in the choice set.

If there is only one option and a no-choice option, being the standard means of transportation, the no-choice utility is set to 0. Since $e^0 = 1$ the choice probability will be calculated with:

$$p_j = \frac{e^{V_j}}{e^{V_j} + 1}$$

**Modelling tool: Biogeme**

Biogeme (Bierlaire 2003) is a free software tool that can estimate these logit models. “Biogeme (Bierlaire’s Optimization Toolbox for GEV Model Estimation) is an object-oriented software package designed for the maximum likelihood estimation of Generalized Extreme Value (GEV) models.” (Bierlaire 2009)

### 7.1.2 Experiment design

The need for an representative overview of the target group implies a large number of people partaking in the research. The goal of the experiment is thus to have as many people as possible, from the target group, fill out as many profiles as possible to estimate the logit model.

Large numbers of respondents are best targeted with a survey (Baarda and de Goede 2001). To prevent the need for extra on-site research, the survey is offered online.

The respondents are reached through a mailmerge. The available database consists of over 1,500 investors and business professionals in the San Francisco Bay Area.

Filling out as many profiles as possible is a function: # respondents x # profiles filled out. There is a delicate balance. Earlier experience with the group in the database, showed that a very short and to the point survey is required to keep the response rate high. It is preferred to be approximately 3 minutes, with an explicit tested maximum of 5 minutes, indicating a design goal for very few profiles per respondent.
However asking little profiles creates the need for many more respondents to estimate a trustworthy model. Since the response rate within the available database shows to be approximately 5% this situation should be prevented as well, creating the design goal for as many profiles per response.

The aim is to reach several hundred observations, which is a standard number for this type of studies. The response rate might be fairly low since the database is already over a year old in a very dynamic environment. Even more important for expecting a low response rate is the fact that it concerns very busy-scheduled people who will see no direct value coming from filling out the survey. The number of profiles per respondent should be around 15-20.

Next to the profiles the option is given to answer extra questions. All respondents are asked to answer questions on their social-demographics.

First an elaboration is given on the stated choice elements. Followed by the remaining questions.

**Stated choice**
The steps taken when designing a stated choice experiment is proposed by (Hair J.F. 1995; Molin 2009):

1. Choose the attributes
2. Choose the attribute levels
3. Construct the profiles
4. Define the choice task

1. **Attributes**
The essence of the value proposition is the assumption that the customer sees value / utility they are willing to pay for. What are elements that customers value most, or have been reported to be most important in transportation research?

The Business Models consist of a list of 28 items, as summarized in section 5.6. Incorporating all the items in a survey asked to the customer is both impossible because of the elements they will not know anything about, but it would also be too time-consuming. A selection must be made. This is done by combining frequently used structures in transportation research with items that are relevant to the customer.

Mathisen and Solvoll (2009) state that the universal attributes of customer satisfaction in transportation services are: travel time, price, frequency, safety, regularity. Next to that observation combining 15 transportation related reports in one overview Table 10 provides a rough insight in the most questioned items. Clearly the top five of items researched are Travel time, Travel costs, frequency of the service, comfort/luxury and reliability.
### Table 10 Items in transportation research on surveys - overview

<table>
<thead>
<tr>
<th>Author</th>
<th>Travel time</th>
<th>Travel costs</th>
<th>Frequency</th>
<th>Comfort/luxury</th>
<th>Reliability</th>
<th>Safety</th>
<th>Transparency</th>
<th>Experience</th>
<th>Ease/Effort</th>
<th>Party size</th>
<th>Household income</th>
<th>Autonomy</th>
<th>Mobility</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Chorus et al. 2006)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Chorus et al. 2007)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Wong et al. 2008)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Ashiabor et al. 2007)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Hess et al. 2005)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Van Wee and Dijst 2002)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Stradling 2002)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>As stated in (Piet 2008)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Egeter 2002)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Bijlsma et al. 2002)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(van Hagen 2003)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>As stated in (Ashiabor et al. 2007)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stopher &amp; Prashker 1976</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grayson, A 1982</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morrison &amp; Winston 1985</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Koppelman 1990</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mode choice model in TSAM 1995</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The most questioned items from Table 10 can be used to select the best survey items from a list of relevant items in the report. In the business models only part of the items described in the previous chapters is relevant to the customer and/or possible for them to give an educated answer. For that reason the list is first reduced to:

- Ticket price
- Trip duration
- Frequency / wait time
- Reliability
- Comfort
- Onboard amenities
- Vessel comfort
- Method of propulsion
- Number of passengers
- Boarding points
- Access & egress
To reach a maximum of 5 attributes a merger is made between this list and the top five in Table 10. The limitation comes from the fact that it is hard to estimate many attributes simultaneously and the fact that more attributes requires more observations, which means a longer survey.

- Trip duration is the top item in the found research and highly relevant for the customer.
- Ticket price is ranked as the second item.
- Frequency of the service and reliability/regularity are combined into maximum delay. This is due to the fact that an on-demand service is envisioned with the aim for a specific arrival time.
- Comfort and luxury is included through a comparison to well known means of transportation. This creates an image for the respondent that includes ride comfort, cleanliness, safety, service etc.
- Preferences on the number of passengers has a significant impact on the hardware needed. If the customer does not mind to share the vessel with 30 other passengers there is less need to rebuild existing vessels. On the other hand if they do only want to have private rides a larger number of vessels is needed.

Boarding points and access and egress methods are excluded from variation due to the vast range of possibilities. These are fixed and equal to all respondents. Method of propulsion is expected to have some impact on the choice and is a ‘nice –to-know’-item for the area involved. However it is expected that it will not show a significant impact. Thus is to chosen not to expand the number of items in the choice task and with that the risk of less response. It is however included in a separate section of questions, along with the need for onboard amenities and the type of access and egress means.

2. **Attribute levels**

All attributes have an expected direction in their utility graph:

- Trip duration: increasing duration reduces utility
- Ticket price: increasing price reduces utility
- Maximum delay: increasing delay reduces utility
- Comfort comparable to...: increasing comfort increases utility
- Number of passengers: decreasing number of passengers decreases utility

The highest and lowest levels are determined by realistic and expected situations for the services. The third level is the average in between. The categorical attributes are limited to three levels as well. Each combination of the levels must be perceived as a realistic service, even though they might not seem plausible. For example: a low quality service and a long travel time with much delay for a very high price, does not immediately seem attractive. But it is a realistic scenario in which it turns out that the high price is needed to provide the service, but due to that usage will be low.

Trip duration is based on the estimated travel times of WETA. The 10 minutes access and egress add-on is based on Krijgsman, Dijst et al (2004). They state that “For most multimodal trips, the ratio falls within a modest range of 0.2-0.5 (x total traveltime). The results can be used, amongst other, in planning the catchment area of public transport and predicting choice sets of realistic multimodal trips.” The wait time is assumed to be zero since within the trip details the access / egress option is chosen and the choice is made in advance.
A Maximum delay of zero is virtually impossible. The lowest level is therefore set to 5 minutes. To be able to compete with current travel times a delay of more than 30 minutes will be unacceptable. This combined with the preference to have equal bracket of time, the range is chosen to be: 5 – 15 – 25 minutes.

Three levels of Comfort need to be chosen that are self explanatory and create an overall image of comfort, service, spaciousness, etc. Local means of transportation are busses metros trains cars and trains. A low, medium and high comfort level is needed. The lowest is the local bus: somewhat dirty, noisy, helpful but often cranky drivers, etc. A medium level option is the metro (BART) or the train. They differ quite a lot, so they are mentioned as a cluster to add toilets and service staff, but still the feel of bulk transportation. They high end service would be the business class section of an airplane. Full service, much space, ability to work. etc.

The Number of passengers is based on the maximum size of the chosen vessel, the maximum number to stay in a different legal bracket and the single person or their private group.

The Ticket price range is the result of a variation in the cost structure sheet presented in previous chapters. The prices are expected to be needed to provide the three services in the Business Models and then geared towards equal brackets and a large range. In previous chapters they were also coupled to comparable services.

Summing up, based on the ability to implement, existing questionnaire variation and interpretability, Table 11 shows the levels of the attributes.

**Table 11 Attributes & attribute levels**

<table>
<thead>
<tr>
<th>Attributes &amp; Levels</th>
<th>Parameter 1</th>
<th>Parameter 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trip duration</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Comfort</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Ticket price</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>60 minutes</td>
<td>AC Transit local bus</td>
<td></td>
</tr>
<tr>
<td>50 minutes</td>
<td>BART/CalTrain/AMTRAK</td>
<td></td>
</tr>
<tr>
<td>40 minutes</td>
<td>Business class (airplane)</td>
<td></td>
</tr>
<tr>
<td>Maximum delay</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Number of passengers</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>25 minutes</td>
<td>maximum 30</td>
<td></td>
</tr>
<tr>
<td>15 minutes</td>
<td>maximum 12</td>
<td></td>
</tr>
<tr>
<td>5 minutes</td>
<td>Private vessel / with a group</td>
<td></td>
</tr>
</tbody>
</table>

Varying attributes on three levels requires an added step of encoding, for this Effects coding is used. In effects coding specifies dummy variables which represent group deviations from the mean of all groups (Hair et al. 1995). The encoding is according a scheme such as in Table 12.

**Table 12 Example effects coding**

<table>
<thead>
<tr>
<th>Attribute level</th>
<th>Parameter 1</th>
<th>Parameter 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attribute level 1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Attribute level 2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Attribute level 3</td>
<td>-1</td>
<td>-1</td>
</tr>
</tbody>
</table>

3. Profiles
The attribute levels need to be combined into different scenarios, different services customer might want to use. To have efficient model estimation, estimating as many significant coefficients with as little observations as possible, correlations between the profiles should be prevented. For example when the no-usage answer is given when a higher price in combination with a longer travel time is suggested, correlation between the item would blur the origin for the choice. When uncorrelated it can be determined if it was the price or the time. This way the standard errors are smallest and the t-value the largest (Weers and Molin 2009).
Since there is almost always a correlation between the attributes, the best way to solve this is to make the measurements uncorrelated. Orthogonal designs are pre-designed in the Basic plans by Addelman (1962). Basic plan is chosen to vary the 5 attributes on 3 levels. Basic plan 4 is designed to test 7 items and thus creates 18 trials, further analysis shows that using only five out of the possible seven columns still creates an orthogonal design.

An option that is briefly explored, is to split the 18 trials in two parts to shorten the survey. This however creates correlations between the items. The 18 trials are time tested found to be short enough and within the range of 16-22 profiles to reach the goal of 1,000 filled out items. This means basic plan 4 is chosen in full, to vary 5 attributes on 3 levels resulting in 18 profiles.

In Appendix K the full overview of the basic plan and the resulting profiles is presented.

4. Choice task and variation

As mentioned before, the task the respondents get is to choose whether or not they would use a proposed service. The respondent will weigh the proposed service along a set of attributes that only he/she knows. It is meant to be weighed against their current means of transportation (whatever that may be), i.e. when not choosing the proposed service the current means will be used.

By varying the levels within the predetermined set attributes of this research on 18 individual profiles, estimates can be made to approximate the complex choice the respondent makes. This way, without knowing all attributes that are important to the respondent, assumptions on their choices process can be derived and modeled.

This means that no choice sets need to be constructed. In order to prevent order effects such as learning effects or tiredness, the order of the profiles is varied over four surveys. The order varies as follows:

- Standard 1-18
- Backwards 18-1
- Split 10-18 / 1-9
- Jumps of three 1-4-7-...-16 / 2-...-17 / 3-...-18

Trip details

An important element in the experiment is finding the right target group. The first step is made by targeting the right group: current, former and future business people in the San Francisco Bay Area. This is checked by a yes/no question.

Secondly the entire setup of the survey is built around one specific business trip. A trip that is potentially viable and of which it is plausible that the targeted group might experience the hindrance of congestion and parking hassles. The question posed is based on one specific route and time, implying a (partly) congested road. The results are thus mainly valid for rush hour.

Trip
Please answer each question as if you intend to make the following trip shortly:

- **Imagine having a 5:30PM business appointment in the San Francisco Financial district.**
- **You are currently in Palo Alto at your office or another meeting.**

The novelty of the proposed alternatives is that the largest part of the trip is over water. Planning is not an issue since all of the alternatives include the necessary arrangements to bring you from door-to-door:

- You will be picked up at the office and driven to the nearest boarding point at the San Francisco Bay shoreline.
- After boarding, the vessel will bring you to one of the piers in San Francisco.
- At the pier you will be picked up and driven to your appointment.
- The car travel legs take a total of 10 minutes on average and are included in the overall trip duration.
Question type
The type of questions needed are not common to most people. Ranking or like/dislike questions are more standard. That is why an elaboration was given at the start of the survey on how to fill out the survey.

Question type
The survey consists of 18 yes/no questions:
- Each question refers to a scenario above it, which we would like to ask you to evaluate.
- These 18 alternatives are created by systematically varying 5 items over 3 values.
- Varying over so many items allows us to model the choice processes, instead of only observing the outcome.
Each time we would like you to answer the following question:

Would you choose to use the proposed service for the indicated trip from Palo Alto to the San Francisco Financial district? Yes or no.

Choosing not to use the service would indicate using your standard means of transportation. To familiarize you with the question type and items involved, first an elaborated example is given.

Example
The example also provides the opportunity to steer the thoughts of the respondent. Such as for the type of comfort involved. The option is given to see another example or to contact the builder.

Example
- Trip duration: 40 minutes
- Maximum delay: 5 minutes
- Comfort level comparable to: BART/CalTrain/AMTRAK
- Number of passengers: maximum 12
- Ticket price (one-way per person): $30

This is to be interpreted as follows:
- Due to a very high speed vessel the trip will normally take 40 minutes, including the car legs.
- You would never have a delay of more than 5 minutes, creating a total travel time of 45 minutes maximum. This delay would only occur at a maximum of 30% of the trips.
- Comfort levels would be in the league of BART/CalTrain/AMTRAK. Decent cushioned seats, a toilet, small snacks and drinks from a vending machine, and a varying level of the opportunity to work based on ride comfort and space.
- You would share the vessel with a maximum of 11 other passengers.
- The total door-to-door trip would cost you $30.

Alternatives
After the example the 18 profiles are presented as alternatives. In eighteen individual questions, see also Appendix K, the respondent is asked to state yes or no on the question Would you choose to use the proposed service for the indicated trip from Palo Alto to the San Francisco Financial district?

Additional questions
Three additional questions are built into the survey. After the 18 travel alternatives, the option is given to answer these as well, resulting in an additional 2 minutes of survey time. The first question is an obligated choice between the three travel arrangements in the Business Models. The second and third question provide information on the distribution of tastes around the average. Train states that "This distribution can be important in many situations, such as forecasting the penetration of a new product that appeals to a minority of people rather than to the average tastes". (Train 2003).
The respondent is asked to state the level of importance (5-point scale ranging from not important-very important) of eight items:
- Trip duration
- Maximum delay
- Comfort level
- Number of passengers
- Ticket price
- Type of transportation to / from the waterfront (private limo, standard taxi, taxivan)
- Onboard amenities (deluxe catering, vending machines, none)
- Propulsion system (electricity, hydrogen, biodiesel, standard diesel)

Social-demographics
The social-demographics asked in the survey and presented in section 7.1.3 are based on a market segmentation study by Mark Bradley for ferries in the San Francisco Bay Area (Bradley 2002).

7.1.3 Experiment

Testing
The survey is optimized several times before distribution. The type and ranges of the questions discussed several times with C. Chorus. Three students from Delft University of Technology (DUT) have tested the type of questions afterwards. Two additional DUT students have tested the timing. Dr. Eric Molin, associate professor in Transport Policy and Logistics at Delft University of Technology, faculty Technology, Policy and Management has reviewed the survey both on question type and completeness. Content testing is concluded with two potential customers. Afterwards three rounds of programming and testing the four surveys have been completed.

The survey is programmed online with at thesistools.com. This free online-tool provides an internet address to direct the respondent to and delivers the data in Excel files.

Response
The aim is to receive response from the following population:

<table>
<thead>
<tr>
<th>Client segments</th>
<th>general</th>
<th>high end</th>
</tr>
</thead>
<tbody>
<tr>
<td>tourism</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>commuters</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>business</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

- Earning at least $100,000 per year
- Both businessmen- and women

To reach a group of respondents fitting this profile a private database of 100 business people in the San Francisco Bay Area is combined with a database of 1,400 investors prepared earlier for the Dutch Ministry of Economic Affairs (Verpoort 2008). Each of the 1,508 email addresses is accompanied with a first name. This database allows for sending personalized invitation to the four different surveys.

An important remark is that the 1,400 investors are known to be a very busy group with an overload in requests for response. If the subject is not interesting to them, or not a priority at this time, no response will be given. It usually helps to be persistent, so a reminder is a must.

The first mailmerge is completed at October 16th 2009. A reminder is sent out October 22nd 2009. The survey closed October 27th 2009.

As can be seen in Table 13 a useful response rate of 4.5% was achieved. This is comparable to research (Verpoort 2008) among the same group a people in 2008. It delivers 972 useful observations which is a good amount for this analysis.
Table 13 Response rate

<table>
<thead>
<tr>
<th></th>
<th>2008 Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total invitations</td>
<td>1,508</td>
</tr>
<tr>
<td>Bounced</td>
<td>275</td>
</tr>
<tr>
<td></td>
<td>18.2%</td>
</tr>
<tr>
<td>Potential</td>
<td>1,233</td>
</tr>
<tr>
<td>respondents</td>
<td>603</td>
</tr>
<tr>
<td>Responses</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>5.4%</td>
</tr>
<tr>
<td>Usefull response</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>4.5%</td>
</tr>
</tbody>
</table>

Table 14 Response rate

Table 14 shows the demographics of the group of respondents. Six respondents did not answer the questions. It shows an excellent reach of the target group. Each age group is represented. 90% thereof has a full time job. Surprisingly only 24% declined to state their income level, since this is often a taboo. The largest group earns over $125,000 and in total 64% of them earns over $100,000 per year. This indicates a rather wealthy response group, since the average total household income in the San Francisco Bay Area is $103,031 and the local average wage rate is $20.82 per hour (MTC 2007). Unfortunately the balance between male and female is a bit skewed. However this might still be a valid representation, because of the dominant nature of the occupation of a large part of the targeted group: angel- and venture capital.

Table 14 Response group characteristics

<table>
<thead>
<tr>
<th>Age</th>
<th>Valid</th>
<th>Demographics (N=50)</th>
<th>%</th>
<th>Gender</th>
<th>Valid</th>
<th>Income Level (individual)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-24</td>
<td>0%</td>
<td></td>
<td></td>
<td>Male</td>
<td>80%</td>
<td>&lt;$24,999</td>
<td>0%</td>
</tr>
<tr>
<td>25-34</td>
<td>6%</td>
<td></td>
<td></td>
<td>Female</td>
<td>14%</td>
<td>$25-49,999</td>
<td>0%</td>
</tr>
<tr>
<td>35-44</td>
<td>32%</td>
<td></td>
<td></td>
<td>Decline to state</td>
<td>6%</td>
<td>$50-74,999</td>
<td>8%</td>
</tr>
<tr>
<td>45-54</td>
<td>28%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$75-99,999</td>
<td>4%</td>
</tr>
<tr>
<td>55-64</td>
<td>28%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$100-124,999</td>
<td>12%</td>
</tr>
<tr>
<td>65-74</td>
<td>0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$125,000+</td>
<td>52%</td>
</tr>
<tr>
<td>75+</td>
<td>0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Decline to state</td>
<td>24%</td>
</tr>
<tr>
<td>Decline to state</td>
<td>6%</td>
<td>Location Employment</td>
<td></td>
<td></td>
<td></td>
<td>San Francisco Bay Area</td>
<td>94%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Other</td>
<td>4%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Decline to state</td>
<td>2%</td>
</tr>
</tbody>
</table>

A good distribution among the surveys is clear from Table 15.

Table 15 Response distribution

| Survey 1 | 11    | 20% |
| Survey 2 | 11    | 20% |
| Survey 3 | 16    | 29% |
| Survey 4 | 18    | 32% |
| Total    | 56    |     |
Also the missing values among the profiles are little and distributed, as in Table 16. Only profile twelve has the least answers.

Table 16 Missing values

<table>
<thead>
<tr>
<th>Profile</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid answers</td>
<td>54</td>
<td>54</td>
<td>53</td>
<td>54</td>
<td>54</td>
<td>54</td>
<td>54</td>
<td>54</td>
<td>54</td>
<td>55</td>
<td>54</td>
<td>54</td>
<td>55</td>
<td>55</td>
<td>55</td>
<td>54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>56</td>
<td>56</td>
<td>56</td>
<td>56</td>
<td>56</td>
<td>56</td>
<td>56</td>
<td>56</td>
<td>56</td>
<td>56</td>
<td>56</td>
<td>56</td>
<td>56</td>
<td>56</td>
<td>56</td>
<td>56</td>
<td>56</td>
<td></td>
</tr>
</tbody>
</table>

Data preparation
The dataset needs preparation before a Biogeme model can be estimated to produce the necessary results. The data from the four surveys was saved in excel files. The order of the 18 profiles was not equal, thus needed to be reordered.
The full dataset was imported into SPSS. All results with less than three answers on the profiles were excluded. Two respondents were not former, current or near future employees in the area and were excluded.

Biogeme needs “flat” ASCII .dat-files (Bierlaire 2008; Weers and Molin 2009). It also needs input on the encoding of each individual choice, as showed in the extract in Table 17. This was produced in excel and exported as a flat file.

Table 17 Biogeme data file - partial

<table>
<thead>
<tr>
<th>SET</th>
<th>CHOICE</th>
<th>DUR1</th>
<th>DUR2</th>
<th>REL1</th>
<th>REL2</th>
<th>COM1</th>
<th>COM2</th>
<th>PAX1</th>
<th>PAX2</th>
<th>PRC1</th>
<th>PRC2</th>
<th>AV1</th>
<th>AV2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
7.2 Forecasting results
The forecasting results are elaborated on in three sections:
- Model estimation
- Model results
- Validation of the results

7.2.1 Model estimation

Model operationalisation
Before estimation of the model is possible, the nonmetric attributes need to be encoded. For this effects coding is used. This leads to two indicators per attribute. For consistency in the final data-handling all metric attributes have been recoded as well. The conceptual model is shown Figure 31, and the full encoding is shown in Appendix K.

![Figure 31 Conceptual model](image)

Each indicator requires their own beta to be estimated. The unobserved effects are averaged into an extra value: the constant in the utility function. This leads to 11 variables to be estimated.
The model itself is also put in Biogeme as a “flat” ASCII .mod-file (Bierlaire 2008; Weers and Molin 2009). The model is presented in Appendix K. The two variables for the standard means of transportation are set as constants.

**Goodness of fit**

The Rho-square is used to determine the goodness of fit. The absolute value of the adjusted Rho-square does not have a real meaning. It should be used to compare models estimated on the same data. However the Rho-square of the estimated model (0.48) can be seen as a very acceptable fit.

### 7.2.2 Model results

Table 9 shows the results of the model estimation. 11 parameters are estimated of which 5 are significant at the 5% level, and one is included since it is significant at the 6% level. Except for Number of passengers variation on each attribute had an significant effect. This leads to a linear effect for Duration, Comfort and Price and a triangular effect for Maximum delay.

#### Table 18 Estimation results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Indicators</th>
<th>Estimator</th>
<th>Parameter</th>
<th>t-statistic</th>
<th>Robust P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water taxi constant</td>
<td>TAXI</td>
<td>asc1</td>
<td>-2.18</td>
<td>-12.66</td>
<td>0.00 ***</td>
</tr>
<tr>
<td>No water taxi constant</td>
<td>NOTAXI</td>
<td>asc2</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration (minutes)</td>
<td>DUR1</td>
<td>beta1</td>
<td>0.25</td>
<td>1.70</td>
<td>0.09 **</td>
</tr>
<tr>
<td></td>
<td>DUR2</td>
<td>beta2</td>
<td>-0.09</td>
<td>-0.60</td>
<td>0.55</td>
</tr>
<tr>
<td>Maximum delay (minutes)</td>
<td>REL1</td>
<td>beta3</td>
<td>0.29</td>
<td>1.55</td>
<td>0.12 *</td>
</tr>
<tr>
<td></td>
<td>REL2</td>
<td>beta4</td>
<td>0.51</td>
<td>2.96</td>
<td>0.00 ***</td>
</tr>
<tr>
<td>Comfort (non-metric)</td>
<td>COM1</td>
<td>beta5</td>
<td>0.25</td>
<td>1.71</td>
<td>0.09 **</td>
</tr>
<tr>
<td></td>
<td>COM2</td>
<td>beta6</td>
<td>-0.06</td>
<td>-0.37</td>
<td>0.71</td>
</tr>
<tr>
<td>Number of passengers</td>
<td>PAX1</td>
<td>beta7</td>
<td>0.09</td>
<td>0.61</td>
<td>0.54</td>
</tr>
<tr>
<td></td>
<td>PAX2</td>
<td>beta8</td>
<td>-0.17</td>
<td>-1.21</td>
<td>0.23</td>
</tr>
<tr>
<td>Price (US Dollars)</td>
<td>PRC1</td>
<td>beta9</td>
<td>1.93</td>
<td>10.41</td>
<td>0.00 ***</td>
</tr>
<tr>
<td></td>
<td>PRC2</td>
<td>beta10</td>
<td>0.00</td>
<td>-0.01</td>
<td>0.99</td>
</tr>
</tbody>
</table>

**Model statistics**

- Date data: 27-10-09 21h55
- # estimated parameters: 11
- # observations: 972
- Null log-likelihood: -673.739
- Final log-likelihood: -342.589
- Rho-square: 0.842
- Adjusted rho-square: 0.475

* Significant at 6% one-sided level
** Significant at 5% one-sided level
*** Significant at 1% level
Using the effect encoding file from Appendix K the utilities for all attribute levels can be calculated, as shown in Table 19. This utility is in relation to the constant of -2.18. That is also why all parameters that are not-significant can be set to 0, indicating no deviation from the average.

<table>
<thead>
<tr>
<th>Utilities per attribute level</th>
<th>Trip duration</th>
<th>Comfort</th>
<th>Ticket price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Utility</td>
<td>Utility</td>
<td>Utility</td>
</tr>
<tr>
<td>Trip duration</td>
<td>40 minutes 0.248</td>
<td>AC Transit local bus -0.25</td>
<td>$30 1.93</td>
</tr>
<tr>
<td></td>
<td>50 minutes 0</td>
<td>BART/CalTrain/AMTRAK 0</td>
<td>$90 0</td>
</tr>
<tr>
<td></td>
<td>60 minutes -0.248</td>
<td>Business class (airplane) 0.25</td>
<td>$150 -1.93</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of passengers</th>
<th>Utility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum delay</td>
<td>Utility</td>
</tr>
<tr>
<td>5 minutes 0.29</td>
<td>maximum 30 0</td>
</tr>
<tr>
<td>15 minutes 0.505</td>
<td>maximum 12 0</td>
</tr>
<tr>
<td>25 minutes -0.795</td>
<td>Private vessel / with a group 0</td>
</tr>
</tbody>
</table>

**Interpretation**

To enhance interpretability these utility values per attribute are plotted in graphs, as shown in Figure 32.

![Figure 32a Trip duration](image)

![Figure 32c Comfort](image)

![Figure 32b Maximum delay](image)

![Figure 32d Ticket price](image)

Figure 32 Visual representation of significant results
Trip duration
The expected direction of the ticket duration is that increasing duration reduces utility. This is affirmed by Figure 32a. The utility drop from 0.25 at 40 minutes to -0.25 at 60 minutes trip duration.

Maximum delay
The expected direction of the maximum delay is that increasing delay reduces utility. Figure 32b shows only a small incline between 5 and 15 minutes delay. This difference will be discarded both due to its relative small size (0.22), but more due to the improbability of an increase in delays leading to increased utility. At 15 minutes the utility drop from 0.51 to -0.80 at 25 minutes delay.

Comfort comparable to...
The expected direction of comfort is that increasing comfort increases utility. This is affirmed by Figure 32c. However it is less steep than expected. The vision was to provide a high-end service. That is indeed what the customer want, but they are not willing to pay a lot for it. The utility improves from -0.25 for the local bus to 0.25 for business class travel.

Ticket price
The expected direction of the ticket price is that increasing price reduces utility. This is affirmed by Figure 32d. The utility drops from 1.93 for $30 down to -1.93 for $150 trips.

Number of passengers
The expected direction of the ticket price is that decreasing number of passengers decreases utility. There is no graph for Number of passengers since this has no significant impact and would only show a straight line on the X-axis. It is unexpected, but not due to modeling errors. Direct questioning resulted in the same view as can be seen in Figure 33.

Figure 33 Number of passengers - stated importance

Willingness to pay
The fact that price influences were researched and have shown to be significant, willingness to pay can be determined for improvements of services. It also allows for determination of the Value of Time (VOT) and the Value reduction of maximum delay, see Table 20.

The price span in the survey was $30 - $150. The data shows thus price has a utility that spans 3.86. Each utility point is thus worth $31. This value of utility is the value to use in calculations. For example in Figure 32a utility drops 0.25 when the trip duration increases from 40 to 50 minutes. This 0.25 utility is worth 0.25 x $31 = $ 7.75. This reads as follows: people in the population, or similar to them, are on average willing to pay almost $8 to travel ten minutes faster. Note: this is valid for the travel time range of 40-60 minutes. Table 20 shows more calculations on willingness to pay. The VOT is $47 per hour and the value of reducing the maximum delay is $242 per hour. Upgrades for the levels of comfort should not cost more than $8 per bracket.
Table 20 Willingness to pay

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Utility difference</th>
<th>Willingness to pay</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>3.86</td>
<td>$ 120</td>
<td></td>
</tr>
<tr>
<td>Value of Utility</td>
<td>1.00</td>
<td>$ 31</td>
<td>valid between $30-$150</td>
</tr>
<tr>
<td>Duration</td>
<td>0.50</td>
<td>$ 16</td>
<td>20 minutes</td>
</tr>
<tr>
<td>Value of time</td>
<td>1.50</td>
<td>$47 / hour</td>
<td>valid between 40-60 minutes</td>
</tr>
<tr>
<td>Maximum delay</td>
<td>1.30</td>
<td>$ 40</td>
<td>10 minutes</td>
</tr>
<tr>
<td>Value reduction maximum delay</td>
<td>7.80</td>
<td>$242 / hour</td>
<td>valid from 15 minutes upwards</td>
</tr>
<tr>
<td>Comfort</td>
<td>0.25</td>
<td>$ 8</td>
<td>ACbus upgrade to BART</td>
</tr>
<tr>
<td></td>
<td>0.25</td>
<td>$ 8</td>
<td>BART upgrade to Business class</td>
</tr>
<tr>
<td></td>
<td>0.50</td>
<td>$ 16</td>
<td>ACbus upgrade to Business class</td>
</tr>
</tbody>
</table>

7.2.3 Validation of the results

The face validity of the results shows that all attributes have the expected direction. However in Figure 32b Maximum delay, a small anomaly occurred. When increasing the maximum delay the population would appreciate it more. Since this is counter intuitive the line is assumed to be straight.

7.2.4 Forecasting the demand

Based on the utilities per attribute level in Table 19, and analogues to the determination of the willingness to pay, the total utility of the three Business Models can be determined. The elements in the Business Models are incorporated one-on-one in the estimated model, thus the utilities can immediately be copied and summed. The total utility is used to determine the choice probability based on the function in section 7.1.2:

\[ p_j = \frac{e^{V_j}}{e^{V_j} + 1} \]

Table 21 shows the calculations based on the fixed prices determined in chapter 5. The choice probability provides an approximation of the market share the different services might have when implemented. It is based on a fixed price as set in chapter 6: High-end Business $70, High-end Commute $50 and General Business $30.

Table 21 Business model utility & choice probability

<table>
<thead>
<tr>
<th>Attribute</th>
<th>High-end Business</th>
<th>Utilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trip duration</td>
<td>60 minutes</td>
<td>-0.248</td>
</tr>
<tr>
<td>Reliability</td>
<td>+5 minutes</td>
<td>0.290</td>
</tr>
<tr>
<td>Comfort</td>
<td>Business class (airplane)</td>
<td>0.250</td>
</tr>
<tr>
<td>Number of passengers</td>
<td>Private vessel / with a group</td>
<td>0.000</td>
</tr>
<tr>
<td>Ticket price</td>
<td>$70</td>
<td>0.640</td>
</tr>
<tr>
<td>Total alternative specific utility</td>
<td></td>
<td>0.932</td>
</tr>
<tr>
<td>Basic utility</td>
<td></td>
<td>-2.180</td>
</tr>
<tr>
<td>Total utility</td>
<td></td>
<td>-1.248</td>
</tr>
<tr>
<td>Choice probability</td>
<td></td>
<td>22%</td>
</tr>
</tbody>
</table>
The minus-sign in the utility does not mean there is a disutility, but is the distance to the average 50% usage point. In this case it is lower than the utility of 'no-choice', meaning less than 50% share.

This means that, at a price of $70, 22% of the market would use a High-end Business water taxi service that has a total travel time of 60 minutes, a maximum delay of 5 minutes, comfort levels comparable to the business class section of an airplane and is occupied by only one person, or one group.

The high-end Commute model would attract 13% of the market at a price of $50. This would provide a 60 minute trip as well, but with a maximum delay of 25 minutes, comfort levels comparable to BART/CalTrain/AMTRAK and the vessel would be shared with a maximum of 30 other passengers.

Clearly the General Business service would have the largest client base, up to 44%. For $30, it would again be a 60 minute trip, with a maximum delay of 15 minutes, comfort levels as on a local AC Transit bus, with a maximum of 12 passengers.

The high market share however does not necessarily mean the business model would perform best when supplying this service. Integration with the business performance is done in chapter 7.
Due to the high impact of price it is decided to make the price variable. This means that the market shares vary as well. This is represented in the continuous graph in Figure 34. In this figure Most Luxurious Service (MLS) and Least Luxurious Service (LLS) are added for reference purposes. They contain the attribute levels at the top cq. bottom of the scale.

This inevitably means that the exact definition of the Business Models as such from chapter 5 is no longer valid, since the prices set at $30, $50 and $70 are now assumed variable. The other attribute values remain the same, thus not changing the type of service. When not considering price it is no more than logical that the most luxurious services score best.

**Figure 34 Market shares at different ticket prices**

The preference for General Business is also clear from the additional question: *If there are no other ways to make your trip besides the three mentioned services. Which one would you choose to use?*. Figure 35 shows 32 respondents would prefer the General Business service over the two other ones.

**Figure 35 Which service would you choose to use - forced choice**
7.2.5 Additional findings

Extra questions in the survey provide insight in three additional subjects:

- Type of transportation
- Onboard amenities
- Propulsion system

The response to the question whether or not the type of transportation to and from the waterfront is important, was fairly average on the scale. 16 respondents ticked the middle box, usually indicating a non-preference. A surprising 11 respondents was clear in their answer that it does not matter what type it is either private limo, standard taxi or taxi van. 4 respondents might actually change their choice based on the type.

Only 1 respondent indicated that onboard amenities, ranging from deluxe catering to none, was very important to them. 9 respondents said it is not important at all. 18 respondents would probably appreciate the availability of the amenities, but wouldn’t use less of the service if it wasn’t available.

The propulsion system is a high cost investment, but is plausible to have an effect in the ‘green-minded’ area of San Francisco. Clearly 22 respondents indicated an above average importance. 17 respondents stated not important. This shows that it would have been useful to incorporate in the experiment, even more so than the number of passengers.
7.3 Results

An online stated preference survey is used to gather data for a binomial logit model to forecast the demand of future water taxi services in the San Francisco Bay Area, for business travelers.

56 useful responses out of 1,500 invitations means a response rate of 4.5%, taking into consideration 275 bounced emails. The response led to 972 observations, since 18 profiles were asked. The five attributes varied in the profiles are Trip duration, Ticket price, Maximum delay, Comfort and Number of passengers. Out of 11 estimated parameters all but Number of passengers, have at least one significant estimator, allowing for determination of utility functions for each attribute.

The question posed was based on one specific route and time, implying a (partly) congested road. The results are thus mainly valid for rush hour and rich people.

The model allows for forecasting the market shares (choice probabilities) of the three Business Models at varying price levels:

- **General Business**
  - **Trip duration**: 60 minutes (45min on-board)
  - **Maximum delay**: 15 minutes
  - **Comfort**: AC Transit local bus
  - **Number of passengers**: maximum 12
  - **Ticket price**: variable

- **High-end Commute**
  - **Trip duration**: 60 minutes (45min on-board)
  - **Maximum delay**: 25 minutes
  - **Comfort**: BART/CalTrain/AMTRAK
  - **Number of passengers**: maximum 30
  - **Ticket price**: variable

- **High-end Business**
  - **Trip duration**: 60 minutes (45min on-board)
  - **Maximum delay**: 5 minutes
  - **Comfort**: Business class (airplane)
  - **Number of passengers**: Private vessel / with a group
  - **Ticket price**: variable

![Market shares](image-url)
The model also allows for estimating:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value ($/hour)</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value of time (VOT)</td>
<td>$47</td>
<td>[valid between 40-60 minutes]</td>
</tr>
<tr>
<td>Value of reduction of maximum delay</td>
<td>$242</td>
<td>[valid between 15-25 minutes]</td>
</tr>
<tr>
<td>Comfort level upgrades</td>
<td>$8</td>
<td>[ACbus upgrade to BART or BART upgrade to Business class]</td>
</tr>
</tbody>
</table>
Step 5 - Supplying the demand

In the previous chapter the market shares have been identified from a customer point of view. These market shares are input for the financial calculation in this chapter. This allows for a choice on the most suitable concept from a company point of view, based on matching of that customer demand, with its financial viability and the practicability thereof.

Section 8.1 elaborates on the assumptions and calculations needed for determining the financial viability. The viability calculations are aimed at finding the business with a positive Return on Investment (ROI), which will be explained later, at a given maximum investment of $15 million, as determined earlier. The main elements that will be looked at are revenues, investments and operational costs in relation to the potential demand.

In Section 8.2 the preferred concept, based on customer research and highest ROI, is identified. The restraints of the design space as set in section 5.6 are already incorporated in the experiment. Thus all data used from that experiment in this chapter, should and does remain within those boundaries.

The business proposition analysis is also based on practicability, since a solid business case is more than only profits and ROIs. For example, it is also about flexibility and strategies in market penetration. The final step therefore is to select the best price structure to guarantee business viability.

8.1 Methodology for financial viability calculations

The methodology for the calculation of viability is based on a causal framework combined with a number of scenarios. First some initial assumptions are made.

8.1.1 Initial assumptions

Route

The previous chapter resulted in a graph with market shares at various ticket prices. A market share is a percentage of a specific market size. This size needs to be identified. For this research the choice is made to start with one route: between Redwood City port in San Mateo county - San Francisco Ferry Building.

This is done for a multitude reasons. The choice to stick to one route is made since it is the aim to find a viable service which does not exist yet, indicating more focus on the fundamentals of the service instead of logistical optimization. Secondly, time constraints simply do not allow for optimization of the services for all six service zones as identified in chapter 6.

The choice for this specific route is based on the urbanization levels, population concentrations and hierarchy of activity, as proposed in the area-oriented design approach by Egeter (2002). Also most is known about this segment due to the survey structure. Next to that it is a route with very high congestion as shown in Table 22. The last columns ‘hours’ also is the input for the number of hours of operations. The overall top 10 of congestion in 2007 is shown in Appendix E.

8 The pictures in the stepwise index suggests that a supply- and demand curve can be constructed. The underlying principles however prohibit this. It is only possible to construct the supply curve “if there are many sellers, each of whom supplies a quantity that is relatively small to the market”. Png, I. (1998). Managerial Economics, Blackwell publishing, Oxford. For now the water taxi does not exist and in case the business would start, there would not yet be other suppliers of the same product.
Table 22 Congestion on route 101

<table>
<thead>
<tr>
<th>rank</th>
<th>route</th>
<th>direction</th>
<th>Living in</th>
<th>Working in</th>
<th>daily delay (vehicle hours)</th>
<th>congestion duration hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>101</td>
<td>S</td>
<td>SF</td>
<td>SM</td>
<td>1,210</td>
<td>8:10-10:35</td>
</tr>
<tr>
<td>19</td>
<td>101</td>
<td>N</td>
<td>SF</td>
<td>SM</td>
<td>2,440</td>
<td>16:35-19:25</td>
</tr>
<tr>
<td>28</td>
<td>101</td>
<td>N</td>
<td>SM</td>
<td>SF</td>
<td>1,580</td>
<td>6:45-9:25</td>
</tr>
<tr>
<td>33</td>
<td>101</td>
<td>S</td>
<td>SM</td>
<td>SF</td>
<td>1,380</td>
<td>16:05-19:40</td>
</tr>
<tr>
<td></td>
<td>total</td>
<td></td>
<td></td>
<td></td>
<td>6,610</td>
<td>average 2.9</td>
</tr>
</tbody>
</table>

Choosing the San Mateo-San Francisco route has one major disadvantage. The General Business service uses vessels, comparable to water taxi Rotterdam, that are more suited to service trips of 10-20 minutes. This route would take approximately 45 minutes. On that basis the decision could be made to eliminate General Business from further analysis.

It is chosen not to do so, for the following reasons. First, it might be possible to make one intermediate stop, cutting the travel time in two. This is not analyzed further, but is a reason for inclusion. And secondly, if the service would appear to outperform the two other business models, it should definitely have follow up research on shorter routes. This comparison or decision could not be made without inclusion of the service in the further analysis.

Market size

Specific data on non-home based business trips (eg. office to meeting and back) is not available. The next best thing is to use the commute data to estimate the movements along the proposed route. The total amount of daily commuters from San Mateo county (home) to San Francisco county (work) is: 112,700 (MTC 2007).

This amount cannot be used in its entirety. Only a small market segment fits the profile of the population targeted in the survey: over 60% has an income of >$100,000. Based on the study Market segmentation for Ridership Forecasting (Bradley 2002), the market size of the population shall be approximated by using the highest tier of household income (>=$150,000) being 18.5% of the daily commuter market. Please note: the $100k-level is an individual income level and the $150k-level is the household income.

This means the overall market size is reduced to 18.5% x 112,700 = 20,800 commuters from San Mateo (SM) to San Francisco (SF) county and back each day.

Analogues to that the maximum market size for the reversed direction of commuters, those living in San Francisco and working south in San Mateo (SF-SM), can be estimated at 18.5% x 55,600 = 10,300 roundtrips as shown by the blue bar on the left in Figure 36.

This indicates a total potential market size of 31,100 passengers making roundtrips.

As can be seen clearly already is that there is an imbalance in the flows in number of passengers between the two locations, referred to as the ‘backhaul problem’. According to Demirel, Oommeren et al. (2009) the degree of imbalance at the level of the individual carrier is difficult to observe. In this case there is the luxury of being the only provider, at least for now, servicing the aggregated flows, meaning that the exact degree of imbalance is known.

For this reason the two market sizes will first be analyzed separately to see the impact of changing service concepts for each direction. This way a clear decision can be made.

It also allows for analysis of servicing the unprofitable directions with already existing lines in profitable situations, increasing the revenues without increasing the costs.
It is highly unlikely that all people in the newly estimated market size will be interested in the service. The survey response (4.5%) will be taken as an absolute low point in population interest (pessimistic). This would indicate that all the people that did not fill out the survey (95.5%) will never consider using any of the water taxi services. This would lead to a smallest number of potential customers for SF-SM of 10,300 x 4.5% = 460 and for SM-SF: 20,800 x 4.5% = 940.

It is hard to determine any other level of interest in the service besides the one found in the data from the experiment. There is no real basis for extrapolation. However it is likely that there is a larger group that might be interested than the 4.5%, for two main reasons. First, the group of respondents was described earlier as a very busy group with an overload in requests for attention. A part of this group might simply not have had time to fill out the survey, but is interested in using the water taxi services. Secondly, it was only one specific group that could be reached. There are more business people in the region in other lines of work but in the same high wage levels. For these reasons a slight extrapolation is made by doubling the 4.5% response rate to an overall level of interest in the service of 9% of the wealthy market size. This optimistic scenario has between 930 – 1,870 potential customers. See also Figure 36.

An intermediate scenario will be set in between at 6%. This is also currently the percentage of all commuters that uses public transit on the route SF-SM. This leads to a number of potential customers in the a intermediate scenario (620/1,250 potential customers).

When multiplying the three market sizes in the scenarios with the market shares from the previous chapter, the expected number of passengers is found.

### 8.1.2 Calculating viability

For each Business model, High-end Business (HB), High-end Commute (HC) and General Business (GB), the number of passengers, profit schemes, investments and ROI need to be calculated for the three scenarios on the two routes: San Mateo / San Francisco and vice versa.
The main steps in the viability calculations per Business Model are: estimate the number of passengers varied over price levels => calculate the needed number of vessels => calculate the accompanying costs, revenues and investment => calculate the ROI.

**Number of passengers**

The number of passengers is simply calculated by multiplying expected market shares with the potential market sizes. The market share however varies due to the different attributes based on the utility scales found from the choice model.

Increasing the number of customers by decreasing the ticket price, will lead to increased investments, since more vessels are needed, also operational costs will rise. Balancing these to find the ideal price and service levels is the challenge. The impact of price difference is largest and also has a large impact on the business. This will be a button to play with: increasing the price will decrease the number of customers, but perhaps the overall revenues (Pax * Price) might rise.

To be able to present these numbers they will be converted to continuous graphs, which also allows for determining the optimum.

Below in Table 23 the overview of the different scenarios and calculated alternatives is given. For each service the passenger load for three routes is calculated:

- Only servicing people living in San Francisco (SF-SM)
- Only servicing people living in San Mateo (SM-SF)
- Servicing both at the same time (Two way)

This also varies over the different market penetration scenarios (pessimistic, intermediate, optimistic) and over ticket price ($30-$150).

**Table 23 Scenario overview**

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>High-end Business</th>
<th>Direction of service</th>
<th>SF-SM</th>
<th>SM-SF</th>
<th>Two-way</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>ticket price</td>
<td>ticket price</td>
<td>ticket price</td>
</tr>
<tr>
<td></td>
<td>pessimistic</td>
<td>pessimistic</td>
<td>pessimistic</td>
<td>pessimistic</td>
<td>pessimistic</td>
</tr>
<tr>
<td></td>
<td>intermediate</td>
<td>intermediate</td>
<td>intermediate</td>
<td>intermediate</td>
<td>intermediate</td>
</tr>
<tr>
<td></td>
<td>optimistic</td>
<td>optimistic</td>
<td>optimistic</td>
<td>optimistic</td>
<td>optimistic</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>High-end Commute</th>
<th>Direction of service</th>
<th>SF-SM</th>
<th>SM-SF</th>
<th>Two-way</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ticket price</td>
<td>ticket price</td>
<td>ticket price</td>
<td></td>
</tr>
<tr>
<td>pessimistic</td>
<td>pessimistic</td>
<td>pessimistic</td>
<td>pessimistic</td>
<td></td>
</tr>
<tr>
<td>intermediate</td>
<td>intermediate</td>
<td>intermediate</td>
<td>intermediate</td>
<td></td>
</tr>
<tr>
<td>optimistic</td>
<td>optimistic</td>
<td>optimistic</td>
<td>optimistic</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>General Business</th>
<th>Direction of service</th>
<th>SF-SM</th>
<th>SM-SF</th>
<th>Two-way</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ticket price</td>
<td>ticket price</td>
<td>ticket price</td>
<td></td>
</tr>
<tr>
<td>pessimistic</td>
<td>pessimistic</td>
<td>pessimistic</td>
<td>pessimistic</td>
<td></td>
</tr>
<tr>
<td>intermediate</td>
<td>realistic</td>
<td>intermediate</td>
<td>intermediate</td>
<td></td>
</tr>
<tr>
<td>optimistic</td>
<td>optimistic</td>
<td>optimistic</td>
<td>optimistic</td>
<td></td>
</tr>
</tbody>
</table>
**Number of vessels**

Travelers will eventually need to return to their original location and thus are assumed to travel both in the morning and evening, meaning twice per day. The assumption is made, ignoring the peak loads, that morning demand is spread over 3 hrs, as found on average for this route in Table 22 (MTC 2007; MTC 2008). The passenger load to be transported becomes: pax/3 per hour.

Per vessel the occupancy rate determines the approximate number of seats filled when it leaves, not assuming set departure times or "full" moments. This determines the number of vessels needed. This can be seen as contradictory to the more standard approach to first choose the number of vessels (based on availability or investment amounts) and then see how many seats need to be filled to have a viable business. However the reason to set the occupancy rate is to see whether any type of service with a non-fixed number of vessels has any chance on viability. This might lie outside the normal scope of fleet sizes. The occupancy rate is chosen to be the lowest that has often shown to be needed, according to J. Tuk, to eventually have a healthy business case: 60% occupancy rate. For the case of high-end Business the occupancy level is set at 4% on the 12 passenger vessel to simulate private usage.

Combining this with the maximum number of passengers per vessel the number of departures can be determined to transport all passengers: pax per hr / (occupancy rate * max pax per vessel) = # departures needed.

Since vessels take 1.5 hours for a roundtrip, this has to be multiplied 1.5 and finally back-up vessel need to be incorporated. Often one spare vessel is sufficient (J.Tuk), for this variable calculation structure without knowledge of the final fleet size however 10% is added and rounded upwards. This means that from 1-10 vessels still only 1 spare is needed, from 11-20 2 spare etc.

In all calculation steps, all numbers are rounded to whole passengers and vessels, leading to the final calculation:

\[
\text{#vessels} = \frac{\text{pax per hr}}{\text{occupancy rate} \times \text{max pax per vessel}} \times 1.5 \times 110\%
\]

**Operational costs**

Accompanying costs are a long list. As referred to before, in Appendix E the cost structure is presented. It is proposed by Damen shipyards and verified by Johan Tuk CFO Doeksen Transport Groep. The sheet has been set up to change per vessel by hours of operation, number of crew and financial & consumption costs as a % of vessel price etc.

**Access and egress**

Also access and egress costs are added. Each passenger receives a trip to and from the vessel. Cab prices per leg are estimated at $3.5 or $10 and are included in the ticket price.

**Return on Investment**

Return on investment (ROI) according to the NY Times Financial Glossary (2009), generally is the “book income as a proportion of net book value. A company's book value is its total assets minus intangible assets and liabilities, such as debt.”

Forbes’ Investopedia (2009) describes it as:

\[
\text{ROI} = \left( \frac{\text{Gain from investment} - \text{Cost of investment}}{\text{Cost of investment}} \right) \times 100\%
\]

It also mentions that “the calculation for return on investment and, therefore the definition, can be modified to suit the situation -it all depends on what you include as returns and costs. The definition of the term in the broadest sense just attempts to measure the profitability of an investment and, as such, there is no one "right" calculation.”

In both cases it is most accurate to work with present values, since a dollar now is worth more than a dollar later, due to inflation and the time value of money. Present values can be calculated by dividing future cash flows by \(1+\text{discount rate } R\) for each year \(Y\): Present value = future cash / \((1+R)^Y\). (Alemi 2008)
Since all capital costs, revenues and operational costs are already calculated in the profits and the fact that the investments are done only at $t=0$, the annual profit is the only value to be discounted. The discount rate $R$ of 15%, is based on the required returns on the privately invested capital, assumed to be $1/3$ of total. Both these numbers are relatively standard according to J. Tuk.

The number of years $Y$ is based on the depreciation period for the vessels, which is 10 years (proposed by R. Luth and confirmed by J. Tuk). For this particular case the ROI will be calculated as follows:

$$ROI = \frac{\sum_{years} \frac{\text{Annual profit}}{(1 + R)^{Y}} - \text{Total initial investment}}{\text{Total initial investment}} \times 100\%$$

Only services with positive ROIs should be considered as viable alternatives.

**Values used per Business Model**

Below in Table 24 all items in the Calculation Framework (Figure 37) which are labeled Determine or Adjust are resented.

**Table 24 Items in calculation per Business Model**

<table>
<thead>
<tr>
<th>Business model</th>
<th>High-end Business</th>
<th>General Business</th>
<th>High-end Commute</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adjust</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>see Calculation framework</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ticket price (one way)</td>
<td>$30 - $150</td>
<td>$30 - $150</td>
<td>$30 - $150</td>
</tr>
<tr>
<td>Number of crew</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Vessel type</td>
<td>ShuttleCat 120</td>
<td>TRANZ (Rotterdam)</td>
<td>ShuttleCat 120</td>
</tr>
<tr>
<td>Capacity utilization</td>
<td>4%</td>
<td>60%</td>
<td>60%</td>
</tr>
<tr>
<td>Number of trips per passenger</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Hours of operation</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Days of operation</td>
<td>250</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>Privately invested %</td>
<td>33%</td>
<td>33%</td>
<td>33%</td>
</tr>
<tr>
<td><strong>Determine</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>see Calculation framework</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comfort level comparable to</td>
<td>Business class (airplane)</td>
<td>AC Transit local bus</td>
<td>BART/CalTrain/AMTRAK</td>
</tr>
<tr>
<td>Maximum delay</td>
<td>5 minutes</td>
<td>15 minutes</td>
<td>25 minutes</td>
</tr>
<tr>
<td>Travel time</td>
<td>45 water / 15 car</td>
<td>45 water / 15 car</td>
<td>45 water / 15 car</td>
</tr>
<tr>
<td>Vessel price</td>
<td>$700,000</td>
<td>$280,000</td>
<td>$700,000</td>
</tr>
<tr>
<td>Vessel capacity</td>
<td>30</td>
<td>12</td>
<td>30</td>
</tr>
<tr>
<td>Cab fares (one way)</td>
<td>$10</td>
<td>$3.5</td>
<td>$3.5</td>
</tr>
<tr>
<td>Full market size (SF-SM)</td>
<td>55,600</td>
<td>55,600</td>
<td>55,600</td>
</tr>
<tr>
<td>Full market size (SM-SF)</td>
<td>112,700</td>
<td>112,700</td>
<td>112,700</td>
</tr>
<tr>
<td>Wealthy %</td>
<td>18.5%</td>
<td>18.5%</td>
<td>18.5%</td>
</tr>
<tr>
<td>Optimistic %</td>
<td>9%</td>
<td>9%</td>
<td>9%</td>
</tr>
<tr>
<td>Intermediate %</td>
<td>6%</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>Pessimistic %</td>
<td>4.5%</td>
<td>4.5%</td>
<td>4.5%</td>
</tr>
</tbody>
</table>
Overview

Figure 36 shows the entire calculation framework. From left to right the calculation leads to the overall Return on Investment. The colors indicate whether the values are determined beforehand, if they are adjusted/varied within the calculations, if they are predicted results from or if they are calculation results.

All estimates are based on roundtrips, so total costs include 4 cab rides and revenues twice the ticket payment. All calculations are to remain within the ranges attributes of the alternatives presented to the participants of the Stated Choice experiment.

Figure 37 Calculation framework
8.2 Results
The calculation framework in combination with the scenarios resulted in data which can be summarized in graphs. This allows for determining the financially viable services based on positive ROIs and selection based on practicability. The preferred service type will be elaborated on for ticket pricing structure.

8.2.1 Selecting viable service types
The viable service types should have positive returns on the investment made. The scenario overview in Table 23 is completed by filling in the price ranges for which all cells have positive ROIs, as presented in Table 25. This table in combination with created from the same underlying dataset will be the basis for the selection of the viable service types. Red (minus) cells indicates that there are no price-level that lead to a positive ROI. The other cells indicate the price (-range) that leads to a positive ROI.

For full insight in the ROI per scenario, see Figure 40 and Figure 41 below for High-end Commute and Appendix L and Appendix M for High-end Business and General Business.

Table 25 Ticket prices with positive ROI indicated for all scenarios

<table>
<thead>
<tr>
<th>High-end Business</th>
<th>Direction of service</th>
<th>Ticket price at which ROI is positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-SM</td>
<td></td>
<td>High-end Business</td>
</tr>
<tr>
<td>pessimistic</td>
<td>ticket price</td>
<td>SF-SM</td>
</tr>
<tr>
<td>intermediate</td>
<td>-</td>
<td>SM-SF</td>
</tr>
<tr>
<td>optimistic</td>
<td>-</td>
<td>Two-way</td>
</tr>
<tr>
<td>pessimistic</td>
<td>-</td>
<td>SF-SM</td>
</tr>
<tr>
<td>intermediate</td>
<td>-</td>
<td>SM-SF</td>
</tr>
<tr>
<td>optimistic</td>
<td>-</td>
<td>Two-way</td>
</tr>
<tr>
<td>pessimistic</td>
<td>-</td>
<td>SF-SM</td>
</tr>
<tr>
<td>intermediate</td>
<td>-</td>
<td>SM-SF</td>
</tr>
<tr>
<td>optimistic</td>
<td>-</td>
<td>Two-way</td>
</tr>
<tr>
<td>pessimistic</td>
<td>-</td>
<td>SF-SM</td>
</tr>
<tr>
<td>intermediate</td>
<td>-</td>
<td>SM-SF</td>
</tr>
<tr>
<td>optimistic</td>
<td>-</td>
<td>Two-way</td>
</tr>
<tr>
<td>pessimistic</td>
<td>-</td>
<td>SF-SM</td>
</tr>
<tr>
<td>intermediate</td>
<td>-</td>
<td>SM-SF</td>
</tr>
<tr>
<td>optimistic</td>
<td>-</td>
<td>Two-way</td>
</tr>
<tr>
<td>pessimistic</td>
<td>-</td>
<td>SF-SM</td>
</tr>
<tr>
<td>intermediate</td>
<td>-</td>
<td>SM-SF</td>
</tr>
<tr>
<td>optimistic</td>
<td>-</td>
<td>Two-way</td>
</tr>
<tr>
<td>pessimistic</td>
<td>-</td>
<td>SF-SM</td>
</tr>
<tr>
<td>intermediate</td>
<td>-</td>
<td>SM-SF</td>
</tr>
<tr>
<td>optimistic</td>
<td>-</td>
<td>Two-way</td>
</tr>
</tbody>
</table>

High-end Business
The High-end Business service, which allows for private transportation in the large comfortable water taxis and on-demand departures has shown to be in no way financially self-sustaining. It’s market shares are based on the following attribute levels, and varied on ticket price:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trip duration</td>
<td>60 minutes</td>
</tr>
<tr>
<td>Maximum delay</td>
<td>5 minutes</td>
</tr>
<tr>
<td>Comfort</td>
<td>Business class (airplane)</td>
</tr>
<tr>
<td>Number of passengers</td>
<td>Private vessel / with a group</td>
</tr>
</tbody>
</table>

Figure 38, which is an excerpt from Appendix L, shows that for none of the scenarios nor pricing schemes any profit can be made. This is also the case for the other route and the two-way strategy.
Table 25 confirms this by showing no positive ROI for any of the scenarios.

When considering the maximum investment amount of $15 million, the ticket price range is limited to $140-$150. Lowering the price would create a demand which would need too many vessels, thus passing the limit of $15 million. For example, when servicing 958 individual passengers, 528 vessels are needed, leading to an investment of $462 million.

The High-end Business model was the initial seed for the idea of water taxis for the high-end market, but even for the optimum price it is just too unprofitable to pursue as the basis for a viable business. The High-end Business model is hereby discarded as a stand-alone option. However, since the calculations are made based on six hours of operations during rush hour and all costs are calculated for a full day, there is time left. When considering only the variable operational costs, approximately $200 for fuel and crew for one roundtrip of 1.5 hours, there is a small window of opportunity. If the business people are willing to pay even more than asked in the experiment, this can generate added revenues.

Two responses to the survey shows the potential for this extra service:

- “There are some meetings that I would pay a premium for; some that I would prefer a private setting so a group could discuss on the way up and back; etc.”
- “One real opportunity is the after-hours market. Many people attend dinners or functions; for both business and pleasure reason in and around the Bay. Examples certainly include San Francisco; but also such trips as Tiburon to Sausalito. Drinking and driving is very important and our current choice is take the car but don’t drink alcohol or take a taxi ($50-100) so that drinking alcohol is possible. The public ferries end at 7-7:30pm and these routes don’t include the likes of Tiburon to Sausalito. I believe that many people would pay $50-100 for a ‘water taxi’ for this.”

Trips between San Francisco and Tiburon would take approximately 20 minutes, which potentially costs $45, based on only the variable costs. The prices mentioned by the respondent would allow for a profit of $5-$55 per trip, not counting the backhaul.

Another proposed option:

- “I would also like to point out that both the current SF Football stadium and the Baseball stadium are very close to the Bay…the baseball stadium is right on the bay. That might be an opportunity for off peak revenues when there is a game.”

---

9 Please note that the investments portrayed in the graphs are 1/3 of the total investment needed. 2/3 has been modeled to be financed externally at an interest rate of 5%.
**General Business**

The General Business service, which allows for group transportation in the small 12 passenger water taxis with regular departures has shown to have the potential to be very well financially self-sustaining. Its market shares are based on the following attribute levels, and varied on ticket price:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trip duration</td>
<td>60 minutes</td>
</tr>
<tr>
<td>Maximum delay</td>
<td>15 minutes</td>
</tr>
<tr>
<td>Comfort</td>
<td>AC Transit local bus</td>
</tr>
<tr>
<td>Number of passengers</td>
<td>maximum 12</td>
</tr>
</tbody>
</table>

General Business (GB) shows in Figure 39, profit from ticket prices of $50 up to $140, even for the most pessimistic scenarios. The rest of the graphs can be found in Appendix M. Annual profits of over $1 million are not an exception. Private investments take no more than $8 million for the largest demand of up to 900 passengers per direction.

![Figure 39 General Business profit scheme (SM-SF)](image)

Table 25 shows positive ROIs for all but the pessimistic scenario on the lightest route. This sounds like the golden opportunity. And it might be, but not for this specific route on a practical basis.

As mentioned in section 8.1.1, all Business Models are compared along the same route for comparison purposes. This route takes approximately 45 minutes by vessel. The comfort level of the vessel used for this service is however not ideally suited for trips of over 10-20 minutes. Therefore the General Business service is hereby discarded as an option for this particular analysis on this particular route.

A good option would be to further investigate using these vessels as short run vehicles, to service within the six service zones (see chapter 6). The decreased trip duration, based on the utility graphs, would potentially increase the demand. This could compensate for the expected decrease in revenues, since looking at the graphs the lower price range $30-$40 will not lead to profit. This larger market share combined with a lower number of vessels needed, due to short roundtrip times, might still be viable. The data for this alternate usage has not been calculated.
**High-end Commute**

The High-end Commute service, which allows for transportation in the large comfortable water taxis and scheduled departures appears to have the potential to be financially self-sustaining on a selection of pricing schemes in the more optimistic scenarios. It’s market shares are based on the following attribute levels, and varied on ticket price:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trip duration</td>
<td>60 minutes</td>
</tr>
<tr>
<td>Maximum delay</td>
<td>25 minutes</td>
</tr>
<tr>
<td>Comfort</td>
<td>BART/CalTrain/AMTRAK</td>
</tr>
<tr>
<td>Number of passengers</td>
<td>maximum 30</td>
</tr>
</tbody>
</table>

The High-end Commute (HC) shows overall losses, when only servicing those living in San Francisco to go southwards to San Mateo (Figure 40c). The route the other way around (SM-SF) shows moderate annual profits, between $50,000-$300,000 for the realistic scenario (Figure 41c) and up to $1.1 million for the optimistic scenario in limited price ranges. The 33% of the total investments are moderate between $875,000-$4.1 million (Figure 41d). The pessimistic scenario shows no profits, but this is only a difference of around $300,000, which is as much as the annual marketing costs.

These profits are discounted over time leading to a positive ROI in the optimistic scenario only at the $80 price level, see also Table 25. The picture changes quite drastically when remembering the remark earlier: this is all assuming an empty return trip. The revenues, between $200,000 - $3 million, portrayed on the left-hand side (Figure 40c) can be added to the SM-SF case, since there are plenty vessels which are already on that route (Figure 41b), to take along the passengers from SF (Figure 40a). When servicing both direction simultaneously, Table 25 shows a multitude of ticket price levels with a positive ROI.

This deserves further elaboration. A selection is hereby made to use the High-end Commute service in the price range of $50-$110, which is the positive profit section in the graph Figure 41c.
8.2.2 Elaborating High-end Commute

The choice for the High-end Commute should be solidified a step further. An annual profit does not immediately mean that the investments will have an overall positive return. Plotting the initial investment and the annual profits over a period of time, should show a break-even point at which all investments are earned back and actual profit will be made. Even when this is the case an overall positive ROI will not always be reached due to the Present Value calculations.

The range of ticket prices is limited to $50-$110 in the previous section. In all graphs the low, middle and high ticket prices ($50, $80, $110) for that range are shown as a reference. Next to that all ticket prices are shown that have a break-even point within ten years, which is the write-off period for the vessels.

Since the southbound oriented route (SF-SM) showed no positive ROIs in Table 25, this route will be discarded as an individual option to service. For the two other directions, SM-SF and two-way, Figure 42 on the next page, shows the breakeven analysis and the ticket prices that reach positive ROIs.

Servicing San Mateo county inhabitants

As could be expected from the lack of positive ROIs (Table 25) for the SM-SF route in the pessimistic and intermediate scenario, their graphs (left-hand side of Figure 42) show no break-even point.

In the optimistic scenario, in which 9% of the wealthy portion of the inhabitants of San Mateo county is interested in the service, break-even points are between 3-9 years for several prices. However as seen before only $80 shows a positive ROI. The proximity of the other break-even points indicates that, at other discount rates or fixed cost structures, those ticket prices might also lead to positive ROIs.

When selecting the $80 ticket price an overall profit of $7million in ten years would be achieved, with the break-even point at 3 years. Selecting other prices would lead to lower profits or even losses of up to $14million.

Servicing both San Mateo & San Francisco county inhabitants

Only servicing SF inhabitants has shown to provide no basis for a financially viable company. Only servicing SM inhabitants would create a viable business case only in the most positive scenario. This is both based on an imbalanced equilibrium (Demirel et al. 2009) in which no passengers are transported from the low demand location and the round trip transport costs are fully borne by the customers in the high demand location.

When deciding to service to the demand from the inhabitants of both San Mateo (SM-SF) and San Francisco (SF-SM) county, the assumption of the empty return trip is dropped, making both locations high-demand. In this case only the round trip transport costs of the heaviest direction need to be calculated and are borne by the customers in both locations. By choosing to do so the backhaul problem is eliminated.

As was already indicated in Table 25 this leads to positive ROIs on a large range of ticket prices. The right-hand side of Figure 42 shows even for the pessimistic scenario an overall profit between $3million-$6million at $60-$80 ticket prizes. Going down the list of graphs the profits go up to $25million for ticket prices between $60-$80, which is over $2.8million profit annually on average. These prices however do not necessarily have the highest ROI.

The graphs are summarized in Table 26 below, showing a decent break-even point when utilizing both direction, between 1-5 years. From a practical point of view there is no reason to not service both directions either. However in the optimistic scenario it would even enough to only focus on the largest direction SM-SF.
Table 26 Break-even points

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Direction of service</th>
<th>Break-even point (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SanMateo to SanFrancisco</td>
<td>Two ways</td>
</tr>
<tr>
<td>Pessimistic</td>
<td>x</td>
<td>5-10</td>
</tr>
<tr>
<td>Intermediate</td>
<td>x</td>
<td>2-5</td>
</tr>
<tr>
<td>Optimistic</td>
<td></td>
<td>3-9</td>
</tr>
</tbody>
</table>

Expected profit over 10 years: -$14million / $7million, -$6million / $25million

Figure 42 Break-even ticket prices & positive ROIs
8.2.3 Selecting best price structure

The graphs in Figure 42 are also the tool to use to make the final choice on pricing. In the optimistic cases $80 ticket prices delivers the highest ROI. When having less optimistic scenarios i.e. less customers, lower prices seem to perform better: intermediate $70 and for pessimistic $60. Three guidelines will lead to the choice of the best price structure:

- Choose the price that generates positive ROIs in all scenarios. This allows for a shift in scenarios, without suddenly creating losses.
- Choose the price that is high at the start. This creates an option to downgrade the prices in a later stage, when market sizes lag. Changing the pricing scheme the other way around is very hard to do.
- Choose the price that can potentially outperform the others in the best scenarios. Since one should always dream.

As can be seen below in Table 27, the top three in ticket prices that generates the most positive ROI, $80 is present in all scenarios.

Table 27 Top 3 ROI generating ticket prices

<table>
<thead>
<tr>
<th>Rank</th>
<th>SM-SF optimistic</th>
<th>SM-SF pessimistic</th>
<th>SM-SF intermediate</th>
<th>two-way optimistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$80</td>
<td>$60</td>
<td>$70</td>
<td>$80</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>$80</td>
<td>$90</td>
<td>$100</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
<td>$80</td>
<td>$90</td>
</tr>
</tbody>
</table>

Table 27 also provides insight for the second bullet. Starting with $80, thus hoping for the optimistic scenario to arise would provide the #1 ROI. When market interest lags, the option remains to take the #1 price for the intermediate scenario ($70). And even dropping down to $60 dollars, if after many efforts only the pessimistic scenario seems to take shape.

The final bullet indicates the search for the highest ROI. Figure 42 shows that in the optimistic scenario, serving both customer groups, at $80 the highest achievable ROI is 277%.

Thus for three reasons $80 ticket prices shows to be the best way to go.

A ticket price of $80 results overall in a break-even in 1-5 years, as shown in Figure 43 Break-even analysis.
8.3 Results

The market shares calculations for the three service concepts can be used to make estimates on the number of passengers per day, the amount of vessels needed and the accompanying costs and revenues.

To increase the market insights these calculations are made for 3 scenarios: optimistic, intermediate and pessimistic. These scenarios indicate what percentage of the wealthy daily commuters (18.5%) might be interested in the service, i.e. the initial potential market size.

Figure 44 from section 8.2.1 and Figure 45 from section 8.2.3, below show the impact of those scenarios on the financial viability based on the market shares.

The viability calculations are aimed at finding the business with the largest Return on Investment (ROI), at an investment of no more than $15 million. The main financial elements that are used in the calculations are revenues, investments and operational costs in relation to the potential demand. For more detail see the calculation framework in Figure 37 on page 94.

The route San Mateo – San Francisco appears to have the potential to be serviced by water taxis on a financially self-sustaining basis. Two Business Models show a profitable business case, see section 8.2.1:

- General Business (GB), for all scenarios except for the SF-SM direction in the pessimistic case.
- High-end Commute (HC), for the optimistic scenario on the SM-SF direction and all two-way scenarios.

The selection of the preferred service concept is also based on practicability, since a solid business case is more than only profits and ROIs. Since GB makes use of vessels better suited for trips up to ~10-20 minutes, for this specific route HC is recommended.

The final step is to select the best price structure with the most flexibility to improve business viability. Utility calculations and thus market shares are based on the following attribute levels:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trip duration</td>
<td>60 minutes (45 min on-board)</td>
</tr>
<tr>
<td>Maximum delay</td>
<td>25 minutes</td>
</tr>
<tr>
<td>Comfort</td>
<td>BART/CalTrain/AMTRAK</td>
</tr>
<tr>
<td>Number of passengers</td>
<td>maximum 30</td>
</tr>
<tr>
<td>Ticket price</td>
<td>variable</td>
</tr>
</tbody>
</table>

Based on the ROI, needed initial investments and a high-end sales strategy the one-way ticket price of $80 is chosen. This daily (250 workdays) leads to approximately 49-97 round-trip passengers originating from San Mateo county and 24-48 round-trip passengers originating from San Francisco, which are transported in both the three morning and evening rush hours. This leads to annual revenues between $2.9 million-$5.8 million.
This sums up to a maximum total initial investment of $3.5 million with annual operational costs between $1.7 million-$2.2 million, excluding access & egress costs. The ten year total profit estimation, including access & egress costs, when serving both customer groups in San Francisco and San Mateo, varies between $4 million in the pessimistic scenario, up to $25 million in the optimistic scenario. This leads to an ROI between 22% - 277%, based on a 15% discount rate on ten years.

A ticket price of $80 results overall in a break-even in 1-5 years, as shown below.
Final business model

The High-end Commute business model is designed through approaching the high standards of the High-end Business model, but making it accessible to a larger audience. The customer has access to a service that has a maximum wait time of 25 minutes.

The vessel is a stable catamaran with 30 seats. It can be partially propelled by electricity which means it is clean, silent and fast. The speed of 30knots allows for a trip from Redwood City port to the San Francisco Ferry Building in 45 minutes (excl. access egress ~15min.).

The on-board bar provides the customer with a small selection of snacks and drinks, always fresh and of high quality. The relation towards the customer is low touch but marketing is personal.

The final version of the business model has a ticket price of $80. This pays for a one-way trip including the pick-up at the office and drop-off at the desired doorstep with group transportation.
Phase 4
Wrap-up
9 Conclusion

The main goal of this pre-feasibility study is to:

*Advise a start-up company, based on the business potential, whether or not it should pursue performing a full feasibility study on high-end water taxi services for business travelers in the San Francisco Bay Area.*

Triggered in 2008 by personal observations of parking hassles, congestion problems, a focus on the environment and the wish of San Francisco to make better use of their unique waterfront, it seems as though there is indeed potential for water taxis. Encouraged by a speech of Ron Cowan\(^{10}\) in which he expressed his dream of water taxi cabs criss-crossing the bay, these claims and its accompanying uncertainties warrants in-depth qualitative research.

The choice is made the focus on business travelers, since they are willing to pay more for higher quality travel. This is necessary considering the fact that the current water transportation in the area is highly subsidized.

The specific business opportunity studied in this thesis concerns the following new service:

**Water taxis**

| On-demand, long-distance (30-50km), high-speed (>30kts), sustainably powered (solar/electricity/hydrogen), relatively small water taxis; for business travelers in need of travelling from the South of the Bay to San Francisco and back; combined with drop off and pick-up at the desired meeting point. |

The objectives of this project, as set forth in section 1.3, are:

1. Design several service concepts for
   - water transportation
   - in the San Francisco Bay Area
   - for business travelers.

2. Choose the most suitable concept from a company point of view, based on matching of
   - customer demand,
   - positive financial viability, and
   - practicability.

To reach the two main objectives the research is performed along four phases as elaborated on in section 1.5. Phase 1 (Research approach) results in the selection of the Business Model Canvas by Osterwalder (2009) as a tool to represent the service concepts and selection of the Business Model Innovation Cycle by Osterwalder (2006). Both combined, form the basis for the methodology for the Design and Choice phases as elaborated on in chapter 3.

The results of phase 2 (Design) and phase 3 (Choice) correspond to the two objectives as stated above. This chapter (Conclusions), along with the further recommendations and reflection, is part of the fourth and last phase (Wrap-up).

First both objectives will be elaborated on in section 9.1. Based on that, the main goal is pursued by stating an advice in section 9.2.

\(^{10}\) Ron Cowan is a prominent local Alameda developer who received a lifetime achievement award at the Bay Area Council annual meeting (April 2008). At the event, he was sharing this dream with the audience of 1,500 business people.
9.1 Objectives

<table>
<thead>
<tr>
<th>Objective 1</th>
<th>Accompanying sub-goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design several service concepts for water transportation in the San Francisco Bay Area for business travelers.</td>
<td>Determine the boundaries of the (technical) design space for water transportation in the SFBA, in terms of:</td>
</tr>
<tr>
<td>- tri duration</td>
<td>- trip duration</td>
</tr>
<tr>
<td>- comfort and service levels</td>
<td>- comfort and service levels</td>
</tr>
<tr>
<td>- sustainably powered or not</td>
<td>- sustainably powered or not</td>
</tr>
<tr>
<td>- boarding points</td>
<td>- boarding points</td>
</tr>
<tr>
<td>- access &amp; egress means</td>
<td>- access &amp; egress means</td>
</tr>
<tr>
<td>- minimum and maximum ticket prices</td>
<td>- minimum and maximum ticket prices</td>
</tr>
<tr>
<td>- maximum initial investments.</td>
<td>- maximum initial investments.</td>
</tr>
</tbody>
</table>

Objective 1 is completed in phase 2: Design. The three steps within phase 2 are:
1. Building the team
2. Framing the design space
3. Design Business Models

The next page completes objective 1. It shows the visual representations of the value proposition within the three service concepts of water transportation for business travelers in the San Francisco Bay Area (Figure 47- Figure 49).

Within the predetermined set of limitations of the design space the combination of the different levels of the attributes within the nine building blocks (section 5.6), results in the three shown unique Business Models from sections 6.1 - 0:
- High-end Business
- High-end Commute
- General Business

The designed service concepts are represented by business models based on Osterwalders Canvas (2009). The visual representation is one of the strengths of Osterwalders Canvas. These business models are designed within the design space from step 2 (section 5.6), which includes all elements of the abovementioned sub-goals.
**Figure 47 Value proposition - High-end Commute**

High-end Business - allows for private transportation in large comfortable water taxis with on-demand departures at comfort levels comparable to airline business class settings.

**Figure 48 Value proposition – High-end Commute**

High-end Commute - allows for transportation in the large comfortable water taxis with mostly scheduled departures at comfort levels comparable to BART, CalTrain and/or AMTRAK;

**Figure 49 Value proposition - General Business**

General Business - allows for transportation in the small 12 passenger water taxis with regular departures at comfort levels comparable to the local AC Transit bus.
Objective 2
Choose the most suitable concept from a company point of view, based on matching of
- customer demand,
- positive financial viability, and
- practicability.

Accompanying sub-goals
Forecast if the high end business market
- consisting of businessmen and -women
- earning over $100,000 per year
is willing to use water transportation instead of their current means,
- based on to be determined decision elements (attributes)
- in quantities and for a price which is sufficient to build and sustain a company.

Objective 2 is completed in phase 3: Choice
The two steps within phase 2 are:
4. Forecasting the demand
5. Supplying the demand

The next page completes objective 2. Figure 50 shows the visual representation of the most suitable service concept of water transportation for business travelers in the San Francisco Bay Area; based on the matching of customer demand, positive financial viability and practicability.

This selected service concept from section 8.3 High-end Commute, is represented by a business model based on Osterwalders Canvas.

The concept i.e. business model is selected based on financial calculations in step 5 (chapter 8) with input of market shares calculated from a local survey in step 4 (chapter 7). The financial constraints led to the exclusion of the High-end Business and the practicability constraint led to exclusion of the General Business, only for the proposed route, in section 8.2.1. This leaves the High-end Commute service, which appears to be profitable with a ticket price adjustment to $80, as presented below.

The High-end Commute oriented business model is designed through approaching the high standards of the High-end Business model, but making it accessible to a larger audience. The customer has access to a service that has a maximum wait time of 25 minutes, combined with the pick-up at the office and drop-off at the desired doorstep with group transportation.

The vessel is a stable catamaran with 30 seats. It can be partially propelled by electricity which means it is clean, silent and fast. The speed of 30knots allows for a trip from Redwood City port to the San Francisco Ferry Building in 45minutes (excl. access egress ~15min.).

The on-board bar provides the customer with a small selection of snacks and drinks, always fresh and of high quality. The relation towards the customer is low touch but marketing is personal.

This final version of the business model has a ticket price of $80. This pays for a one-way trip between Redwood City Port and San Francisco Ferry Building, including the pick-up at the office and drop-off at the desired doorstep with group transportation.
Figure 50: High-end Commute - Final
9.2 Main goal: Advice

The main goal of this pre-feasibility study is to advise a start-up company, based on the business potential, whether or not it should pursue performing a full feasibility study on high-end water taxi services for business travelers in the San Francisco Bay Area.

First the opportunity is explicated, followed by an advice. This chapter, and entire study if you will, concludes with final words of inspiration.

Opportunity

Water taxis for the high-end business market in the San Francisco Bay Area appear to have potential when considering the local situation. The High-end Commute oriented business model is recommended. The final version of the business model has a ticket price of $80. This pays for a one-way trip between Redwood City Port and San Francisco Ferry Building, including the pick-up at the office and drop-off at the desired doorstep with group transportation.

The main competitive advantages are predictability of travel time and full door-to-door service. This validates a premium price strategy, for which a high-end service is provided in return. The combination of the survey data with a varying price level, showed an optimum at a high-end commuter service, priced at $80 per single trip. This ticket price is used to forecast that 5% of the mentioned potential customer would actually use the service. On a daily basis (250 workdays), this leads to approximately 49-97 round-trip passengers originating from San Mateo and 24-48 round-trip passengers originating from San Francisco, which are transported in both the three morning and evening rush hours.

Based on the made assumptions, as elaborated on in the next chapter, the business is predicted to lead to annual revenues between $2.9million - $5.8million. This is expected to be sufficient to pay-off the $3.5million investment in four vessels and to pay for the $2.2million annual operational costs, as well as the $0.5million - $1million annual cab fares for the on-shore taxi rides.

ROI calculations, based on a 15% discount rate over a period of ten years, leads to a ROI of 22% and a break-even point of 5 years in the pessimistic scenario. The intermediate scenario reaches a ROI of 48% and break-even in 3 years. The optimistic scenario has the potential to reach a ROI of 277% and break-even within a year of operating at full capacity.

Advice

Based on the positive preliminary economic criteria as stated above, given the conservative approach for the estimates in the project and clear view on the underlying assumptions (next chapter), it seems worth it to proceed to performing a full feasibility study.

The advice is to accept the proposed business model for High-end Commute as a potentially viable service and to proceed into a next step of research, by an experienced team.

The main reasons for this advice are shortly summarized here.

The returns of 22%-277% and a break-even period of 1-5 years are still manageable when compensating with a known precaution: it will always be twice as expensive and will take twice as long. This could bring the numbers down to 11%-139% ROI in 2-10 years.

The conservative approach has gradually brought the initial market of 122,000 down to a plausible daily estimate of approximately 100 customers. Viewing the results from another angle is a good reality check.

The number of passengers in the conclusion ranges between 24-97 per commute direction. A small dataset has been gathered on a commuter line with the AC transit M-line transbay touring bus in July 2009. This bus line on a 30-minute schedule, costs $4 per single ride or $132.50 per month. The number of passengers was around ten in each of the three measured morning departures (8:12, 9:12, 10:15) towards San Mateo (West) and around 25 at 17:23 and 17:53 back to Hayward (East). Earlier in the afternoon at 16:20, the headcount was 15.
Extrapolating these numbers roughly to the estimated three commute hours this would lead to approximately 60-100 passengers on the line that has a total of 50,000 commuters; while between San Francisco and San Mateo county 168,000 people commute.

The number of passengers calculated in this project are thus not unimaginable. Admitting, the analogy in this particular comparison is skewed based on the price, but the current services do not include the benefits of the personalized access and egress.

Since the route calculated in this project departs from both Redwood City port and docks in San Francisco, another comparison can be made. A study by WETA (watertransit.org) for a proposed route on the same points, predicts that a two 300pax fast ferry configuration, would attract 1,400 daily passengers. Catching 5%-10% of this amount would lead to the estimated and needed numbers of passengers to sustain the service.

Both checks seem to indicate realistic estimates.

The advice to continue research is based on the amount of assumptions which needed to be made in this study. The underlying assumptions with the most impact, which need further research are:

- Full market sizes are based on the numbers found for the commuter market, not on business trips during the day. Data on these types of trips was not found.
- The vessel type is selected based on trusted advice and quick multi criteria analysis. This needs more attention to verify suitability for the local situation. The currently selected vessels are the ShuttleCat120 by FontainePajot (France) and the Water taxi by TRANZ (Netherlands).
- Permits for operation are assumed to be obtained.
- All berthing locations are assumed to be available for usage, but all need individual negotiations.
- The vessels would need testing, to see if they actually perform up to par in comfort and travel times.

A suggested timeline if the decision would be made to perform a full feasibility study and after a dedicated team is gathered, could be:

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>Q2</td>
</tr>
<tr>
<td>Research</td>
<td></td>
</tr>
<tr>
<td>Permits</td>
<td></td>
</tr>
<tr>
<td>Funding</td>
<td></td>
</tr>
<tr>
<td>Letter of intent</td>
<td></td>
</tr>
<tr>
<td>Operational setup</td>
<td></td>
</tr>
<tr>
<td>Purchase</td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td></td>
</tr>
</tbody>
</table>

An issue to keep under consideration, is that the analysis has followed the most suitable concept from a business perspective. From a customer perspective the other two concepts would have led to larger market shares, but not higher returns. A combination of factors can explain this discrepancy. Low market shares lead to little customers. A small number customers require few vessels, strongly reducing the investment costs. Also the operational costs drop drastically due to this small amount of vessels in operation. On top of that the High-end Commute concept has the largest capacity, reducing the needed number of roundtrips for the same amount of passengers. Thus again reducing the hours of operation.

This does not directly imply that bigger is better. Larger vessels require more investments and reduce flexibility, two aspects that are the exact strengths of water taxis. The High-end Commute seems to indicate sound business potential by itself. Addition of the General Business concept on shorter distances however might lead to a more complete and synergetic, but more complex, service system.
Final words of inspiration

When asked the question: “If you would have $1 million in the bank, would you invest that right now?”
The recommendation is to indeed spend part of that money to do more local research on the underlying assumptions by an experienced team.

This advice is strengthened by a remark by one of the respondents who is a transnational investor:
“If this survey was given in a stronger economy; the price sensitivity may be less. However, in this economy the price is highly sensitive.”

Also a quote from Johan Tuk, CFO at Koninklijke Doeksen Transport Groep BV, positively supports the findings in this study:
“I discussed the business model in detail with Jody Verpoort and read (parts of) his report. As CFO of Koninklijke Doeksen, I see several business models a year. Often they are put aside after first reading. In this particular case my first impression is that we are quite willing to put more effort in this project. Specific reasons are the niche market and the statistical model behind the plan.”

Business Improvement Manager Heineken Netherlands, ir J.L. van Thiel mba, quotes on this study:
“Watertaxi as a new Dutch export product is an interesting market opportunity. The San Francisco Bay Area market research indicates clear consumer demand potential. It is recommended to reuse Dutch watertaxi experiences to ensure success when launching the venture.”
10 Further recommendations

The previous chapter concluded the study with the advice that it seems to be worth it to proceed into the next step towards starting the business by performing a feasibility study. This would mainly involve doing more local research on the underlying assumptions by an experienced team.

This chapter starts by listing those assumptions made (10.1). The assumptions are also prioritized and made more explicit in an overview of Go / No-go items (10.2). A useful, or even vital, overview of contacts for the steps following the full feasibility study, is provided in section 10.3.

This chapter also provides a first glance on those steps towards starting the business in section 10.4, for which the previous concluding chapter already hinted upon a suggested timeline. Section 10.5 suggests a number of fields with the potential for expansion of the company and its services in a later stage.

10.1 Overview of assumptions

To be able to reach the point of profit estimations many assumptions needed to be made in this project. More research can be done on all of these assumptions, amongst others a sensitivity analysis.

The assumptions made in this research are summarized here and ordered according to the five important elements for projects with societal impact. Within each of the five elements, the assumptions are ranked by importance.

- A Financial and economic aspects
- B Technical aspects
- C Legal aspects
- D Governance and organizational aspects
- E Socio- and psychological aspects

A Financial and economic aspects

1. Full market sizes are based on the numbers found for the commuter market, not on business trips during the day. Data on these types of trips was not found.
2. Privately invested amount is set at 33%, by one (or more) initial shareholder(s) and operating partner(s). Remaining 66% is assumed to be collected from outside investors/banks at an interest rate of 5% based on Dutch experiences. The prime loan in the USA is currently 3.25%\(^1\). Often an additional rate is set on top of that. An example interest rate\(^2\) of a loan up to $1million is 8.5%. Also examples are found up to 11\(^3\).
3. Cab fares assumed to be very low ($3.5-$10), this due to price arrangements.
4. Fuel price #2 marine diesel per Gallon in California (pre-tax) 2009 $2 // 2008 $5. In general diesel in the SF Bay Area is more expensive than petrol.
5. Mooring overnight is set at $87, which is valid for at least one port (Redwood City) in the area.
6. No costs have yet been calculated for using piers ‘Berthing rights’. The PPP structure is a good option here.
7. Insurance percentage 2% based on Dutch experiences. No comparing rates were found.
8. Captains wages are set at $50 per hour based on Dutch experiences. These are plausible when considering the minimum wages are a little under $10.
9. Crew wages are set rather high at $50 per hour, equal to the captains wage. These employees with lower nautical qualifications than the captain, will also be a host for the passengers.
10. Office rent is set at $50,000 per year.
11. Marketing costs are set at $300,000 per year.
12. The two staff number receive a wage of $50 per hour.
13. Maintenance and repair is outsourced.
14. Exchange rate is set at EUR 1 = USD 1.4.

---

1\(^1\) http://www.federalreserve.gov/Releases/H15/Update/ access date 22-1-2010
3\(^3\) http://www.scruzzcu.org/rates/business-english.shtml access date 22-1-2010
15. The wealthy percentage of the market is based on household income >$150k. Thus not equal to the current population definition which is based on individual income >$100k.
16. Scenario percentages are based on survey response and are not likely to be lower, perhaps higher.

B Technical aspects
1. The vessel type is selected based on trusted advice and quick multi criteria analysis. This needs more attention to verify suitability for the local situation. The currently selected vessels are the ShuttleCat120 by FontainePajot (France) and the Water taxi by TRANZ (Netherlands).
2. Maximum speeds up to 35knots seem allowed, but there is uncertainty if it is technically achievable with the current vessels and water depths.
3. Many attempts were made on finding data related to the impact of fog and waves on operational conditions. Since no publically accessible measurements on this are being made, hunches and stories from personal experience, leave a much to wide array of possibilities. This would require local testing or measuring.
4. For Travel time the assumption, calculations and references are made that 45min by vessel is technically feasible and that all trips involve a total of 15min access and egress. These calculations should be based on the actual distance between the location of the inhabitants to the location of the boarding points. One tool to do this is using the US census data in a GIS model. It would allow for in-depth research on income, location of living, location of work, method of transportation, average commute time, etc.
5. Fuel consumption calculated for 24kts speed with 250kw power. kw power/4 = liter per hour of operation.
6. Passengers are assumed to return to their original location. So the number of trips per passenger is two.
7. On the number of vessels needed only very basic calculations are made. Full logistical analysis is advised.
8. Capacity utilization is set, instead of optimized. Full logistical analysis is advised.
9. Maximum delay is only indirectly accounted for in the calculations on profitability. This should be an important factor in further logistical analyses.
10. Hours of operation is set to be only during 3hour morning- and evening commute, which covers all fixed costs. This leaves much room for other services.
11. Days of operation set at the 250 workdays, which covers all fixed costs. This leaves much room for other services; which are not taken in consideration in his research.
12. No sustainable means of propulsion is selected.
13. Vessel prices are assumed to be equal to current Dutch versions, but are converted to USD with the exchange rate mentioned in A13. Might need extra modifications for American market.
14. Vessel capacity is assumed to be equal to current Dutch versions. This might need extra modification for American market, but no limitations or regulations have yet been found.

C Legal aspects
1. Permits for operation are assumed to be obtained.
2. Vessels are assumed to be allowed to be imported one way or the other. This has been researched partially but needs further attention.

D Governance and organizational aspects
1. All berthing locations are assumed to be available for usage, but all need individual negotiations.
2. Environmental Impact Assessments are very expensive. Worth investigating is whether or not a non-scheduled service also needs to have such an Assessment for each location the service goes to.
3. Currently the decision is made to not make use of subsidies, mainly to not be dependent on the government, except for permitting. Also it appears to break-even without it. Advertising would still be a simple but profitable option to explore.
4. Tourists assumed to not be serviced, but could me a profitable market.
5. Planning &scheduling is expected to be carried out by the two members of staff.
6. At least one of the employees in the company needs a nautical technical background, to be able to assist in and have hands on control in maintenance and repair.
7. A reservation system is assumed to be implemented relatively easily, cost included in office rent.
8. The impact of developments in other modalities and the public ferry system, need to be discussed with the relevant authorities. This would also be a subject of discussion in the permit application.
9. The assumption is made that high quality marine personnel is available.
10. Onboard service assumed to be done by crew.
11. Based on initial research the assumption is made that the ‘captain-only’ operation is possible.
12. Distribution channels are not investigated.
13. Client relationships are not investigated.
14. Leasing-out of vessels not chosen.
15. General commuters assumed not to be serviced.

E Socio- and psychological aspects

1. The vessels would need testing, to see if they actually perform up to par in comfort and travel times. Two different vessels currently in the Bay Area would allow for testing partially the concept of water taxis. One similar sized similar type vessel (Eldorado in Berkeley) and one that can operate at the required speeds (Angel Island Ferries).
2. Comfort levels assumed to be equal to comfort on the compared means of transportation. This needs further research.

10.2 Go/No-Go

The five highest ranking assumptions that should have priority in the research are:

- Full market sizes are based on the numbers found for the commuter market, not on business trips during the day. Data on these types of trips was not found.
- The vessel type is selected based on trusted advice and quick multi criteria analysis. This needs more attention to verify suitability for the local situation. The currently selected vessels are the ShuttleCat120 by FontainePajot (France) and the Water taxi by TRANZ (Netherlands).
- Permits for operation are assumed to be obtained.
- All berthing locations are assumed to be available for usage, but all need individual negotiations.
- The vessels would need testing, to see if they actually perform up to par in comfort and travel times. Two different vessels currently in the Bay Area would allow for testing partially the concept of water taxis. One similar sized similar type vessel (Eldorado in Berkeley) and one that can operate at the required speeds (Angel Island Ferries).

A useful checklist of key elements to consider when implementing a transportation service over water was already discussed in section 2.1.

Essential elements all having a Go/No-go influence are:

- Research findings
- Permits
- Funding
- Operations
- Purchasing
- Construction
- Testing

10.3 Contacts

Often the role of one single person or a small group of people who believe in the innovation and know how to play ‘the game’ is of the utmost importance, according to van Wee and Marchau (2004). They further state that the role of the lower governments can become crucial. This is also the case in this project. Permitting, access to piers, certification of the vessels are all done by local institutes. These relevant actors, perhaps even the potential customers and other public, need to be addressed as soon as the goals of the project are determined.

If the decision is made to pursue the proposed business, a number of people have shown interest or are put forward by others in the team as important individuals to get on-board:
“Your survey could have asked many more useful questions. If you are serious about trying to start this business, I suggest that you contact me about it.”

“Splendid. I thoroughly believe that there's a solid market for this, particularly after 7:15pm. I'll respond to your survey and am happy to help with any information or ideas via email or phone.”

On current development projects potentially creating the need for water taxis:
- “Jack London Square (see [http://www.jacklondonsquare.com](http://www.jacklondonsquare.com)). Talk to Jim Falaschi or Dean Rubinson, who represents the partner firm that invests in this space.”
- “The other major project is Oak to Ninth, see [http://www.oakto9th.com](http://www.oakto9th.com). Signature Properties is the developer, Jim Ghielmetti the head guy. Contact him through his assistant, see below.”

Local government to convince:
- “What you need is an advocate to advise you on who to speak to, and how to do it. I recommend talking to Bruce Kern, Executive Director of East Bay Economic Development Assn. He knows EVERYONE locally and at the state level, and could be a tremendous advocate for you, steering you in the right direction. Plus, Jim Falaschi and other developers are on his Board of Directors.”
- “An enabler? See Bruce, above. He could be just what you need if you have a viable proposition”

The Emery-Go-Round shuttle is a private transportation service in Emeryville, funded solely by commercial property owners in the citywide transportation business improvement district, such as PIXAR, IKEA, movie theaters and Ex’pression College for Digital arts. This shows the potential impact of local companies investing in accessibility.

It is however difficult to get feedback or even through the front door at large corporations, while these corporations could also create a sound basis for the demand. This creates the need for an even more extensive network through the team.

The companies currently involved and interested in the projects are: Red&White fleet, Fort Mason, Blue&Gold fleet, Bay Quakers, Marine Express, WESTAR, Pacific Waterfront, Hornblower, Wax Museum, San Francisco Port and the Port of Oakland. Next to these companies the responsible local governmental department are involved as well as the following (semi-)governmental agencies: WETA, AC Transit, BCDC, ABAG and USCG.

The development of new vessels was not a priority. Hybrid designs however are being explored by multiple companies: the Canal Company in Amsterdam (Felix Guttman), the Doeksen Transport Group (Johan Tuk) and a consortium with Siemens.

If the choice is made to start the feasibility study, an initial research and startup budget is needed. Initial research costs can be kept low by utilizing the passion and resourcefulness of students. Many of the assumptions above can be researched further, with limited means. The accompanying danger can be that the speed of research is slower and/or the quality is less then when using an experienced team. The creative solution space of students however is much larger and their access to information is usually wider, due to a low threat level.

10.4 Towards starting the business

As concluded in chapter 9 the proposed service is the concept of High-end Commute on the route between Redwood City port in San Mateo county and the San Francisco Ferry Building.

Osterwalders Business Model Innovation Cycle (2006) provides additional phases towards starting the business which are Organizational design and Business model implementation.

Organizational design

In order to stay lean and mean as a starting company, outsourcing of the access and egress is preferred.
To minimize the investments needed, the most promising structure seems to be a Public Private Partnership, in which the local governments provide the investments on the land-based infrastructure. The operator must then invest in the vessels and setting up the business.

Also to limit the upfront investments the hybrid design is currently the only technology within reach.

Business Model implementation
A way to become a player in the area and with that possibly easier permitting and reduced research costs, is not necessarily to start with the service as proposed here in this research, but to apply to one of the projects under investigation, as also addressed in this research:

- Water taxis along the San Francisco piers (Aaron Golbus, Wharfinger at Port of San Francisco) (SFPort 2009)
- Estuary crossing between Alameda & Oakland (Obaid Khan, City of Alameda Public Works Dept.) (Multiple 2009)

10.5 Expansion opportunities
The current research is exploratory for the concept of water taxis in a high-end market, elaborated for one route. Larger logistical models and network designs are needed, to estimate future expansion of the company. Such as combinations of different services, with several types of vessels, servicing different routes and the proposed service zones.

Routes
With the investment needed for two 300pax fast ferries (~$22million), as suggested for the route under investigation, a fleet of twenty-five 30pax water taxis could be purchased achieving 25% more passenger capacity and a lot more flexibility, both in service as in purchasing of the vessels. When considering these amounts of vessels additional routes become attractive. This could lead to significant synergy effects. The benefit now is that the method used allows for estimation of market shares on routes that have not explicitly been questioned.

There is a chance however that on a different route the majority of the flow has different travel goals and thus perhaps different preferences. Also congestion levels are different or are perceived differently. Since the model is based on the comparison to the current means, as described in section 7.2.1, the results could differ. For example, less congestion on a route, can influence both the original travel time and maximum delay. It could change the utility levels when dropping outside the validity range.

This is the case for the General Business model. It was excluded at a certain point due to its inappropriateness for long distances. A solution for this could have been to compare all models on a shorter route. This would have required a somewhat wider scale of the attribute travel time in the survey.

Customer segments
The amount of hours available for finding added sources of revenues, without immediately increasing the fixed cost is large. The six commute hours in the area lie, on average, between 7:00-10:00 and 16:00-19:30. This leaves the time slot of 10:00-16:00 open for dedicated business trips or tourists, after 19:30 for wining-and-dining trips and all weekends for tourists or other purposes one might think of. These would all add to the profit, provided that these services cover at least their own variable costs and added wear and tear to the equipment.

In the current setup the system is more of an expensive public transit, than it is an on-demand service. However this is still possible considering the fact that much time is vacant per day, while fixed costs are covered. This does however need a more advanced reservation- and planning system.
Supply chain
In order to stay lean and mean as a starting company, outsourcing of the access and egress is preferred. This brings along high costs for the customer, without the company profiting from it. When the company is financially healthy, a base-load service should be started to reduce cost for the customer or increase the profit margins.

Technology
In hindsight the influence of types of sustainable propulsion seems to be greater than the number of passengers aboard a vessel. It would thus have been interesting to see what the impact on the market shares would have been.

Pursuing the purchase of an off the shelf hybrid vessel is advisable. This appears to save in fuel consumption, engine wear and noise- and pollution- nuisance. Technologies at this stage do not yet suffice to make a fully sustainable propulsion system for the long 45minute trip. For the shorter runs within the six service zones (up to 20 minutes) this might already be possible.

Geographical locations
Other ways of expansion is at different sites, such as proposed by one of the respondents: “but in addition to that - take a look at the Seattle Area. There is a basic Washington State ferry service, that could use some competition. So from the "islands" to Seattle -- also to the Airport (would need a shuttle bus to finish the journey).” The analogy can be made to areas such as Hong Kong, New York, Boston and Sydney.
11 Reflection

The reflection, or discussion if you will, on this project is mainly structured along the subjects of a SWOT analysis on both the contents (service concepts) and the process (methodology).

Without actually performing a typical and full scale SWOT analysis, the four elements: strengths, weaknesses, opportunities and threats, are used to reflect on the proposed service concept and the methodology.

11.1.1 Strengths

Strengths refer to internal elements which distinct the service concept and methodology from others in a positive manner and creates a competitive edge.

Service concept

The strengths of the service concept, which has been represented by a business model, are the focus on a niche market in an area with sufficient high-end customers, the proper infrastructure, being water and landings and the integrated door-to-door service.

- The general ferry services have shown (section 5.2.3) to be in need of much subsidies, both in the San Francisco Bay Area and the Netherlands. By elevating the price levels this can be avoided. This needed the change towards a high-end and reliable service to compensate for the higher price level.
- Compared to the Ijselmeer/Markermeer area in the Netherlands, as referred to in section 5.3.3, the shores around the San Francisco Bay are very densely populated and full of businesses. This creates a large potential customer base.
- The San Francisco Bay has many landings that allow for small vessels to dock, as shown in section 5.3.3. Only in the most southern parts it becomes too shallow to operate at high speeds.
- The added benefits of providing the door-to-door service have not been elaborately investigated, but conversations on this matter with the experts indicated positive effects. A starting point for further research on this subject are for example Knoppers and Muller (1995) and Clever (1997).

Methodology

The strengths of the methods used to determine the potential of the service concepts, are: the approach from a customer perspective, the accuracy of the discrete choice analysis and the use of industry expertise. Also the study adheres to a list designed to the success rate of transportation innovations.

- When continuously using the customer perspective in a study, the best foreseeable service is designed and later the check is made whether or not it can be supplied. If it doesn’t seem to be a viable case, one can decide to cancel the effort or to start on a smaller scale, but not on a different set of criteria such as a lower quality.
- Discrete choice analysis, as discussed in section 7.1.1, has initially been designed and used to forecast the usage of a metro service in the same Bay Area. Within less than one percentage-point difference, the analysis was able to predict the usage of a few years later. The inventor received a Nobel prize for his efforts.
- The added value of the 34 experts as listed in chapter 4 can only be appreciated when the field of study is known. The complexity of designing an experimental service for a location abroad, in a redeveloping industry of water transportation all on a scientifically sound basis, cannot be solved only from books. The many assumptions that needed to be made while avoiding ending up with a report that has many flaws from an industry perspective, created the need for need expert input.
Van Wee, Marchau and Kleinknecht (2004) have studied the success and failure factors of innovation in transportation and identified a list of items that seem to improve the chances of success for innovations. Among others the study mentions (translated freely):

- Often the role of one single person is vital importance.
- Relatively simple options applied in a creative manner, can be promising.
- Objectives of the project must be explicit and widely communicated.
- The role of the lower governments can become crucial.
- Transportation services must take the user as a centerpiece, not the system.
- The role of the process should be very clear.
- Multi-disciplinary research seems to be more useful than mono-disciplinary research.

This research has adhered to or reflects on all items. This does not directly imply that it will be a success, but it does increase the strength of the analysis.

11.1.2 Weaknesses

Weaknesses refer to the most important internal elements which distinct the service concept and methodology from others in a negative way. This creates an increased danger of lesser results or even failure.

Service concept

Weaknesses of the service concept are: the inability to compete with non-congested travel times, the need for transfers, dependency on weather conditions and the dependency of ports and harbors for boarding.

- In section 8.1.1 the route San Mateo-San Francisco was selected based on a multitude of reasons. A disadvantage is the fact that it is a route parallel (longitudinal) to the main road. Maximum speeds of vessels are in general lower than cars, and will have difficulty competing on parallel routes. This means that the calculated travel times on this route are only competitive in congested hours. River/water-body crossings are often more competitive.
- Even though access and egress to-and from the vessel are arranged, the fact that transfers are needed usually has a negative effect on traveler (Molin et al. 2009). The survey included the mentioning of this, but the actual impact is uncertain.
- Current ferry operations in the area only have adjusted time tables, due to unexpected bad weather, 5 days a year; and just once a year no operations are possible. These are promising numbers, but are related to larger vessels. The lack of information on nautical conditions creates a weakness, since it is now unsure how the smaller selected vessels will operate under the same conditions, thus potentially creating reduced reliability.
- Many docking and boarding points are present around the San Francisco Bay, as presented in section 5.3.3. This does not yet mean that the usage is allowed. This needs individual arrangements with each boarding point, or a cross-county governmental initiative.

Methodology

Weaknesses of the methodology are: uncertainty of stated versus actual usage, a lack of sensitivity analysis and unfamiliarity in the scientific domain.

- Transportation research, as well as marketing research, has a known history on difficulties with predicting actual usage. Stated and revealed preference research or combinations thereof, differ in forecasting results (Ben-Akiva and Morikawa 1990; Brownstone and Small 2005; Hensher 1994; Shires and de Jong 2009; Van Der Hoorn et al. 1984; Wardman 1998). On top of that, the preference prediction tends to vary from actual usage (Kroes and Sheldon 1988; ‘Van Der Hoorn et al. 1984), especially when it involves new or innovative concepts. This means that the results of the survey have the danger of being overestimated.
- The assumptions made in section 10.1 are ranked according to expected impact. A more thorough (financial) sensitivity analysis could be made to verify their importance. Also an analysis of the growth over time needs to be addresses.
• The innovation focused methodology seems to be hard to fit into an academic environment. In a later stage of the project, an economic framework for fast ferry selection (Hockberger 1997) was found at the Faculty of Maritime Engineering of DUT. The ferry analysis process as shown on the right, includes much of the steps taken in the current project, but in a more mature stage. This would be a good tool to use in the next stage of the project development.

11.1.3 Opportunities
Opportunities are external situations that allow for increased or additional results.

Service concept
Opportunities within the service concept lay within expansion. This includes multiple client segments, multiple routes, multiple service zones, supply chain by expanding to access & egress) and even different regions in the world. This has already been elaborated on in section 10.5.

Methodology
Opportunities in the methodology lay in application to other situations.
• Applying the Canvas tool has created the opportunity for clear communication to the outside world. The business model pictures from chapter 6 clearly state what will be done, and with that also what not.
• The book on which the main structure of the methodology is based (Osterwalder et al. 2009) is so popular that it is currently out of stock. It is being used in a wide array by consultants, business development departments of large companies, start-up companies both in high-tech and design and courseware. In that sense the methodology has unlimited opportunities of being applied.
• The personalized design steps in this research are perfect for early stage, preliminary feasibility studies on innovative ideas. Opportunities in applying this approach will thus mainly be in situations with a limited amount of boundaries. In situations that have for example a relatively limited price range, such as public transit, the exploratory nature of the approach is likely to be less fruitful.

11.1.4 Challenges (threats)
The threats, from an optimistic business perspective preferably referred to as challenges, are: external situations that can jeopardize the success.

Service concept
The main challenges for the service concept partially come from the weaknesses as mentioned in section 11.1.2 and also from the assumptions made as described in section 10.1.
• The largest challenge for the water taxi service is receiving permissions to operate. This includes permits for transporting people, permits for importing vessels, certification of vessels, American ownership, contracts or PublicPrivatePartnerships to use piers and docks, etc.
• Next, the validation of vessel choice is key. The selected vessels are well priced for their quality, but will they perform good enough for the proposed service, or will they need adjustments.
• Even though the needed numbers of passengers are fairly low, up to 150 passengers per day, it is a challenge to actually reach that level; and within a short period of time after start.
• Not impossible, but still hard in the economic downtimes, is gathering $3.5 million.
• Competition is present, but not pressing.
  - The longitudinal nature of the selected route has the down side that fast rail based competition is present. A metro and a train travel along the same line. However they both have the disadvantage of the need for access and egress, and the metro won’t travel as far south.
- People movers are a widely researched phenomenon, also locally. The necessary infrastructure would require many years and multibillion dollar investments. At this stage, without individual stops at each house, it is no better than BART.
- Some companies have their own transit services via the road, this does not immediately reduce the risk of delays.
- Limousine services are present, but will not be able to bypass congestion. Nor are they comfortable to work in.
- There are carpool lanes on parts of the route, they seem to work. The state is also considering allowing travel on them at extra costs. However the most congested parts currently has too little space to easily allow for a dedicated car pool lane.
- There are car share initiatives at the ends of the most heavily travelled bridges, which allows for free passage on the carpool lane, which saves each car $5. However it is hardly used.
- The new ferry lines under development will transport a large part of the commuters that were used in financial calculations. The target group however is different.
- Helicopters would be a great competitor. However it is not allowed for them to land in San Francisco. Also the number of landing sites is more limited than the number of landings for the water taxi.

**Methodology**

In general the methodology is not so much challenged by external conditions. Conditions related to external factors which at this point limit the transfer of results to other areas, are caused by the design of the data collection. These can thus be solved by extra data gathering.

- The data obtained through the survey mostly comes from San Mateo- and San Francisco county. This limits the certainty of applicability to all routes that are possible between the six service zones as proposed in chapter 6.
- The applicability within the service zones is limited due to the range of travel times used in the survey: 40-60 minutes. Travel times within the service zones are more likely to lay between 5-20 minutes.
Reference list


Chorus, C. G., Walker, J. L., and Ben-Akiva, M. E. "Travel information use and effects." *11th International Conference on Travel Behaviour Research*, Kyoto.


CPUC. (2009). "Passenger Carriers Subject to Permit or Certificate Requirements ".


Directorate-General Environment and AEA Technology plc; see website [www.eutransportghg2050.eu](http://www.eutransportghg2050.eu).


McCaffrey, E., and Professor Nixon, D. "REGULATION OF FLOATING BILLBOARDS." *Proceedings of the 12th Biennial Coastal Zone Conference*, Cleveland, OH.


MTC. (2007). "Transportation 2035 Plan for the San Francisco Bay Area - Detailed Data Summary Tables."


Osterwalder, A. (2007). "How to Describe and Improve your Business Model to Compete Better - Draft version v0.8 (beta)."
USCG. "Navigation Rules Homepage."
USCG. "Rule 6 - Safe Speed."
USDoT. "Small Vessel Waiver Program."


WETA. (2009c). "A New Commute Option for Redwood City."

WETA. (2009d). "Request for qualifications (rfq) for design services for WETA maintenance and operations facility."

WETA. (2009e). "South San Francisco Ferry news."


Water Taxis in the San Francisco Bay Area
Transforming travel time into quality time.

APPENDICES
Appendix A  Graduation committee

Persons
Graduation Professor - Prof. dr. Bert Van Wee
Professor in Transport Policy and Logistics and head of the section at Delft University of Technology, faculty Technology, Policy and Management. His main interests are in long-term developments in transport, the environment, safety and accessibility, and in policy analyses.

First supervisor - Dr. Ir. Caspar Chorus
Assistant Professor at the Transport Policy and Logistics' Organization Section of TU Delft's Department of Technology, Policy and Management. His research concerns the development and testing of travel choice models that combine behavioral realism with econometric tractability.

Second supervisor - Dr. Dap Hartmann
Assistant professor at Delft University of Technology in the faculty of Technology, Policy and Management (section Technology, Strategy & Entrepreneurship). His current field of research is innovation management and entrepreneurship. He is co-author of The Cyclic Nature of Innovation. Connecting Hard Sciences with Soft Values, published by Elsevier

Entrepreneurial advisor - Meinard Sprenger
• Adjunct-Directeur ThyssenKrupp Veerhaven B.V. - global supply chain management of export steel from Brazilië to US Gulf and via Rotterdam to Duisburg and Bochum, as part of ThyssenKrupp Steel.
• Landsdiep BV – independent project manager/advisor
• Directeur Fast Ferry BV and Waterbus BV
  Responsible for complete project management and creation of a public transportation system with 8 fast ferries around Drechtsteden and between Rotterdam and Dordrecht.
• Directeur of Veerdienst Maassluis – Rozenburg
• Directeur Marketing Koninklijke Scheepsagentuur Dirkzwager BV

Roles
Every supervisor has his own role in the committee:

The professor’s task is to monitor the scientific subject matter of the graduation project. He is also the chairperson of the graduation committee.

The first supervisor is the day-to-day supervisor for content-related matters. Specifically on Mixed Logit. The project progress is discussed every other week.

The second supervisor has two roles: second content-related supervisor and co-reader. Specifically on strategy and entrepreneurship.

The entrepreneurial advisor will provide support specifically for the entrepreneurial component. This includes the assessment of the Entrepreneurship Annotation element of the thesis as described in Appendix B.
Appendix B  Annotation Entrepreneurship

If the student completes two components successfully,
- A combination of entrepreneurship modules
- A graduation project (the Entrepreneurship Annotation Final Thesis)
he will receive a separate certificate with his Masters diploma, the “Annotation Entrepreneurship”.

The graduation project is incorporated within the final Master Thesis, focusing on the business aspects of a technology. A member who supervises the student especially with regard to entrepreneurship: the entrepreneurship supervisor, will coach and grade the student. This could be a young entrepreneur, an employee of the TUDelft, a consultant or a retired entrepreneur etc. depending on the topic and the wishes of the student.

The number of ECTS spend on entrepreneurship during the students final thesis is about 10 ECTS, but may vary per faculty, education and thesis topic. These 10 ECTS consist of the 2 ECTS from the mandatory Entrepreneurship Annotation Week (this is the only mandatory module for all students taking the annotation) and 8 ECTS for the entrepreneurship accent within the final thesis that will be coached on entrepreneurship specifically.

Learning objectives

The Entrepreneurship Annotation Final Thesis should be seen as a complement to the overarching Master Thesis. The underlying idea is to make a bridge between the technical aspects, examined in the student’s Master Thesis, and business aspects of the technology/subject of the Master Thesis. The ability to make this connection is at the heart of technology-based entrepreneurship. Together with the supervisors of the overarching Master Thesis and the Entrepreneurship Annotation Final Thesis, students should clearly understand the application context and the reasons for bringing the specific technology to the market.

By the end of the Entrepreneurship Annotation Final Thesis, students should be able to:
- Understand the practical business aspects of bringing a technology to the market (in either a corporate setting or in a new start-up);
- Estimate a (potential) market and derive pricing strategies from this analyze.
- Draw up the cost structure of a product or service and translate this into the accompanying financial statements.
- Further develop their insights into what their motivations, ambitions and objectives are as entrepreneurs (in either a corporate setting or in a new start-up);
- Be able to report their findings in a well-readable and attractive format, which should be easy to understand for decision makers;
- Present their findings in the form of a short 'elevator pitch', so that decision makers understand the value of the concept and are motivated to know more about it.

Entrepreneurship supervisor

The Entrepreneurship Annotation Final Thesis is based on the student's own work and planning, while using the skills and knowledge acquired during the electives related to entrepreneurship within the annotation program. However, support will be given specifically for the entrepreneurial component, in the form of a dedicated supervisor.

Supervisors are likely to be entrepreneurs or executives dedicated to entrepreneurship in existing corporations. To give an idea of the type of supervisors that could coach a student, he or she should:
- Have experience with entrepreneurship. Depending on the focus of the thesis, this experience could be more towards 'Starting your own Company' or 'Corporate Entrepreneurship';
- Have experience, or at least knowledge and affinity, with the technology at hand, preferably within a business context;
- Be able to dedicate time for regular discussions with the student and the Master Thesis supervisor on the student's work progress;
- Dedicate time to evaluate the planning, reports and eventually even the elevator pitch for the final assessment.
Supervisors could expect about 3 meetings with the student and the other members of the students supervising team throughout the program, which should last between 4 and 8 months depending on the time and effort dedicated by the students to the Entrepreneurship Annotation Final Thesis.

**Assessment**

A separate assessment will be made of the Entrepreneurship Annotation Final Thesis. This assessment includes grading of the effort of the student, the final report and a presentation in the form of an elevator pitch and/or power-point presentation by the student.

Students need to have a positive grading on the Entrepreneurship Annotation Final Thesis, the Entrepreneurship Annotation Week and have passed all the courses corresponding to the 15 ECTS to qualify for the annotation.

The assessment is composed of three main elements:

- **35%** = Planning and execution of the thesis, including the necessary phases for literature review, field research, analysis and reporting. The timing for the delivery of the plan should be agreed upon with the supervisor for the Entrepreneurship Annotation Final Thesis, who will also evaluate it. The evaluation follows the following: (i) quality of the work plan (ii) ability to live up to the work plan and (iii) ability to be autonomous and having own initiative. The student should prove what he has learned about his own insights into what his motivations, ambitions and objectives with respect to entrepreneurship are.

- **50%** = Final thesis report evaluated by the dedicated supervisor on Entrepreneurship. The evaluation should follow these criteria: (i) ambition level, (ii) structure and boundaries, (iii) academic level with respect to the entrepreneurship skills taught at Delft University of Technology, (iv) originality, (v) usability, (vi) relevance and (vii) reflection on the product. Additional criteria, include: (i) the line of argument, (ii) use of English and (iii) design of the report. Criteria could vary per faculty, education and even student.

Furthermore, the student will be judged on his ability to understand the practical business aspects of bringing a technology to the market, and to analyze real-life business problems in the field of entrepreneurship and innovation.

- **15%** = Elevator pitch and/or PowerPoint presentation given by the students during the EAW or at the end of their final thesis, evaluated by supervisor. The evaluation should follows these criteria: (i) performance, (ii) ability to clearly answer to questions and (iii) usage of English language.
## Appendix C

### Longlist relevant in passenger transport over water

<table>
<thead>
<tr>
<th>Technical aspects</th>
<th>Aspects mentioned in:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed vessel</td>
<td>v</td>
</tr>
<tr>
<td>low wash</td>
<td>v</td>
</tr>
<tr>
<td>comfort ride</td>
<td>v</td>
</tr>
<tr>
<td>shore facilities</td>
<td>v</td>
</tr>
<tr>
<td>parkinglots</td>
<td>v</td>
</tr>
<tr>
<td>docking points: location</td>
<td>v</td>
</tr>
<tr>
<td>docking points: accessibility (car, bike, PT)</td>
<td>v</td>
</tr>
<tr>
<td>fuel (50% of operating costs)</td>
<td>v</td>
</tr>
<tr>
<td>traveltime</td>
<td>v</td>
</tr>
<tr>
<td>reliability / punctuality</td>
<td>v</td>
</tr>
<tr>
<td>sound levels low</td>
<td>v</td>
</tr>
<tr>
<td>personnel: service</td>
<td>v</td>
</tr>
<tr>
<td>personnel: number</td>
<td>v</td>
</tr>
<tr>
<td>before- after transportation</td>
<td>v</td>
</tr>
<tr>
<td>tidal differences might influence vessel choice</td>
<td>v</td>
</tr>
<tr>
<td>Ship purchase and speeds underestimated</td>
<td>v</td>
</tr>
<tr>
<td>product of research and implementation very different</td>
<td>v</td>
</tr>
<tr>
<td>frequency</td>
<td>v</td>
</tr>
<tr>
<td>bike</td>
<td>v</td>
</tr>
<tr>
<td>comfort overall (amenities, safety)</td>
<td>v</td>
</tr>
<tr>
<td>rivercrossing relations</td>
<td>v</td>
</tr>
<tr>
<td>should not compete with parallel PT routes</td>
<td>v</td>
</tr>
<tr>
<td>focus is on PT, so large flows</td>
<td>v</td>
</tr>
<tr>
<td>high population density in proximity to stops</td>
<td>v</td>
</tr>
<tr>
<td>dependence on area and prosperity</td>
<td>v</td>
</tr>
<tr>
<td>still not much known on passenger transport over water as part of urban and regional (public) transportation system</td>
<td>v</td>
</tr>
<tr>
<td>type boats: ability to upgrade</td>
<td>v</td>
</tr>
<tr>
<td>Judicial aspects</td>
<td>v</td>
</tr>
<tr>
<td>Speed</td>
<td>v</td>
</tr>
<tr>
<td>low wash</td>
<td>v</td>
</tr>
<tr>
<td>still not much known on passenger transport over water as part of urban and regional (public) transportation system</td>
<td>v</td>
</tr>
<tr>
<td>crew</td>
<td>v</td>
</tr>
<tr>
<td>right-of-way</td>
<td>v</td>
</tr>
<tr>
<td>sluices</td>
<td>v</td>
</tr>
<tr>
<td>visual polution</td>
<td>v</td>
</tr>
<tr>
<td>docking permits</td>
<td>v</td>
</tr>
<tr>
<td>government law and financial role for initiating the projects</td>
<td>v</td>
</tr>
</tbody>
</table>

**Financial and economic aspects**

- dependence on area and prosperity | v |
- trip can be a goal in itself | v |
- stimulus for urban development | v |
- image enhancing capabilities for the region | v |
- still not much known on passenger transport over water as part of urban and regional (public) transportation system | v |
- little investments due to niche-segment | v |
- not profitable without subsidies | v |
- dedicating water transport to PT reduces input of entrepreneur and flexibilities on tariffs | v |
- Ship purchase and speeds underestimated | v |
- product of research and implementation very different | v |
- forecasts usage too easily accepted and little critisized | v |
- multiple targetgroups | v v v v v v |
- (agressive) marketing strategie vs promotional campaigns (long vs short term results) | v v |
- operating permit of 6 years too short considering investmentamounts | v |
- pilot period sufficiently long. Difficult modality | v |
- alternative means of finance (selling boat name/creative usage off-peak hours) | v |
- uniform ticketing system | v |
- extensive market research | v v |
- allow 3 year period to stabilise usage before introducing radical change | v |
- government participation needed | v |
- back-up vessel should be present for reliability | v |
- fuel 50% of operating costs | v |
- traveltime | v v |
- reliability | v |
- new opportunities (companies | v |
| costbreakdown (fixed/variable/cost ship/cost quay/cost infrastructure/cost promotion) | v |
- comfort seating | v |
- tariffs | v |
- frequency | v |
- subsidies (pilot / long-term) | v |

**Socio- and psychological aspects**

- dependence on area and prosperity | v |
- trip can be a goal in itself | v |
- still not much known on passenger transport over water as part of urban and regional (public) transportation system | v |
| dedicating water transport to PT reduces input of entrepreneur and flexibilities on tariffs | v |
| positive experience compared to other modalities | v |
| marketing approach: experience and ecofriendly | v |
| product of research and implementation very different | v |
| comfort overall | v |
| punctuality | v |
| social safety | v |
| information on board | v |
| facilities on-board | v |
| frequency and travel time often complained on | v |
| pilot period sufficiently long. Difficult modality | v |
| back-up vessel should be present for reliability | v |
| adress wash problems for public support | v |
| comfort seating | v |
| comfort ride | v |
| sound levels low | v |
| service personnel | v |
| image of boat transit | v |
| acceptance longer duration 50% for PT | v |

**Governance and organizational aspects**

| stimulus for urban development | v |
| image enhancing capabilities for the region | v v |
| aim for congestion relief | v v v v v |
| still not much known on passenger transport over water as part of urban and regional (public) transportation system | v |
| dedicating water transport to PT reduces input of entrepreneur and flexibilities on tariffs | v |
| product of research and implementation very different | v |
| Ship purchase and speeds underestimated | v |
| forecasts usage too easily accepted and little criticized | v |
| operating permit of 6 years too short considering investment amounts | v |
| influence of demands for short preparation period and speed underestimated | v |
| decentralised governments influence underestimated | v |
| jurisdiction on regional issues | v |
| involvement and motivation of governments to little | v |
| laws not designed for water transit | v |
| local differences, so national policy is difficult | v |
| extensive market research | v |
| allow 3 year period to stabilise usage before introducing radical change | v |
| government law and financial role for initiating the projects | v v v |
| alignment shipping company & wishes government | v |
Appendix D  Business Model Frameworks

Components of a business model 2003

(Hedman and Kalling 2003)

Figure 1  The components of a business model.

(Hedman and Kalling 2003)
Components of a business model 2004
(Shafer, Smith et al. 2004)

Figure 1  Components of business model affinity diagram.
(Shafer et al. 2004)
**Dynamics of business**  
(Weil 2006)

- **Organizational level:**
  - acquisition and allocation of resources
  - technical effectiveness
  - filtering of information
  - response to innovations
  - evolution of capabilities
  - competitiveness
  - profitability
- **Market level:**
  - intensity of competition
  - commoditization
  - entry and exit of firms
  - technology evolution
  - willingness to take risks
  - emergence of dominant standards and designs
  - adoption of new technologies
- **Contextual level:**
  - network effects
  - social change
  - expansion of market opportunities
  - effects of government policies
  - influence of universities
  - availability of resources
  - emergence of innovation clusters

(Weil 2006)
Six questions that underly a business model
(Morris, Schindehutte et al. 2005)

Component 1 (factors related to the offering): How do we create value? (select from each set)
- offering: primarily products/primarily services/heavy mix
- offering: standardized/some customization/high customization
- offering: broad line/medium breadth/narrow line
- offering: deep lines/medium depth/shallow lines
- offering: access to product/ product itself/ product bundled with other firm’s product
- offering: internal manufacturing or service delivery/ outsourcing/ licensing/ reselling/ value added reselling
- offering: direct distribution/indirect distribution (if indirect: single or multichannel)

Component 2 (market factors): Who do we create value for? (select from each set)
- type of organization: b-to-b/b-to-c/ both
- local/regional/national/international
- where customer is in value chain: upstream supplier/ downstream supplier/ government/ institutional/ wholesaler/ retailer/ service provider/ final consumer
- broad or general market/multiple segment/niche market
- transactional/reational

Component 3 (internal capability factors): What is our source of competence? (select one or more)
- production/operating systems
- selling/marketing
- information management/mining/packaging
- technology/R&D/creative or innovative capability/intellectual
- financial transactions/arbitrage
- supply chain management
- networking/resource leveraging

Component 4 (competitive strategy factors): How do we competitively position ourselves? (select one or more)
- image of operational excellence/consistency/dependability/speed
- product or service quality/selection/features/availability
- innovation leadership
- low cost/efficiency
- intimate customer relationship/experience

Component 5 (economic factors): How do we make money? (select from each set)
- pricing and revenue sources: fixed/mixed/ flexible
- operating leverage: high/medium/low
- volumes: high/medium/low
- margins: high/medium/low

Component 6 (personal/investor factors): What are our time, scope, and size ambitions? (select one)
- subsistence model
- income model
- growth model
- speculative model

(Morris et al. 2005)
IBMs Component business model

<table>
<thead>
<tr>
<th>Direct</th>
<th>Business Administration</th>
<th>New Business Development</th>
<th>Relationship Management</th>
<th>Servicing and Sales</th>
<th>Product Fulfillment</th>
<th>Financial Control and Accounting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Business Planning</td>
<td>Sector Planning</td>
<td>Account Planning</td>
<td>Sales Planning</td>
<td>Fulfillment Planning</td>
<td>Portfolio Planning</td>
</tr>
<tr>
<td>Control</td>
<td>Business Unit Tracking</td>
<td>Sector Management</td>
<td>Relationship Management</td>
<td>Sales Management</td>
<td>Fulfillment Planning</td>
<td>Compliance Reconciliation</td>
</tr>
<tr>
<td></td>
<td>Staff Appraisals</td>
<td>Product Management</td>
<td>Credit Assessment</td>
<td>Sales</td>
<td>Product Fulfillment</td>
<td>Customer Accounts</td>
</tr>
<tr>
<td></td>
<td>Staff Administration</td>
<td>Product Delivery</td>
<td>Credit Administration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Product Administration</td>
<td>Marketing Campaigns</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Figure 2. IBM’S Component Business Model.

(Chesbrough 2009)
The Business Model Framework
(Chesbrough 2007)

Type 1 – Company has an undifferentiated business model.
The vast majority of companies operating today do not articulate a distinct business model, and lack a process for managing it. These companies are operating with Type 1 business models. A business using the undifferentiated model competes on price and availability, and serves customers who buy on those criteria. In a word, firms utilizing Type 1 business models are selling commodities, and are doing so in ways that are no different from many, many other firms. They often are caught in the “commodity trap”. Think of restaurants and barber shops as examples of this commodity model.

Type 2 – Company has some differentiation in its business model.
In companies using Type 2 business models, the company has created some degree of differentiation in its products or services. This differentiation can also lead to a different business model from that of the Type 1 company, allowing the company to target a customer other than those that buy simply upon price and availability (such as a performance-oriented customer). This allows the Type 2 company to serve a different and less congested market segment from that served by its Type 1 counterpart. The Type 2 company may lack the resources and staying power to invest in the supporting innovations to sustain its differentiated position. This gives rise to the pattern of so-called “one hit wonders”, where a company or inventor has a successful first product, but is unable to follow up this success with additional products of similar success. Many technology startup companies fall into this type.

Type 3 – Company develops a segmented business model.
The company now can compete in different segments simultaneously. More of the market is thus served, and more profit is extracted from the market as well. The price sensitive segment provides the volume base for high volume, low cost production. The performance segment supplies high margins for the business. Other niches can now be addressed, creating a stronger presence in the distribution channels. The firm’s business model now is more distinctive and profitable, which supports the firm’s ability to plan for its future via product and technology roadmaps. While its greater level of planning helps the Type 3 company avert the one-hit wonder syndrome, problems still remain. The Type 3 firm remains vulnerable to any major new technical shift beyond the scope of their current business and innovation activities, and also to major shifts in the market. Think of a mature, vertically integrated industrial company, as an example of this kind of model. Or in the IT space, think of an ERP system that is deeply connected to business processes, but has few ways to link in other software on top of its own code.

Type 4 – Company has an externally aware business model.
In this business model, the company has started to open itself to external ideas and technologies in the development and execution of the business. This unlocks a significantly greater set of resources available to such a company. The roadmaps of the Type 4 firm provide a shopping list of needs within the firm for external ideas and technologies. Relationships with outsiders help identify external projects that fulfill some of these needs. This reduces the cost of serving the business, reduces the time it takes to get new offerings to market, and shares the risks of new products and processes with external parties. Internal roadmaps are now shared with suppliers and customers on a frequent basis. This enables the firm to make much more systematic use of innovative ideas from suppliers and from customers. It also allows suppliers and customers to plan their own activities in concert with the innovative activities of the firm. Companies that make it a practice to share real-time information with their suppliers exemplify this approach.

Type 5 – Company integrates its innovation process with its business model.
In a Type 5 model, the company’s business model now plays a key integrative role within the company. Suppliers and customers now enjoy formalized institutional access to the firm’s innovation process, and this access is now reciprocated by the suppliers and customers. Customers and suppliers now share their own roadmaps with the company, giving the company much better visibility into the customers’ future requirements. In this stage, companies begin to experiment more directly with the business model itself. Type 5 companies now take the time to understand the supply chain all the way back to the basic raw materials, as they look for major technical shifts or cost reduction opportunities. Type 5 companies also invest substantial resources to study “the customer’s customer” to learn about the deeper unmet needs and opportunities in the market. Some experimentation is conducted on alternative distribution channels, and indeed, upon alternative configurations of the business model. Companies that are moving from offering products to offering services, and are bringing in external technologies to support this new approach are examples of Type 5 models.
Type 6 – Company’s business model is an adaptive platform.

The Type 6 business model is an even more open and adaptive model than types 4 or 5. This ability to adapt requires a commitment to experimentation with one or more business model variants. This experimentation can take a number of different forms. Some companies utilize corporate venture capital as a means to explore alternative business models in small startup companies. Some utilize spin-offs and joint ventures as means to commercialize technologies outside of their own current business model. Some have created internal incubators to cultivate promising ideas that are not yet ready for high volume commercialization. In Type 6 firms, key suppliers and customers become business partners, entering into relationships in which both technical and business risk may be shared. The business models of suppliers are now integrated into the planning processes of the company. The company in turn has integrated its business model into the business model of its key customers. Intel, Microsoft and Wal-Mart are examples here. One important capability that enables this integration of business models throughout a value chain is the ability of the company to establish its technologies as the basis for a platform of innovation for that value chain. In this way, the company can attract other companies to invest their resources, expanding the value of the platform without consuming extra investment by the platform maker. For example, anyone making software for PCs, accessories for iPods, or games for cell phones is indirectly contributing to the value of each of these platforms.
Appendix E Local analysis

Visual comparison Ijssel-/Markermeer, SouthWest Holland and San Francisco Bay Area

Figure 51 Ijssel-/Markermeer, SouthWest Holland and San Francisco Bay Area (Google Earth, satellite altitude 50 miles)
Visual overview

Figure 52 Visual overview of the San Francisco Bay Area

Sources
2005 USGS - hydrographic survey of South San Francisco Francisco Bay CA
Association of Bay Area Governments ABAG www.abag.ca.gov
Personal photo stock

The strong winds typical during summer afternoons and winter storms exert considerable stress on the bay’s surface. Prevailing summer winds generate waves with maximum periods of 2-3 s and wave heights exceeding 1 m. During winter storms, 5-s waves can be generated. Seaward of the Golden Gate, swells with periods of 8-12 s are common during summer and with periods of 18 s during winter.

Daily Inter-County commuters

Figure 53 Daily Inter-County commuters (x1000) – only >25,000 showed
Current Public Transportation

Figure 54 Current Public Transportation (Source: ABAG)
Boarding points

Figure 55 Boarding points
Water depths (feet)

Figure 56 Nautical map of the San Francisco Bay Area
30 Day Traffic on the bay

On the right hand side, where the two bleu Cargo lines are, is the fourth busiest port in the US. The green lines are ferry movements.

Figure 57 30 Day traffic on the Bay
Bay Area Freeway Locations
With Most Delay During Commute Hours, 2007

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I-80 E/W, Alameda/Contra Costa County</td>
<td>1</td>
<td>11,100</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>I-80 S, Alameda County</td>
<td>2</td>
<td>7,110</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>US-101 S, Marin County</td>
<td>3</td>
<td>6,400</td>
<td>4</td>
<td>5</td>
<td>7</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>I-80 S, Alameda County</td>
<td>4</td>
<td>4,110</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>US-101 S, San Francisco</td>
<td>5</td>
<td>4,730</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>US-101 E/W, Alameda County</td>
<td>6</td>
<td>4,750</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>US-101 S, Alameda County</td>
<td>7</td>
<td>3,930</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>15</td>
<td>7</td>
</tr>
<tr>
<td>I-80 S, Alameda County</td>
<td>8</td>
<td>3,790</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>7</td>
<td>10</td>
</tr>
</tbody>
</table>

Note: This table shows the top 10 freeways in the Bay Area with the most delay during commute hours in 2007. The rankings are based on the total daily volume of vehicles and the delay caused by congestion. The locations are marked on the accompanying map.
Appendix F  Cost Structure

Numbers in the Table 28 below are based on:

- Expert advice from Robert Luth – Manager Fast Ferries at Damen Shipyards Gorinchem
- Expert advice from Johan Tuk CFO at Doeksen Transport Groep
- Expert advice from Gerbrand Schutten – General director at Aqualiner
- Expert advice from Meinard Sprenger - Former director Fast Ferry BV and Waterbus BV
- Expert advice from Dap Hartmann - Assistant professor Technology, Strategy & Entrepreneurship
- Estuary Crossing Study 2009 by CalTrans, City of Oakland, City of Alameda and ACTIA
- Port of San Francisco Water Taxi feasibility Study 2009 by Veronica Sanchez Consulting & Walter Engineering Services
<table>
<thead>
<tr>
<th>Construction &amp; procurement</th>
<th>Type</th>
<th>Unit</th>
<th>Quantity</th>
<th>Price</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vessel</td>
<td>Shuttlecat 120</td>
<td>250kw @ 24 knots</td>
<td>4</td>
<td>$ 700.000</td>
<td>$ 2.800.000</td>
</tr>
<tr>
<td>Pier</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal construction &amp; procurement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$ 2.800.000</td>
</tr>
<tr>
<td>Contingencies</td>
<td>Percentage of subtotal</td>
<td>25%</td>
<td>$ 700.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total cost construction &amp; procurement</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$ 3.500.000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vessel Operation &amp; maintenance costs</th>
<th>Type</th>
<th>Unit</th>
<th>Quantity</th>
<th>Price</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crew</td>
<td>Hours</td>
<td>1500</td>
<td>$ 50</td>
<td></td>
<td>$ 75.000</td>
</tr>
<tr>
<td>Captain</td>
<td>Hours</td>
<td>1500</td>
<td>$ 50</td>
<td></td>
<td>$ 75.000</td>
</tr>
<tr>
<td>Mooring overnight</td>
<td>Nights</td>
<td>365</td>
<td>$ 87</td>
<td></td>
<td>$ 31.755</td>
</tr>
<tr>
<td>Berthing rights</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest = Percentage of external investment = 2/3 x total constr&amp;proc</td>
<td>5%</td>
<td>$ 29.167</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>Percentage of vessel price</td>
<td>10%</td>
<td></td>
<td>$ 70.000</td>
<td></td>
</tr>
<tr>
<td>Insurance</td>
<td>Percentage of vessel price</td>
<td>2%</td>
<td></td>
<td>$ 14.000</td>
<td></td>
</tr>
<tr>
<td>Maintenance</td>
<td>Percentage of vessel price</td>
<td>5%</td>
<td></td>
<td>$ 35.000</td>
<td></td>
</tr>
<tr>
<td>Fuel</td>
<td>Hours</td>
<td>1500</td>
<td>$ 34</td>
<td></td>
<td>$ 51.563</td>
</tr>
<tr>
<td>Other Consumables</td>
<td>Percentage of fuel price</td>
<td>10%</td>
<td></td>
<td>$ 5.156</td>
<td></td>
</tr>
<tr>
<td>Contingencies</td>
<td>Percentage of vessel price</td>
<td>2.5%</td>
<td></td>
<td>$ 17.500</td>
<td></td>
</tr>
<tr>
<td>Days of operation</td>
<td></td>
<td></td>
<td>250</td>
<td>6</td>
<td>$ 404.140</td>
</tr>
<tr>
<td>Costs per vessel (annually)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$ 1.616.562</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Land-based costs</th>
<th>Type</th>
<th>Unit</th>
<th>Quantity</th>
<th>Price</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office rent</td>
<td>Lump sum</td>
<td>1</td>
<td>$ 50.000</td>
<td></td>
<td>$ 50.000</td>
</tr>
<tr>
<td>Marketing</td>
<td>Lump sum</td>
<td>1</td>
<td>$ 300.000</td>
<td></td>
<td>$ 300.000</td>
</tr>
<tr>
<td>Staff x2</td>
<td>Hours</td>
<td>2000</td>
<td>$ 100</td>
<td></td>
<td>$ 200.000</td>
</tr>
<tr>
<td><strong>Total Land-based costs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$ 550.000</td>
</tr>
</tbody>
</table>
Appendix G Permits & regulation

Permits

CPUC

“The CPUC issues operating authority to companies (except taxicabs) that are for hire to transport passengers, including charter buses, airport shuttles, and limousines that operate in California.” (CPUC 2009).

The authority to operate comes with the obligation to adhere to the requirements. These include insurance levels and fee payments. The CPUC has the power to regulate the fares and to decline the request to operate based on fair competition standards.

There are three passenger carrier types that would apply to a water taxi service, of which two require permits or a certificate and one needs only registration. All three have different requirements and all three might apply dependent on the chosen business model.

“Subject to Permit or Certificate Requirements

- CHARTER-PARTY CARRIERS charter their vehicles for the exclusive use of an individual or group. Examples are a group charter of a bus to go to a sporting event and the charter of a limousine for a wedding. Also falling under the charter-party category are some specialized types of passenger carrier services: Round-trip sightseeing service, Transportation incidental to another business and Transportation under contract to a business, government agency, or private school
- VESSEL COMMON CARRIERS transport persons or property between points within the state. Examples are commute ferry service on San Francisco Bay and service between California mainland points and Catalina Island.

Subject To Registration Requirements

- FOR-HIRE VESSEL CARRIERS perform passenger transportation services for compensation other than point-to-point service that is subject to vessel common carrier regulation. Examples are loop sightseeing service and fishing boat trips.”


Commercially supplying access and egress to the customer would require additional permission from the CPUC. Outsourcing this to existing companies would eliminate this need.

Vessel certification

The U.S. Coast Guard certifies vessels operating in American waters. Discussion in this section is limited to small size vessels. U.S. Code of Federal Regulations Title 46 part 175-185: Subchapter-T is designed specifically for vessels of less than 100 gross tons that carries 150 or less passengers (GPOAccess 2009a).

These co-called Small Passenger Vehicles (SPVs) fall under a comprehensive safety inspection program:

“SPVs undergo regular safety equipment, training, construction, stability and drydock inspections by a qualified Coast Guard marine inspector leading to issuance of a Certificate of Inspection.” (USCG 2006)

Subjects covered by Subchapter T include Construction & arrangement, Intact stability & seaworthiness, Lifesaving equipment & arrangements, Fire protection equipment and Operations

Exemptions

Vessels are exempted from USCG inspections either by based on the number of people aboard the vessel and its weight or by presenting accepted alternative certification.
Table 29 shows a distinction between Uninspected- and Small Passenger Vehicles. Uninspected Passenger Vessels (UPV) in the San Francisco Bay Area are only required to adhere to the UPV Requirements Guide of MSO San Francisco (USCG 2003), but encouraged to participate in the Voluntary 5 Star Safety Program (USCG 2006). Which is much less elaborate, less time consuming and less costly.

Two alternative certifications also allow for exemption: SOLAS and certificates of equal standards to those of the U.S.

SOLAS:
“A vessel of foreign country that is a party to the International Convention for the Safety of Life at Sea, 1974, as amended (SOLAS), to which the United States Government is currently a party, and that has on board a current valid SOLAS Passenger Ship Safety Certificate” - CFR Title 46 §175.110 par b4

Equal standard:
“A vessel of a foreign country, whose government has inspection laws approximating those of the United States and that by its laws accords similar privileges to vessels of the United States, which has on board a current valid certificate of inspection, permitting the carrying of passengers, issued by its government.” - CFR Title 46 §175.110 par b5

Wetlands
The wetlands in the Bay Area are mostly indicated as protected. Basically this would mean stay of. Research however for the redwood City ferry terminal indicated the possibility to get a permit when the wetlands cannot be avoided. These permits would come from the US Army Corps of Engineers, the Water Quality Control Board, and Bay Conservation Development Commission (Multiple 2007).

Regulation
To protect life and property on the U.S. waterways many Federal and State government agencies have designed statutes. The United States Coast Guard (USCG), is the key department authorized to regulate waterway usage and certify vessels. USCG is a military branch of the United States and part of the Department of Homeland Security (USCG 2009).

The main section on requirements for shipping in the U.S. Code of Federal Regulations (CFR) is Title 46 - Shipping. CFR Title 33 - Navigation and Navigable Waters is concerned with safety management, pollution prevention and navigation safety regulations.

The main items that will be influenced by the regulations in those sections are:
- Speed
- Noise
- Purchase

Also security measures and air emission are discussed in this section.

14 Statutes are laws enacted by a legislative branch of the government
Speed limits

Speed of vessels is a key variable in the service levels of water transportation. The Navigation Center (USCG) of the USCG provides an extensive overview of all rules for both International and Inland navigation. The main rule is:

“Every vessel shall at all times proceed at a safe speed so that she can take proper and effective action to avoid collision and be stopped within a distance appropriate to the prevailing circumstances and conditions.”

It further states that a safe speed is, among others, affected by the state of visibility, the traffic density, the manageability of the vessel and the state of wind, sea and current. This always considering the rules of the road. (USCG)

Vessels under 1600 Gross Ton are not specifically required to manage their speed in regards to wake, they are still required to operate in a prudent matter “which does not endanger life, limb, or property” according to U.S. Code Title 46 Chapter 23 – Operations of vessels generally. The above indicates that there is not a general speed limit.

This has been confirmed by a member of the Water Emergency Transportation Association (WETA) in San Francisco. In the SF Bay Area the only enforcement by Local Law Enforcement agencies on speeds is when wake damage is an issue. This is the reason that most marina’s often do have a 5 mile per hour speed limit.

This means that too much wake could still become an issue due to the new generation of high speed craft (Hoppe 2005). These high speeds craft (>30knots) are not limited to top speeds either, but the International Maritime Organization (IMO) has designed the International Code for High-Speed Craft (HSC-Code). This code has been adopted by the USCG according to an internal policy distribution in 2000 (USCG 2000). The HSC-code defines requirements in a wide range from Structures & Navigational equipment to Handling, controllability & performance.

Concerns have been expressed by the USCG Office of Vessel Traffic Management on the increased risk of collision (Blume 2001) due to the high speeds. There are two reasons for this concern. The first is due to the decreased time to respond caused by the high speeds, creating the need for better radars. Also sonar is needed for whale detection. The second is due to the forecast increase in both the number of high-speed ferries as well as other commercial and recreational vessels operating on the Nation’s waterways.

Noise levels

Noise levels are becoming increasingly important, with the increase of environmental awareness, both for users and the surroundings. The National Association of State Boating Law Administrators provides lists of regulations that are more stringent at the State level than the Federal laws are. For California the noise levels of motorized vessels have been explicitly adjusted, “Vessels built on or after 1/1/93 88 dB(A) using SAE J2005” (NASBLA 2007). Older vessels have less strict levels as low as 75 dB(A) using SAE J1970.

Local ordinance may be even stricter, these could even restrict full areas of operation. These details have not been found for the San Francisco Bay Area.

Importing foreign vessels

There is a wide variety of vessels available in the world. The protective behavior for has made it hard to import readymade vessels for commercial purposes into the United States. Section 27 of the Merchant Marine Act of 1920 (46 U.S.C. 883; 19 CFR 4.80 and 4.80b), better known as the Jones Act, states:

“It is necessary for the national defense and for the proper growth of its foreign and domestic commerce that the United States shall have a merchant marine of the best equipped and most suitable types of vessels sufficient to carry the greater portion of its commerce and serve as a naval or military auxiliary in time of war or national emergency, ultimately to be owned and operated privately by citizens of the United States…” (JONES ACT - Section 27, Merchant Marine Act, 1920, § 861. Purpose and policy of United States)” (USC 1920)
The Transportation Institute (TransportationInstitute 2009) states that this cabotage policy basically requires that only U.S.-built, U.S.-owned, and U.S.-crewed vessels be used to transport merchandise in U.S. domestic trade.

The same goes for passenger vessels since merchant vessels are defined as Ship designed for the carriage of goods, transport of passengers or specially fitted out for a specific duty (OECD 2004). Next to that the Passenger Vessel Services Act (46 App. U.S.C. 55103) - Transportation of passengers in foreign vessels states:

“No foreign vessel shall transport passengers between ports or places in the United States, either directly or by way of a foreign port, under a penalty of $200 for each passenger so transported and landed.”

Meetings with Port officials show that either importing vessels in parts or changing the vessel to American flagged might work.

Also applying for the Small Vessel Waiver Program (USDoT) at the Maritime Administration, part of the U.S. Department of Transportation is an option. There are some basic requirements for a vessel to qualify for a waiver under this program. Among others the vessel:

- must be at least three years old,
- must be of at least 5 net tons (approximately 24’ in length),
- when in service, cannot carry more than 12 passengers.

This needs further research mainly in the form of legal advice on a (set of) preferred vessel(s).

**Security**

The close proximity of small passenger vessels to critical infrastructure and key resources, including major transportation channels and military ships, is just one of the reasons why the Department of Homeland Security designed a Small Vessel Security Strategy. The strategy’s purpose is to:

“address the risk that small vessels might be used to smuggle terrorists or Weapons of Mass Destruction into the United States or might be used as either a stand-off weapon platform or as a means of a direct attack with a Water-Borne Improvised Explosive Device.” (DHS 2008)

The Strategy announces a potential increase in registration efforts and integration of new technologies on each vessel.

The three main pieces of legislation on maritime security are (TRB 2006):

- International Ships & Port Facility Security Code (ISPS)
- Maritime Transportation Security Act (MTSA)
- CFR Title 33

The same source refers to the circularizes that enact the regulations. It also contains a practical seven step evaluation process has been designed to “allow users to weigh their evaluation criteria and then identify and quantitatively contrast candidate security measures for their ferry system operation.” (TRB 2006).

For most existing water taxi services, often by definition a ferry system, this process would apply. The expectation is that for the service in this research the process would result in at least sufficient security levels.

**Air emissions**

New California air emission rules went into effect on January 1, 2009: Harbor Craft Air Emissions Rule (CEPA 2009). This rule will affect virtually every vessel in the State of California.

---

15 In the Strategy Small vessels are characterized as any watercraft regardless of method of propulsion, less than 300 gross tons. Although there is no exact correlation between a vessel’s length and its gross tonnage, a vessel of 300 GT is approximately 100 ft in length.
Summarized from the Passenger Vessel Association (PVA), here are key features of the new Emission rule (PVA 2009). Obligation to use Low Sulfur Fuel, use non-resettable hour meters, incorporate new EPA Tier 2 or Tier 3 engines according to schedule and for certain newly built vessels (incl Ferries >75pax) there is the obligation to use Best Available Control Technology (BACT) as approved in advance by CARB Executive Officer.
## Appendix H Vessel specifics

### Vessel inventory

<table>
<thead>
<tr>
<th>Company</th>
<th>Name</th>
<th>Type</th>
<th>Price</th>
<th>Speed (knots)</th>
<th>Pax</th>
<th>Length (m)</th>
<th>Propulsion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tranz</td>
<td>TRANZ Watertaxi &quot;Rotterdam&quot;</td>
<td>Monohull</td>
<td>~€0,2mio</td>
<td>8-12</td>
<td></td>
<td></td>
<td>Waterjets</td>
</tr>
<tr>
<td>Damen Shipyards</td>
<td>DFF1004 &quot;Dubai&quot;</td>
<td>Catamaran</td>
<td>~€1mio</td>
<td>35</td>
<td>11</td>
<td>10</td>
<td>Waterjets</td>
</tr>
<tr>
<td>Damen Shipyards</td>
<td>DFF1907</td>
<td>Catamaran</td>
<td>~€2mio</td>
<td>28</td>
<td>40</td>
<td>19</td>
<td>Waterjets</td>
</tr>
<tr>
<td>Fontaine Pajot</td>
<td>ShuttleCat 120 &quot;Paris&quot;</td>
<td>Catamaran</td>
<td>~€0,5mio</td>
<td>24</td>
<td>40</td>
<td>12</td>
<td>Propeller</td>
</tr>
<tr>
<td>Damen Shipyards</td>
<td>DFF3007 &quot;Waterbus&quot;</td>
<td>Catamaran</td>
<td>~€3mio</td>
<td>30</td>
<td>149</td>
<td>30</td>
<td>Propeller</td>
</tr>
<tr>
<td>Fontaine Pajot</td>
<td>ShuttleCat 240 &quot;Aqualiner&quot;</td>
<td>Catamaran</td>
<td>~€1mio</td>
<td>28</td>
<td>149</td>
<td>24</td>
<td>Propeller</td>
</tr>
<tr>
<td>Voskhod</td>
<td>2M-FFF &quot;Meteoor&quot;</td>
<td>Hydrofoil</td>
<td>~€1mio</td>
<td>34</td>
<td>79</td>
<td>28</td>
<td>Propeller</td>
</tr>
</tbody>
</table>

*Figure 58 Overview of most of the different types of advanced marine vehicles*
Vessel acceleration

Figure 59 Conventional ship displacement

Figure 60 Allowable limits of vertical acceleration as function of human effectiveness

Figure 61 Degradation of human performance due to lateral acceleration

Figure 62 Effect of roll angle on human performance

Source (Frouws 2000)
### Propulsion systems

**Table 31 Engine types**

<table>
<thead>
<tr>
<th></th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Diesel</strong></td>
<td>relatively low purchase costs</td>
<td>high emissions</td>
</tr>
<tr>
<td>(Kite-Powell (2005))</td>
<td></td>
<td>high fuel price</td>
</tr>
<tr>
<td><strong>Diesel-electric</strong></td>
<td>low noise</td>
<td>high fuel price</td>
</tr>
<tr>
<td>(IHI Marine United (2008))</td>
<td>low vibration disturbances</td>
<td></td>
</tr>
<tr>
<td></td>
<td>lower energy consumption than diesel</td>
<td></td>
</tr>
<tr>
<td></td>
<td>higher flexibility in the ship design</td>
<td></td>
</tr>
<tr>
<td></td>
<td>possibility of no emissions in urban areas</td>
<td></td>
</tr>
<tr>
<td><strong>Electricity</strong></td>
<td>no emissions</td>
<td>very low power to weight ratio, because of need for batteries</td>
</tr>
<tr>
<td>(Georgescu &amp; mammut 2004)</td>
<td>low vibration disturbances</td>
<td>high storage space needed for batteries</td>
</tr>
<tr>
<td></td>
<td>silent</td>
<td></td>
</tr>
<tr>
<td></td>
<td>reduced space machinery</td>
<td></td>
</tr>
<tr>
<td><strong>Gas turbines</strong></td>
<td>high power to weight ratio</td>
<td>higher purchase cost</td>
</tr>
<tr>
<td>(Kite-Powell (2005) and Jofs (2008))</td>
<td>high operating speeds</td>
<td>higher maintenance cost</td>
</tr>
<tr>
<td></td>
<td>no vibration</td>
<td>high fuel price</td>
</tr>
<tr>
<td></td>
<td>lower maintenance requirements</td>
<td></td>
</tr>
<tr>
<td></td>
<td>reduced emission</td>
<td></td>
</tr>
<tr>
<td><strong>Hydrogen</strong></td>
<td>High potential thermal efficiency</td>
<td>high cost</td>
</tr>
<tr>
<td>(Hazeldine, Pridmore et al. 2009)</td>
<td>low emissions</td>
<td>questionable durability</td>
</tr>
<tr>
<td></td>
<td></td>
<td>questionable reliability</td>
</tr>
<tr>
<td></td>
<td></td>
<td>excessive weight and volume</td>
</tr>
<tr>
<td></td>
<td></td>
<td>low safety of onboard storage and dangerous handling of fuel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>high administrative effort to get approval</td>
</tr>
</tbody>
</table>

Sources (Hazeldine et al. 2009; Piet 2008; WETA 2002)

Original sources of (Piet 2008):

- Georgescu, C., Mammut E.: A study concerning the possibilities for using fuel cells systems for maritime propulsion, Constanta Romania (December 21, 2004)
Appendix I Travel time

Travel times for new WETA routes

Table 32 Travel times for new WETA routes (expected by 2025)

<table>
<thead>
<tr>
<th>To/From</th>
<th>To/From</th>
<th>Minutes</th>
<th>Pax (daily)</th>
<th>Costs $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berkeley</td>
<td>San Francisco Ferry Building</td>
<td>22</td>
<td>1716</td>
<td>34 mio terminal includes all environmental, design and engineering, mitigation and construction costs</td>
</tr>
<tr>
<td>Richmond</td>
<td>San Francisco Ferry Building</td>
<td>30</td>
<td>1947</td>
<td>23 mio vessel costs includes costs for two 25 knot, 199 passenger-only ferries</td>
</tr>
<tr>
<td>Redwood City</td>
<td>San Francisco Ferry Building</td>
<td>47</td>
<td>1420</td>
<td>20 mio Terminal construction</td>
</tr>
<tr>
<td>Redwood City</td>
<td>East Bay (Jack London)</td>
<td>45</td>
<td></td>
<td>5 mio Annual operating costs</td>
</tr>
<tr>
<td>South San Francisco</td>
<td>East Bay (Jack London)</td>
<td>30</td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>Treasure Island</td>
<td>San Francisco Ferry Building</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treasure Island</td>
<td>Berkeley</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treasure Island</td>
<td>Oakland</td>
<td>23</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: WETA website and (WETA 2009b)
Service zones and travel times

Figure 63 Service zones and travel times
Example comparison travel time car versus boat
DLA Piper Silicon Valley – San Francisco

By car
According to employee:
+/- 60 minutes dependent on rush hour.

“Ik reken 1 uur voor de trip van PA naar SF. Zonder spits is het in werkelijkheid wat minder en met spits waarschijnlijk iets meer. Groot verschil (maar dat weet jij natuurlijk wel) is het vinden van parking en het bijbehorende prijskaartje. Plus; het kunnen werken op de boot, of ander vertier is natuurlijk priceless.” (E. van Gool)

According to Google Travel Planner:
35-40 minutes during lunch.
60min and up in rush hours

Figure 64 Travel estimation Car

By Boat (for the route see next page)
Car stretch 1: 7min
Boat 27,5miles = 44,3km by water
Car stretch 2: 5min

To beat traffic, boats have to travel at least (without delays):
Compete during quiet hours: \( \frac{44.3}{((35-12)/60)} = 116 \text{ km/h} \sim 63\text{knots} \) [impossible]
Compete with rush hour time: \( \frac{44.3}{((60-12)/60)} = 55.4 \text{ km/h} \sim 30\text{knots} \)

By known fastest vessel
\( \sim 100\text{km/h} \) [55 knots]: 27minutes + car stretches = 39minutes
Figure 65 Travel estimation Boat
Appendix J Stakeholders analysis

Stakeholder overview

Figure 66 Stakeholder overview
<table>
<thead>
<tr>
<th>Actor</th>
<th>Resources</th>
<th>Replace-ability</th>
<th>Importance of resources</th>
<th>Critical stakeholder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal Government</td>
<td>Legislative power, Financial support</td>
<td>Large</td>
<td>Average</td>
<td>No</td>
</tr>
<tr>
<td>California State Government</td>
<td>Legislative power, Financial support</td>
<td>Large</td>
<td>Average</td>
<td>No</td>
</tr>
<tr>
<td>Environmental Protection Agency</td>
<td>Permit issuing - environmental</td>
<td>Irreplaceable</td>
<td>Large</td>
<td>Yes</td>
</tr>
<tr>
<td>US Army Corps of Engineers</td>
<td>Permit issuing - technical, Technical support, Technical evaluation</td>
<td>Irreplaceable</td>
<td>Large</td>
<td>Yes</td>
</tr>
<tr>
<td>Department of Homeland Security</td>
<td>Legislative power</td>
<td>Small</td>
<td>Average</td>
<td>No</td>
</tr>
<tr>
<td>US Coast Guard</td>
<td>Permit issuing - operational</td>
<td>Irreplaceable</td>
<td>Large</td>
<td>Yes</td>
</tr>
<tr>
<td>Department of Boating and Waterways</td>
<td>Officer training, Financial aid, Equipment grants</td>
<td>Large</td>
<td>Average</td>
<td>No</td>
</tr>
<tr>
<td>Business, Transportation &amp; Housing Agency</td>
<td>Infrastructure advisory, Financial support, Starting a business in California</td>
<td>Large</td>
<td>Average</td>
<td>No</td>
</tr>
<tr>
<td>California Transportation Commission</td>
<td>programming and allocating funds for the construction of highway, passenger rail and transit</td>
<td>Large</td>
<td>Average</td>
<td>No</td>
</tr>
<tr>
<td>California Public Utilities Commission</td>
<td>Permits issuing - transporting passengers / concession</td>
<td>Irreplaceable</td>
<td>Large</td>
<td>Yes</td>
</tr>
<tr>
<td>Department of Transportation</td>
<td>Funding to improve mobility, ADA compliance</td>
<td>Large</td>
<td>Average</td>
<td>No</td>
</tr>
<tr>
<td>SFBA Water Emergency Transportation Authority</td>
<td>Expertise Passenger transportation over water, Regionwide objective to enhance water transportation network, Current public transportation operator</td>
<td>Large</td>
<td>Small</td>
<td>No</td>
</tr>
<tr>
<td>San Francisco Bay Conservation and Development Commission</td>
<td>Permit issuing - construction on the Bay or within 100 feet of the shoreline, Lobbying power</td>
<td>Irreplaceable</td>
<td>Large</td>
<td>Yes</td>
</tr>
<tr>
<td>Association of Bay Area Governments</td>
<td>Lobbying power</td>
<td>Small</td>
<td>Large</td>
<td>Yes</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>----------------</td>
<td>-------</td>
<td>-------</td>
<td>-----</td>
</tr>
<tr>
<td>Metropolitan Transportation Commission</td>
<td>Transportation planning</td>
<td>Average</td>
<td>Small</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Transportation coordination in Bay Area</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Financial support</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>County Government</td>
<td>Financial support</td>
<td>Small</td>
<td>Large</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Owner of land</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>City Government</td>
<td>Financial support</td>
<td>Small</td>
<td>Large</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Owner of land</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Port Authorities</td>
<td>Financial support</td>
<td>Small</td>
<td>Large</td>
<td>Yes</td>
</tr>
<tr>
<td>San Francisco</td>
<td>Owner of land</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oakland</td>
<td>Boarding points</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Redwood City</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Richmond</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sacramento</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passenger Vessel Association</td>
<td>Knowledge on water transportation</td>
<td>Large</td>
<td>Average</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Lobbying power</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AC Transit</td>
<td>Current public transportation operator</td>
<td>Large</td>
<td>Small</td>
<td>No</td>
</tr>
<tr>
<td>San Francisco Bay Area Rapid Transit Commission</td>
<td>Current public transportation operator</td>
<td>Large</td>
<td>Small</td>
<td>No</td>
</tr>
<tr>
<td>AMTRAK</td>
<td>Current public transportation operator</td>
<td>Large</td>
<td>Small</td>
<td>No</td>
</tr>
<tr>
<td>Marina's</td>
<td>Boarding points</td>
<td>Small</td>
<td>Large</td>
<td>Yes</td>
</tr>
<tr>
<td>Recreational Boaters</td>
<td>Hindering power</td>
<td>Large</td>
<td>Small</td>
<td>No</td>
</tr>
<tr>
<td>Cruise/Tourist/Fishing operators</td>
<td>In possession of transportation permits</td>
<td>Average</td>
<td>Average</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Possible competitor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ferries</td>
<td>Current public transportation operator</td>
<td>Average</td>
<td>Average</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>In possession of transportation permits</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Possible competitor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marine Services</td>
<td>In possession of transportation permits</td>
<td>Average</td>
<td>Average</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Possible competitor</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Appendix K  Experiment elements

**Items included/excluded from survey**

<table>
<thead>
<tr>
<th>Key activities</th>
<th>In profiles</th>
<th>In remaining part of survey</th>
<th>excluded</th>
</tr>
</thead>
<tbody>
<tr>
<td>operating</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>planning</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>scheduling</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>reservations</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>marketing</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>on-board service</td>
<td>v</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| partner network         |             |                             |          |
| access / egress arranged| v           |                             |          |
| cooperation             | x           |                             |          |

| key resources           |             |                             |          |
| vessels                 |             |                             |          |
| speed (influences travel time) | v     |                             |          |
| comfort (vessel stability)     | v           |                             |          |
| Comfort (luxury / seating)   | v           |                             |          |
| propulsion               | v           |                             |          |
| # pax                    | v           |                             |          |
| Max wait time (based on #vessels) |          |                             |          |

| manning                 |             |                             |          |
| #                       | x           |                             |          |
| quality                 | v           |                             |          |
| boarding points         | x           |                             |          |

| client relationships    |             |                             |          |

| client segments         |             |                             |          |
| tourism                 | x           |                             |          |
| commuters               | v           |                             |          |
| business                | v           |                             |          |

| distribution channels   |             |                             |          |

| cost structure          |             |                             |          |
| construction & procurement | x       |                             |          |
| vessel operation & maintenance | x   |                             |          |
| land-based costs        | x           |                             |          |

| revenue flows           |             |                             |          |
| ticket fares (one-way)  | v           |                             |          |
| external funding        | x           |                             |          |
| leasing-out vessels     | x           |                             |          |
### Attributes, attribute levels & encoding

<table>
<thead>
<tr>
<th>Attributes &amp; Levels</th>
<th>Encoding</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trip duration</strong></td>
<td></td>
</tr>
<tr>
<td>0 60 minutes</td>
<td>-1 -1</td>
</tr>
<tr>
<td>1 50 minutes</td>
<td>0 1</td>
</tr>
<tr>
<td>2 40 minutes</td>
<td>1 0</td>
</tr>
<tr>
<td><strong>Maximum delay</strong></td>
<td></td>
</tr>
<tr>
<td>0 25 minutes</td>
<td>-1 -1</td>
</tr>
<tr>
<td>1 15 minutes</td>
<td>0 1</td>
</tr>
<tr>
<td>2 5 minutes</td>
<td>1 0</td>
</tr>
<tr>
<td><strong>Comfort</strong></td>
<td></td>
</tr>
<tr>
<td>0 AC Transit local bus</td>
<td>-1 -1</td>
</tr>
<tr>
<td>1 BART/CalTrain/AMTRAK</td>
<td>0 1</td>
</tr>
<tr>
<td>2 Business class (airplane)</td>
<td>1 0</td>
</tr>
<tr>
<td><strong>Number of passengers</strong></td>
<td></td>
</tr>
<tr>
<td>0 maximum 30</td>
<td>-1 -1</td>
</tr>
<tr>
<td>1 maximum 12</td>
<td>0 1</td>
</tr>
<tr>
<td>2 Private vessel / with a group</td>
<td>1 0</td>
</tr>
<tr>
<td><strong>Ticket price</strong></td>
<td></td>
</tr>
<tr>
<td>0 $30</td>
<td>1 0</td>
</tr>
<tr>
<td>1 $90</td>
<td>0 1</td>
</tr>
<tr>
<td>2 $150</td>
<td>-1 -1</td>
</tr>
</tbody>
</table>
### Profile construction

**BASIC PLAN 4: $3^2$; 18 trials**

<table>
<thead>
<tr>
<th>Attribute #</th>
<th>1 Trip duration (DUR)</th>
<th>2 Maximum delay (REL)</th>
<th>3 Comfort (COM)</th>
<th>4 Number of passengers (PAX)</th>
<th>5 Ticket price (PRC)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unused</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Unused</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Profile #</td>
<td>Attribute level in profile:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>-----------------------</td>
<td>-----------------------</td>
<td>-----------------</td>
<td>-------------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>12</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>16</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>17</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>18</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
### Survey profiles

#### Profile 1
<table>
<thead>
<tr>
<th>Trip duration</th>
<th>0</th>
<th>60 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum delay</td>
<td>0</td>
<td>25 minutes</td>
</tr>
<tr>
<td>Comfort</td>
<td>0</td>
<td>AC Transit local bus</td>
</tr>
<tr>
<td>Number of passengers</td>
<td>0</td>
<td>maximum 30</td>
</tr>
<tr>
<td>Ticket price</td>
<td>0</td>
<td>$30</td>
</tr>
</tbody>
</table>

#### Profile 2
<table>
<thead>
<tr>
<th>Trip duration</th>
<th>0</th>
<th>60 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum delay</td>
<td>1</td>
<td>15 minutes</td>
</tr>
<tr>
<td>Comfort</td>
<td>1</td>
<td>BART/CalTrain/AMTRAK</td>
</tr>
<tr>
<td>Number of passengers</td>
<td>2</td>
<td>Private vessel / with a group</td>
</tr>
<tr>
<td>Ticket price</td>
<td>1</td>
<td>$90</td>
</tr>
</tbody>
</table>

#### Profile 3
<table>
<thead>
<tr>
<th>Trip duration</th>
<th>0</th>
<th>60 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum delay</td>
<td>2</td>
<td>5 minutes</td>
</tr>
<tr>
<td>Comfort</td>
<td>2</td>
<td>Business class (airplane)</td>
</tr>
<tr>
<td>Number of passengers</td>
<td>1</td>
<td>maximum 12</td>
</tr>
<tr>
<td>Ticket price</td>
<td>2</td>
<td>$150</td>
</tr>
</tbody>
</table>

#### Profile 4
<table>
<thead>
<tr>
<th>Trip duration</th>
<th>1</th>
<th>50 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum delay</td>
<td>0</td>
<td>25 minutes</td>
</tr>
<tr>
<td>Comfort</td>
<td>1</td>
<td>BART/CalTrain/AMTRAK</td>
</tr>
<tr>
<td>Number of passengers</td>
<td>1</td>
<td>maximum 12</td>
</tr>
<tr>
<td>Ticket price</td>
<td>1</td>
<td>$90</td>
</tr>
</tbody>
</table>

#### Profile 5
<table>
<thead>
<tr>
<th>Trip duration</th>
<th>1</th>
<th>50 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum delay</td>
<td>1</td>
<td>15 minutes</td>
</tr>
<tr>
<td>Comfort</td>
<td>2</td>
<td>Business class (airplane)</td>
</tr>
<tr>
<td>Number of passengers</td>
<td>0</td>
<td>maximum 30</td>
</tr>
<tr>
<td>Ticket price</td>
<td>2</td>
<td>$150</td>
</tr>
</tbody>
</table>

#### Profile 6
<table>
<thead>
<tr>
<th>Trip duration</th>
<th>1</th>
<th>50 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum delay</td>
<td>2</td>
<td>5 minutes</td>
</tr>
<tr>
<td>Comfort</td>
<td>0</td>
<td>AC Transit local bus</td>
</tr>
<tr>
<td>Number of passengers</td>
<td>2</td>
<td>Private vessel / with a group</td>
</tr>
<tr>
<td>Ticket price</td>
<td>0</td>
<td>$30</td>
</tr>
<tr>
<td>Profile 7</td>
<td>Profile 8</td>
<td>Profile 9</td>
</tr>
<tr>
<td>----------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td><strong>Trip duration</strong></td>
<td>2</td>
<td>40 minutes</td>
</tr>
<tr>
<td><strong>Maximum delay</strong></td>
<td>0</td>
<td>25 minutes</td>
</tr>
<tr>
<td><strong>Comfort</strong></td>
<td>2</td>
<td>Business class (airplane)</td>
</tr>
<tr>
<td><strong>Number of passengers</strong></td>
<td>2</td>
<td>Private vessel / with a group</td>
</tr>
<tr>
<td><strong>Ticket price</strong></td>
<td>1</td>
<td>$90</td>
</tr>
<tr>
<td><strong>Trip duration</strong></td>
<td>0</td>
<td>60 minutes</td>
</tr>
<tr>
<td><strong>Maximum delay</strong></td>
<td>0</td>
<td>25 minutes</td>
</tr>
<tr>
<td><strong>Comfort</strong></td>
<td>2</td>
<td>Business class (airplane)</td>
</tr>
<tr>
<td><strong>Number of passengers</strong></td>
<td>1</td>
<td>maximum 12</td>
</tr>
<tr>
<td><strong>Ticket price</strong></td>
<td>0</td>
<td>$30</td>
</tr>
<tr>
<td><strong>Trip duration</strong></td>
<td>0</td>
<td>60 minutes</td>
</tr>
<tr>
<td><strong>Maximum delay</strong></td>
<td>2</td>
<td>5 minutes</td>
</tr>
<tr>
<td><strong>Comfort</strong></td>
<td>1</td>
<td>BART/CalTrain/AMTRAK</td>
</tr>
<tr>
<td><strong>Number of passengers</strong></td>
<td>2</td>
<td>Private vessel / with a group</td>
</tr>
<tr>
<td><strong>Ticket price</strong></td>
<td>2</td>
<td>$150</td>
</tr>
<tr>
<td>Profile 13</td>
<td>Profile 14</td>
<td>Profile 15</td>
</tr>
<tr>
<td>------------</td>
<td>------------</td>
<td>------------</td>
</tr>
<tr>
<td><strong>Trip duration</strong></td>
<td><strong>Trip duration</strong></td>
<td><strong>Trip duration</strong></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>50 minutes</strong></td>
<td><strong>50 minutes</strong></td>
<td><strong>50 minutes</strong></td>
</tr>
<tr>
<td><strong>Maximum delay</strong></td>
<td><strong>Maximum delay</strong></td>
<td><strong>Maximum delay</strong></td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>25 minutes</strong></td>
<td><strong>15 minutes</strong></td>
<td><strong>5 minutes</strong></td>
</tr>
<tr>
<td><strong>Comfort</strong></td>
<td><strong>Comfort</strong></td>
<td><strong>Comfort</strong></td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>AC Transit local bus</strong></td>
<td><strong>BART/CalTrain/AMTRAK</strong></td>
<td><strong>Business class (airplane)</strong></td>
</tr>
<tr>
<td><strong>Number of passengers</strong></td>
<td><strong>Number of passengers</strong></td>
<td><strong>Number of passengers</strong></td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Private vessel / with a group</strong></td>
<td><strong>maximum 12</strong></td>
<td><strong>maximum 30</strong></td>
</tr>
<tr>
<td><strong>Ticket price</strong></td>
<td><strong>Ticket price</strong></td>
<td><strong>Ticket price</strong></td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>$150</strong></td>
<td><strong>$30</strong></td>
<td><strong>$90</strong></td>
</tr>
</tbody>
</table>
**Survey profile variation**

<table>
<thead>
<tr>
<th>Profile</th>
<th>Location in Survey 1</th>
<th>Location in Survey 2</th>
<th>Location in Survey 3</th>
<th>Location in Survey 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>10</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>11</td>
<td>17</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>12</td>
<td>16</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>13</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>13</td>
<td>14</td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>16</td>
<td>15</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>16</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>5</td>
<td>17</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>8</td>
<td>18</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>10</td>
<td>11</td>
<td>1</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>11</td>
<td>14</td>
<td>2</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>12</td>
<td>17</td>
<td>3</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>13</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>14</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>14</td>
</tr>
<tr>
<td>15</td>
<td>9</td>
<td>6</td>
<td>4</td>
<td>15</td>
</tr>
<tr>
<td>16</td>
<td>12</td>
<td>7</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>17</td>
<td>15</td>
<td>8</td>
<td>2</td>
<td>17</td>
</tr>
<tr>
<td>18</td>
<td>18</td>
<td>9</td>
<td>1</td>
<td>18</td>
</tr>
</tbody>
</table>
**Biogeme model**

// File Biogeme.mod

[ModelDescription]
"Biogeme"

[Choice]
CHOICE

[Beta]
// Name Value LowerBound UpperBound status (0=variable, 1=fixed)
asc1 0 -10000 10000 0
asc2 0 -10000 10000 1
beta1 0 -10000 10000 0
beta2 0 -10000 10000 0
beta3 0 -10000 10000 0
beta4 0 -10000 10000 0
beta5 0 -10000 10000 0
beta6 0 -10000 10000 0
beta7 0 -10000 10000 0
beta8 0 -10000 10000 0
beta9 0 -10000 10000 0
beta10 0 -10000 10000 0

[Utilities]
// Id Name Avail linear-in-parameter expression (beta1*x1 + beta2*x2 + ... )
1 TAXI AV1 asc1 * CONST + beta1 * DUR1 + beta2 * DUR2 + beta3 * REL1 + beta4 * REL2 + beta5 * COM1 + beta6 * COM2 + beta7 * PAX1 + beta8 * PAX2 + beta9 * PRC1 + beta10 * PRC2
2 NOTAXI AV2 asc2 * CONST

[Expressions]
// Define here arithmetic expressions for name that are not directly available from the data
CONST = 1

[Model]
// Currently, only $MNL (multinomial logit), $NL (nested logit), $CNL (cross-nested logit) and $NGEV (Network GEV model) are valid keywords

$MNL

Figure 67 Biogeme model
Email invitation & reminder

Dear <<mailmerge>>,

With this email we would like to take the liberty to point out the importance of your reply to the survey in the email below. Answering these questions might lead to a new water taxi service in the San Francisco Bay Area. It would take less than five minutes to answer the questions.

If you have other preferences, questions or suggestions, please let us know. Thank you in advance.

PS the survey closes next Wednesday October 28th.

Kind regards,

Jody Verpoort

Delft University of Technology (TU Delft)
The Netherlands

T  +31 6 - 519 402 83
E  j.verpoort@student.tudelft.nl
W  home.tudelft.nl/en/

Sent Friday October 16th

There seems to be great business potential for the niche market of executive transportation over water. This contrary to the highly subsidized market of public transit, for which increasing efforts are underway to further utilize the Bay Area waters for passenger transportation.

In collaboration with Delft University of Technology in the Netherlands, a feasibility study is underway focused on developing a high-end business water taxi for the San Francisco Bay Area. Amongst others it would provide a solution for the increasing unpredictability in travel times due to congestion and parking problems.

For us to be able to identify the most feasible business opportunities we need your feedback.

It would be greatly appreciated if you would be so kind to answer a survey mainly consisting of yes/no choices. The survey has been designed and tested to take no more than 5 minutes of your time.

Please use the following link to reach the survey:

http://www.thesistools.com/?qid=92075&ln=eng

Note: the initial email address is asked by the webhost and is not needed to participate. Instead you can enter a random but unique username to enter the survey.

This survey is meant for current, former and future business people in the San Francisco Bay Area. Please feel free to forward this message to anyone who might be interested in the research.

If you have any questions or would like to have more information, please feel free to contact us at any time.

Kind regards,

Jody Verpoort
Online survey screenshots

1. Are you currently or formerly employed in the San Francisco Bay Area, or will you be in the near future?
   - Yes
   - No

Continue...

Trip details
Please answer each question as if you intend to make the following trip shortly:

- Imagine having a SCIFRR business appointment in the San Francisco financial district.
- You are currently in Palo Alto at your office or another meeting.

The novelty of the proposed alternatives is that the largest part of the trip is over water.

Moving is not an issue since all of the alternatives include the necessary arrangements to bring you from door-to-door.

You will be picked up at the office and driven to the nearest boarding point at the San Francisco Bay shoreline.

Upon boarding, the vessel will bring you to one of the piers in San Francisco.

At the pier, you will be picked up and driven to your appointment.

The car travel legs take a total of 15 minutes on average and are included in the overall trip duration.

Questions type
The survey consists of 18 yes/no questions:

- Each question refers to a scenario above it, which we wish to ask you to evaluate.
- These 18 alternatives are created by systematically varying 3 items over 3 values.
- Varying over as many items allows us to model the choice process, instead of only observing the existence.

Each time we would like you to answer the following question:

Would you choose to use the proposed service for the indicated trip from Palo Alto to the San Francisco financial district? Yes or no.

Choosing not to use the service would indicate using your standard means of transportation.

To familiarize you with the question type and items involved, first an elaborated example is given.

To the example...
3. Would you choose to use the proposed service for the indicated trip from Palo Alto to the San Francisco financial district?

- Yes
- No

In the rest of the survey only the short table will be presented, instead of the full text.

4. Are the type of questions and the meaning of the same clear?

Alternative 5

- Trip duration: 30 minutes
- Maximum delay: 15 minutes
- Comfort level: comparable to Business class (airplane)
- Number of passengers: maximum 35
- Ticket price (one-way per person): $110

5. Would you choose to use the proposed service for the indicated trip from Palo Alto to San Francisco financial district?

- Yes
- No
Individual comments (online)

I found myself comparing this directly to taking my own car; and in particular the cost (and hassle) of parking. When its cheaper to take mass transit than to park; its a no brainer (BART). When price gets over $20 or $30; you have to start asking how much your time and flexibility is really worth.

The survey doesn't take into account the meeting situation. There are some meetings that I would pay a premium for; some that I would prefer a private setting so a group could discuss on the way up and back; etc.

The problem with taking a ferry to SF; even if fast; cheap and comfortable; is that it won't deliver you to your exact destination. Having to take a cab etc. at the other end adds too much complexity and delay compared to driving.

I lived in the Bay area for the past 19 years and I just moved to Seattle six weeks ago; but for the past nine years I lived on the island of Alameda (across the bay from SF). I've always thought that some form of water taxi in the SF bay (not just SF to Palo Alto) was a great idea. Good luck

The lack of comments section is a significant flaw

One real opportunity is the after-hours market. Many people attend dinners or functions; for both business and pleasure reason in and around the Bay. Examples certainly include San Francisco; but also such trips as Tiburon to Sausalito. Drinking and driving is very important and our current choice is take the car but don't drink alcohol or take a taxi ($50-100) so that drinking alcohol is possible. The public ferries end at 7-730pm and these routes don't include the likes of Tiburon to Sausalito. I believe that many people would pay $50-100 for a 'water taxi' for this.

you forgot to include whether I needed to get back to my car. what if I started in SF and went south; or if I started in the south and needed to get back or to go somewhere else. That is the problem with United States public transportation. You can't get everywhere you need to

I'm afraid your scenario makes no sense for me.Although I work in Palo Alto; my home is further away. For a meeting in SF I would drive from the office; and then drive straight home -- which is not near Palo Alto. Thus; the shuttle and water taxi are really not a good alternative.

Your survey could have asked many more useful questions. If you are serious about trying to start this business, I suggest that you contact me about it.

Sorry guys; if you live in the bay area you have a car. You're frickin' hallucinating if you think anyone will pay $30 ONE WAY to get from Palo Alto to San Francisco financial district. Maximum price of $10 one way and it is BARELY acceptable because the we'll pick you up at your office is a little strange. Think about the comparison. Gas is <$5 each way and parking is the only real expense. The convenience factor of having your own car and keeping your own schedule is huge. I think this idea is a dud; frankly. Sorry...

Your prices are too high to get people to exchange their car for an alternative. Traffic is bad going to SF but it probably isn't ever over one hour to get there. You might find more interest from people traveling from the other side of the Bay who need to get to SF and have to cross one of the three bridges.

I have driven from Palo Alto to SF financial dist for 10 years and only once did it take more than 50 mins. Why would I use this service unless it were faster?

Concerns I have with the concept - weather conditions and how it impacts the routings. Fog and/or bad weather would impact the water taxi. A parallel business I see are the shuttle vans that pick up up to 12 passengers for transportation to/from the airports. I always find it inconvenient to "wait" for more passengers and would prefer to get going once on board. Final concern - inflexibility if I had taken a water taxi to a location and now find I need to change plans and head somewhere not served by the water taxi. If I had driven; I would have the flexibility to switch plans.
I would think you need the higher price point to make this work and that will be a challenge (two car rides and a long boat ride). Water taxis would be very cool; but I don't know if it will pencil. People are car-centric around here.

Seems like this type of service is not feasible without massive taxpayer subsidy.

The trip used is not one that I would use as a starting point for a business. There is good train service along that route -- with a connection to BART at Milbrae. Worst case drive time (Limo) into San Francisco is under 90 minutes which is usually Monday morning. So a cross bay trip like Fremont to San Francisco would at least have just BART as the common route for public transport. There are high speed ferry services out of the North Bay now that do well -- and even the water taxi from Alameda is full during commute times. Maybe something to REALLY look at is San Jose to San Francisco .. you still have Cal Train as public transport -- but keep in mind the bay is very shallow (1 meter in many places) below the Dunbarten Bridge.

The proposed route is much easier to do by car; A water taxi does not make much sense in Palo Alto

If this survey was given in a stronger economy; the price sensitivity may be less. However; in this economy the price is highly sensitive.

Interesting idea. you mention nothing of the return trip and schedules for timing as with any multiple person shuttle. The big draw will be from Marin to SF and the airport as well
Individual comments (private email)

I did your survey; some of the questions were subjective, but I suppose that's how you have to quantify the data.

Without having read your business plan, my visceral reaction is that it would be hard to make this profitable and viable (in comparison, for example, to the economies-of-scale of existing ground-based services like SuperShuttle, etc.). Why?
1) Unless you're going after a high-end (e.g., limo/private car) market, customers will be very price-sensitive;
2) People are time-sensitive and won't want to wait a long time for their pick-up boats (so, you'd need a sizable number of boats: based on destinations, length of trip, etc.)
3) You have very limited key Bay Area [business] locations near water that would not require additional/lengthy/costly ground transportation anyway; and, the City traffic is often the time-killer, not the highways! [w/ or w/out the shuttles using commuter/HOV lanes]: I can make it to SF in 15 minutes from my house on the peninsula, but then often wait in city traffic even longer to get where I want to go downtown.

I am really not the best person to answer this survey. I have forwarded it to 2 local real estate developers working on projects in the area as well as a newly formed agency that is taking over the commuter ferry service.

The survey question is nonsense, in my opinion. The assumption of a ten minute ride to a water taxi at rush may be of by half an hour or more. Add about 1/2 hour before and after the water taxi, and the questions may make sense.

I would not be a user of such a service so am probably not a good person to respond to your survey. It would be great to see a Water Taxi service on San Francisco Bay. Good luck with your study.

I tried to take the survey but:
- there is now way for me to tell you my opinion
- asking the same question over and over with different parameters is not the best way to get information from your users
- I have been doing user research for several years :-)
So here is what I have to share, in a nutshell:
- I have been sailing on the San Francisco bay for many years, I know the wind and wave conditions
- your time estimate are very optimistic, to go from Palo Alto (Redwood City port) to Pier 19 will take considerably longer than the 40 to 60 minutes you propose while providing a comfortable ride (more next)
- to reach the proposed delivery time, you need a vessel capable of speed in excess of 30kts. At that speed a small craft will give its occupant a very bumpy ride by the time you reach South San Francisco were wind and waves increase. Speed increases running costs as well so you may end up with a $300 fare to break even.
- you may want to check with the USCG if you are even allowed to carry that speed in the water you are planning to use. Most likely you will be asked to reduce the speed past Coyote point going north.
- current in the bay change direction four times a day, you have a 50% chance to be going against the current that can reach as much as 5kts or more adding time to your trip
- the bay get shallower as you move south and your vessel will be restricted by draft in several areas. These will effectively be bottleneck where once more you will not be able to carry high speed.
I would love to be able to use water transportation! But you need to be realistic about time and costs.
I hope this helps.

I filled out the survey for you. This seems interesting. Let me know what is the final results.
Take care and I wish the best with this.

Thanks for getting in touch with us in regards to idea for water taxis. After a review with our partnership we have determined it not a good fit at this time with our firm. We wish you the best of luck in your fundraising efforts.
Splendid. I thoroughly believe that there's a solid market for this, particularly after 7:15 pm. I'll respond to your survey and am happy to help with any information or ideas via email or phone (+1.415.990.4240). What would be realistic numbers per evening to/from Tiburon-San Francisco? I would guess an average of 5 journeys Sun-Wed and 10 for Thurs-Sat. I also think that if you charge for the journey, as a taxi does, and ignore the number of passengers in the party, you'll have more overall journeys.

Hope that helps

filled out survey -- but in addition to that - take a look at the Seattle Area. There is a basic Washington State ferry service, that could use some competition. So from the "islands" to Seattle -- also to the Airport (would need a shuttle bus to finish the journey)...

Also for San Francisco Bay -- San Francisco Airport to Oakland Airport -- a natural -- BART takes about an hour .. Check out a map... Than my be a good route for yur paper if you are committed to the San Francisco Bay... Again it is shallow around the Airports.

I am not a great person to fill out this survey, as I walk to work.

I agree water transport is a good solution, but we do have unpredictable and very dense fog some days. I would also like to point out that both the current SF Football stadium and the Baseball stadium are very close to the Bay...the baseball stadium is right on the bay. That might be an opportunity for off peak revenues when there is a game.

I only cross the bay once or twice a month. Most of the time I'm going somewhere within the city where I would need to take some other form of transportation. In those cases my auto is much easier. Best of luck.
Appendix L: High-end Business graphs

High-end Business

San Francisco – San Mateo

San Mateo – San Francisco
### General Business

**Capacity utilization:** 60%

**Roundtrip @ one-way price:**
- 4xcab @ USD3.5
- 10% spare vessel
- 6 hours per day

**San Francisco – San Mateo**

**General Business**

| Number of passengers / day
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
</tr>
<tr>
<td>2010-01-01</td>
</tr>
<tr>
<td>2010-02-01</td>
</tr>
<tr>
<td>2010-03-01</td>
</tr>
</tbody>
</table>

**Profit scheme / year**

<table>
<thead>
<tr>
<th>Revenue</th>
<th>Expenses</th>
<th>Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010-01</td>
<td>1000000</td>
<td>500000</td>
</tr>
<tr>
<td>2010-02</td>
<td>2000000</td>
<td>100000</td>
</tr>
<tr>
<td>2010-03</td>
<td>3000000</td>
<td>150000</td>
</tr>
</tbody>
</table>

**ROI @10yr NPV @15% discount rate @ total investment:**

<table>
<thead>
<tr>
<th>Year</th>
<th>Net Income</th>
<th>Total Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>1000000</td>
<td>5000000</td>
</tr>
<tr>
<td>2001</td>
<td>2000000</td>
<td>10000000</td>
</tr>
<tr>
<td>2002</td>
<td>3000000</td>
<td>15000000</td>
</tr>
</tbody>
</table>

**San Mateo – San Francisco**

**General Business**

| Number of passengers / day
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
</tr>
<tr>
<td>2010-01-01</td>
</tr>
<tr>
<td>2010-02-01</td>
</tr>
<tr>
<td>2010-03-01</td>
</tr>
</tbody>
</table>

**Profit scheme / year**

<table>
<thead>
<tr>
<th>Revenue</th>
<th>Expenses</th>
<th>Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010-01</td>
<td>1000000</td>
<td>500000</td>
</tr>
<tr>
<td>2010-02</td>
<td>2000000</td>
<td>100000</td>
</tr>
<tr>
<td>2010-03</td>
<td>3000000</td>
<td>150000</td>
</tr>
</tbody>
</table>

**ROI @10yr NPV @15% discount rate @ total investment:**

<table>
<thead>
<tr>
<th>Year</th>
<th>Net Income</th>
<th>Total Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>1000000</td>
<td>5000000</td>
</tr>
<tr>
<td>2001</td>
<td>2000000</td>
<td>10000000</td>
</tr>
<tr>
<td>2002</td>
<td>3000000</td>
<td>15000000</td>
</tr>
</tbody>
</table>