KTH Royal Institute of Technology

Project Report - Space Hotel

Blue Team - Overall Coordination

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1 Introduction

Today's technical progress allows it to develop, design and build more and more reliable possibilities to get into space without penalties in safety. New technologies like re-usable rockets, alternatives to reach the orbit and better understanding of the behaviour of human bodies in space make it cheaper to live and experience the borders of our world. These leads to an increase of space tourism which becomes more and more interesting after people has already been sent up to the International Space Station.
The price for such a trip is still high. To allow more people with curiosity and passion for space to experience this foreign environment it is necessary to reduce the costs and grow the market for space tourism. The commercial usage of already developed space prodcucts makes this possible. The vision of a space hotel is only one of several ideas to offer more and more people what our ancesteros only dreamt about. But these undertakings do not only provide profit, it also helps to accelerate the development of space technology and to achieve more knowledge about psychology and physiology.
This report shall give an idea how a project on the basis of a space hotel could be realized. It includes financial aspects as well as timelines and investigations of available technology. More detailed efforts for technical details has been made by *Vehicle Concept and Layout*, *Human Aspects including Life Support* and *Mission Teams, Logistics and Operation*. These can be found in separate reports.
There is a mention made of the space hotel itself like size, basic concepts, power and thermal facts, the life support system and communication as well as its orbit in space. It also includes operational information like preperation of tourists, number of crew, staff and guests, safety and medical aspects, the mass budget and logistics.
The content of this *Overall Coordination* report is devided in six chapters. The first one is about the rrequirements and contraints which are set. This includes also a part about the communication and project time schedule. The second one explains the space hotel concept. The physical layout, mass budget, cost budget, assembling of the space hotel, guest and crew schedule are integrated in this chapter. The following is about logistics of the space hotel which involves launch site, launchers, capsule, orbit, launches per year and the resupply missions. The human aspects are reported in the next part and includes the training and treatment of the tourists before and after the flight. The last two chapters are about the financies and risk management which involves an off-nominal case.

2 Requirements and Constraints

In this section the initial requirements and constrains are discussed, and how they evolved and changed during the project. Additionally, some insight is given in how the project was guided and organised.

For the feasiblity study of the Space Hotel certain constrains and requirements are imposed. The main constrain given by the project is that the Space Hotel is to be operational in 2025. It was changed from 2022 to 2025 because when developing the overall programme timeline it was concluded that it would not be possible to develop a space hotel in 6 years and creating a reliable design. A second constrain was that the ticket cost should not exceed 30 M$. This limit was imposed after a best guess for the price based on the Dragon Capsule and the potentional customers. The last constrain was the amount of project time for this study, which was 1 month.

To ensure that every team worked in the same framework a list of requirements and an activity schedule (for the tourists) were made. The goal of the requirements was that every group should account for the different requirements in their design, in that way it functions as a guideline what each team was supposed to do. The requirements were divided up in the Human aspect and the technical performance. The technical performance mainly dealt with the performance of the physical space hotel and the space environment. That the hotel should account for space debris, radiation, and so on.
The second part was the human aspect requirements and constrains. These requirements were mainly dealt with by the Human Aspect team. The human aspect requirements and constrains consisted of mental considerations, physical consideration and Medical considerations. The activity schedule was used as main basis for the design. Based on the schedule the Space Hotel was designed and the logistics could be determined.

3 A Conceptual Overview of the Space Hotel

In this section a summary from the other report of the Space Hotel is given. It is to have a good comprehensive understanding of the space hotel.

3.1 Physical layout, mass budget, budgets

The hotel is composed of five modules:

- Module 1: lab module (includes a robotic arm).
- Module 2: airlock (includes life support systems).

- Module 3: crew module.
- Module 4: observation module.
- Module 5: inflatable module.

Initially, there were seven modules but two sleeping modules have been removed in order to reduce the final size of the hotel.

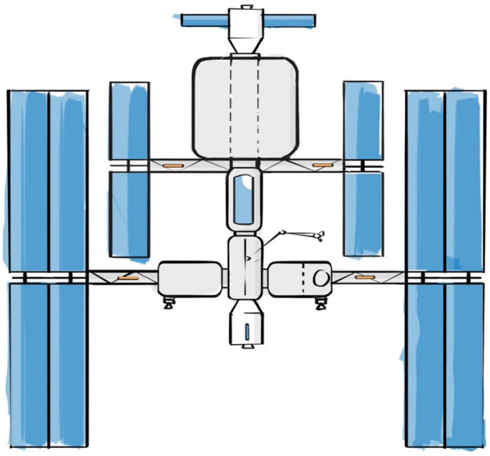

Figure 1: Concept sketch of the complete space hotel

After some approximations, this modules give us a total space 600 m^3. With seven separate modules and a payload equal to 50 tonnes for the Falcon Heavy, the total mass is about 350 tonnes. Concerning the power budget, a result of 100 kW has been found. A detailed cost analysis is found in Section **??**.

3.2 Guest schedule

For the guests, a normal day begins at 9 am with a breakfast. A first activity (spcae billiard, exercise machine...) is organized for the morning, then a lunch and a big activity(EVA, Guided Tour...) the whole afternoon. They can be a part of the check-up and communication just after the dinner with the crew. They finally have two idle hours before going to sleep. You can see more precisely the guest schedule in the appendices (see Figure 5), especially with both arrival and departure days which are a lot different from the others.

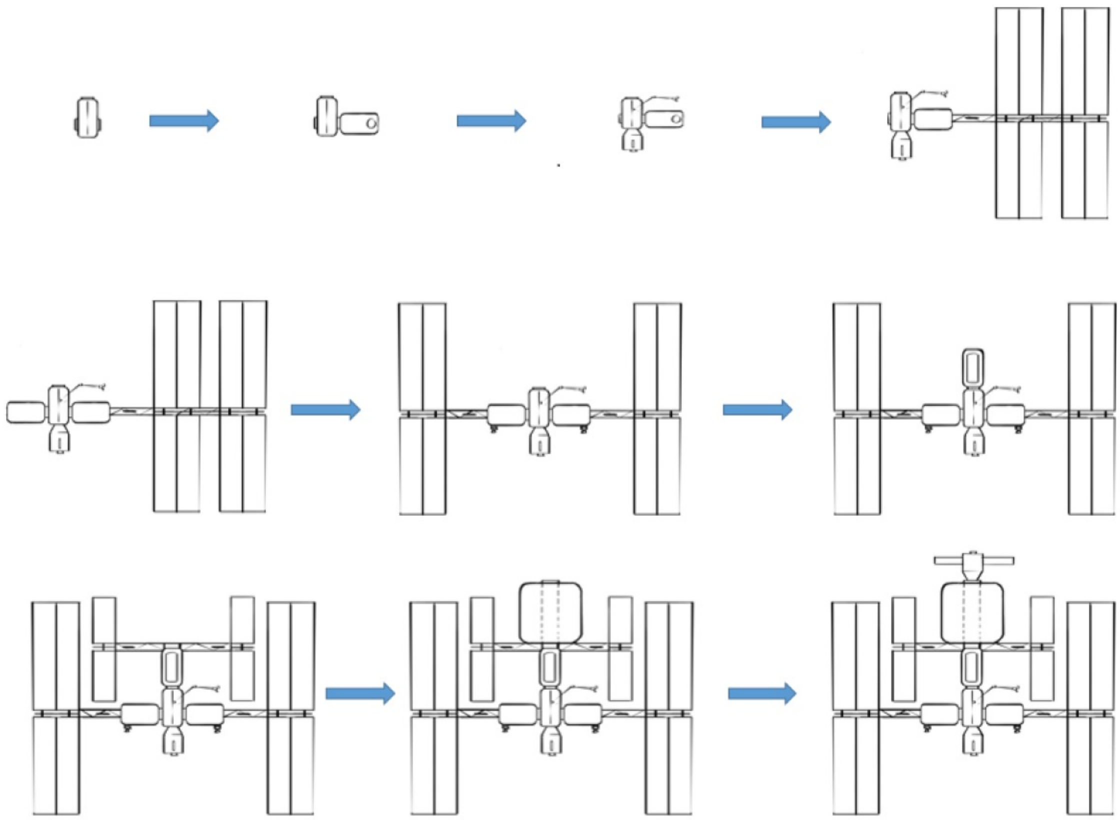

Figure 2: Mission timeline - Assembling

3.3 Crew schedule

For the crew, a normal day begins at 7 am. Every member of the crew has to train two hours a day between 9 and 11 am, as you can see in the Figure 6 in the following appendix. This a countermeasure against the weightlessness effects on human body. Every day, they have to manage waste management, activity organisation (both morning and afternoon), food preparation, check-up and communication with the ground. Last but not least, a report of the day is mandatory at 11 am, just before hygiene and sleeping. Of course, the arrival and departure day are very specific. For example, unpacking and and a briefing about the whole week is needed the first day.

3.4 Construction and operation of space hotel

You can see below (Figure 2) an overview of the space hotel assembly. The assembly will require 7 launches and at least 4 EVA's. More precisely, at least 15 weeks is needed to finish the space hotel assembly, with in average one launch every two weeks.

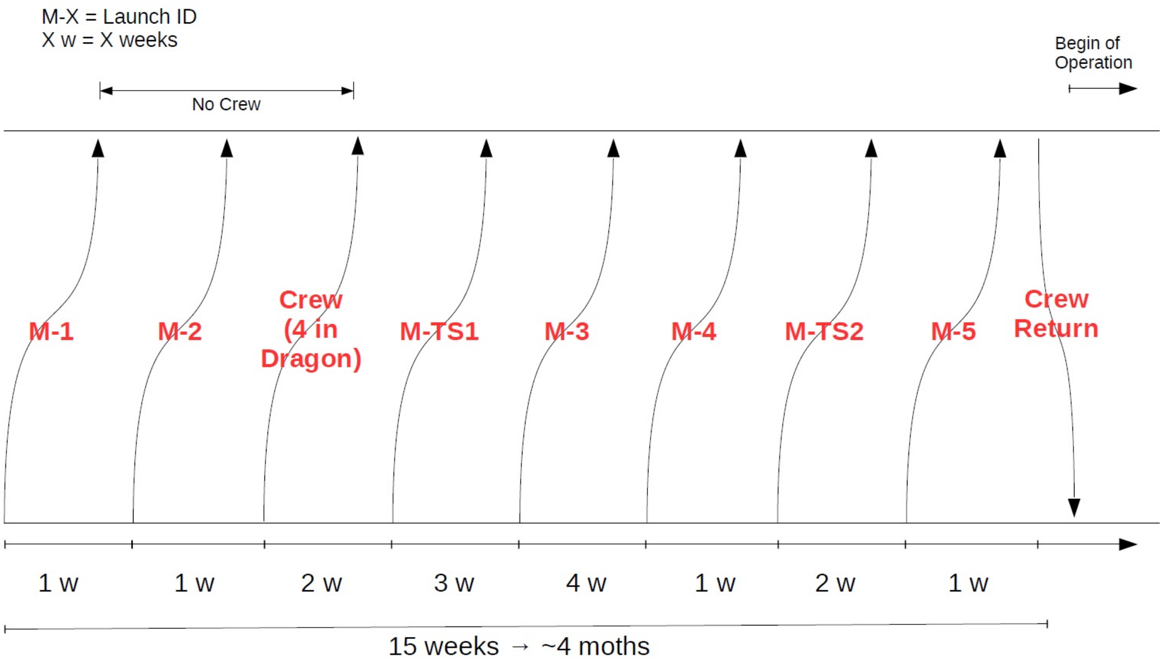

Figure 3: Overview of the space hotel assembly

The following figure (Figure 3) show you more precisely the evolution of the construction. The two first launches allow us to send up both module 1 (lab module, robotic arm) and module 2 (airlock, life support systems). The airlock module is docked to the lab module. A crew, composed of four people, accesses the hotel with the Dragon capsule. The robotic arm is attached during an EVA.The first solar arrays and trusses are launched and attached to the airlock module with an EVA. Then, the crew module is launched and docked to the hotel. One truss and its solar array is moved and fixed to the crew module during the third EVA. Thanks to the launch 5, the observation module is launched and docked. The launch 6 is needed to launch the truss segments, the thrusters and the remaining solar panels. All these components can be fixed during an EVA. The seventh and last launch allows to send up the inflatable module and docked it to the observable module. Now, the hotel can receive guests.

4 Logistics of the Space Hotel

4.1 Capsule, Launcher and Launch site

To get the a flight ticket as low priced as possible the launcher has to be low priced, too. The development of the manned Dragon V2 capsule promises it as a good possiblity. After a comparison of several capsules the Dragon V2 was clearly the cheapest with

140 $M\$$ per launch. The sufficient payload of 3310 kg [1] adds enough space to resupply the space hotel with every launch. With its seven seats the Dragon V2 gives the oppertunity to lift up six guests and one pilot. The usage of the Dragon V2 is bonded to the Falcon 9 rocket of SpaceX. This rocket and the Falcon Heavy which shall be used for the assembling mission of the space hotel. The operation of both rockets makes it obvious to launch them from the by SpaceX mainly used launch site Cape Canaveral.

4.2 Orbit

The orbit of the space hotel is nearly circular, has an altitude of 350 – 360 km and an inclination of 51.6°. This is the same orbit like the one of the International Space Station. This orbit can be reached by launchers of many known launch sites like Guyane, Cape Canaveral or Baikonur. The known trajectories and operation of a spacecraft at this orbit is already well known. This also includes safety concerns like radiation at the South Atlantic Anomaly, micrometeroids or space debris.
A further important point is the possibility to reach a high latitude of 51.6°. This gives the tourists a chance to see their homeland from space.

4.3 Launches per year

Two weeks after the assembling crew has finished their work at the space hotel the first operational crew of two astronauts will be launched. They prepare the space hotel and bring first payloads with them. Another two weeks later the very first guests will be sent up with the third crew member. After that follows a rotating system. The third astronaut who came with the tourists stays in orbit and one of the crew members that had been there before returns to Earth with the guests. Due to the fact that the workload is very high the whole year is devided between fourteen employed astronauts. This system provides two shifts of five weeks per crew member per year. The crew on the ground is than working as Capcom, as a trainer in the training facility for the guests or gets prepared for the next mission. Figure 4 gives an overview for this system. The two weeks without guests is used for preperation for the next guests and can additionally be used for maintenance or science. This whole logistic part requires 25 launches per year to supply the space station with crew and guests as well as with water, food, oxygen, fuel and possibly science experiments.

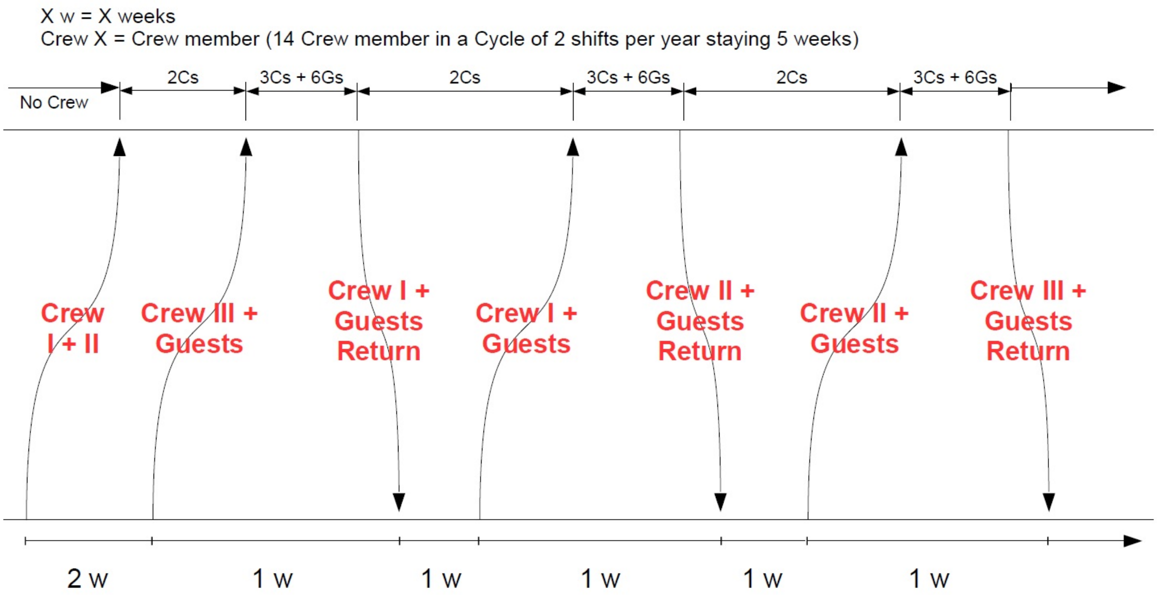

Figure 4: Operational Timeline

4.4 Resupply

The resupply of the space hotel is given by every launch. The Dragon capsule provides 3310 kg [1] of payload. By an assumed average weight per person of 100 kg including private belongings etc. a rest amount of 2610 kg of supplies can be lifted to the space hotel. This includes water, food, oxygen and fuel for altitude maintenance and attitude control and optional science experiments. The human waste, science or carbon dioxide will be be either brought back to Earth or pushed off-board. The mass that can be brought back is 2500 kg [1] minus the weight of the crew and equals 1800 kg.

5 Human Aspect of the Space Hotel

The space hotel was designed to accommodate six guests and three crew per visit. Each guest visit will have a duration of one week and the frequency of visits is aimed to be fortnightly. Each crew member will stay on the space hotel for five weeks at a time.

5.1 Selection of the Number of Guests and Crew

The choice of the number of guests and crew members staying in the space hotel at one time was the starting point of the project. The decision to use the SpaceX Dragon capsule allowed for up to seven passengers to be transported to the space hotel per launch. From this, the guest-to-crew ratio was determined by considering safety at each stage of the space hotel timeline. The timeline was divided into four stages:

- Launch bringing up the guests
- Week when guests are present in the space hotel
- Return of guests to Earth
- Week when there is only crew in the space hotel

While the launch and return can be fully automated, it was decided that there should be at least one trained crew present in case a problem arises. This would also help the guests feel safer. Secondly, it was decided that there should never be one crew member left onboard the space hotel alone during the week with no guests. These two criteria together meant that a minimum of three crew were needed and a maximum of six guests can visit at one time. This creates a 2:1 guest-to-crew ratio which was considered suitable as it is small enough for the crew to manage the guests and ensure their safety. With the number of guests and crew set, the specifications for the space hotel systems and design as well as the activities and timeline could be decided. A space hotel where two guests were sent up with one crew member on a Soyuz vehicle was considered briefly. However, this would require the guests to actively participate in the launch and return since the Soyuz is not fully automated. The training required for this is too great. The risk in case of an off-nominal case during launch and return is also higher as well as the cost per seat. Thus, this idea was quickly abandoned.

5.2 Pre-flight: Selection and Training

While the aim is to allow as many people to travel to space as possible, safety dictates that precautions need to be taken to ensure that all guests are able to meet the physical and mental demands of space travel. As a consequence of this, all people who express interest to go to the space hotel will first undergo strict physical and psychological check-ups. Potential guests must pass these tests in order to be allowed to travel. After passing these tests, the guests will be assigned into the groups based on the results of the psychological test as well as their personal preferences. These will be people they spend the week in the space hotel with. As a group, the guests will then take part in a five-day program introducing them to the space hotel and providing them with basic training on living in space. Safety procedures and drills will also be conducted. Following this, the guests will be allowed a week to pack and privately prepare for their stay in space. The *Human Aspects and Life Support* group report provides more information on the physical and psychological requirements as well as the details of the training program.

5.3 One Week in Space

5.3.1 Activities

During their week in space, the guests will have the opportunity to participate in a variety of unique activities. In general, the activites aim to make use of the microgravity environment and to simulate the tasks trained astronauts have done on board the ISS in the past. This includes mock science experiments, microgravity games, astronaut food tasting and a guided observation of the Earth. The guests will also have the opportunity to do an EVA for an additional cost. This is to be decided during the application to stay at the space hotel. Guests who choose to conduct an EVA will be given additional training during the pre-flight preparations. A detailed description of all the space activites are given in the *Human Aspects and Life Support* group report.

5.3.2 Schedule

To provide the most comfort, a regular 24 hour sleep-wake cycle is followed in the space hotel. For the guests, a regular day begins at 0900 hrs with breakfast. An activity is then run in the morning and is followed by lunch and a longer activity will take place in the afternoon. After dinner, the guests will be given an opportunity to communicate with their family and friends on Earth. This is followed by two hours of free time before going to sleep. The schedule allows for slight changes to occur depending on the preferences of the guests. Also, the arrival and departure days follow a different schedule. A detailed guest schedule is attached in Appendix 5. The crew follow a similar schedule during the week when guests are present as they will be regularly working with the guests. However, some additional tasks need to be done by the crew including the preparation and organisation of the activities, daily briefings and debriefings and two hours per day of exercise. The crew schedule can be seen in Appendix 6.

5.4 Post-flight

After returning from their stay at the space hotel, the guests will each be given a quick medical check-up to ensure a full health recovery. The guests will also have a chance to give feedback on their experience in the space hotel. This feedback will be used to improve future visits.

6 Financial Overview

?? In this section the financial overview is presented. First it is estimated how many potentional customers are available for the space hotel. The amount of customers is the basis for further cost estimations, since it dictates the operation time and the cost per ticket.

6.1 Estimation on total potentional customers

The requirements state that a ticket to the space hotel shall not exceed 30 M$FY16. This implies that customers should have at least more wealth to be able to buy the ticket. The limit imposed in this study was 50 M$FY16. It is estimated that there are about 117500 persons who are capable of buying a ticket [2].
From all High-Net-Worth individuals only a small fraction of them would consider going to the space hotel. There are multiple reasons: they dont want to go to space because they consider it to dangerous or are not in the right physical state to safely compleet the space trip. Considering all these factors it is estimated that about 1 to 2 % of these people will buy a ticket. This means that about 1700 people will buy tickets to the space hotel. Assuming that the amount of customers is limited and the amount of HNWI does not increase greatly in the next 15 years the space hotel programme will have enough customers for at least 12.5 years. Therefore it was decided to design the space hotel programme for 15 years of operation, starting in the year 2025. The details of this estimation can be found in the Appendix (Chapter 9).

6.2 Estimation on total Space Hotel Programme cost

To determine the cost for a ticket to the space hotel the next step is to calculate the total cost for the 15 years of operations. The total cost is divided up in three different parts. First, The Space hotel construction cost, which includes the development and construction of the modules, the required launches, and the development and construction of the payloads. The required training for the astronauts for the construction from modules to space station is included in the Operation cost. The construction cost is a one-time investment. Table 1 shows the construction costs. The cost to construct and develop the modules is based on the ISS module cost of the ESA and NASA modules, furthermore marginfactor of 2 is applied according to [3]. The payload cost was provided by the Human Aspect team. The launch cost is based on the current Heavy Falcon price [4].

The second cost is the operational cost. This includes the required training for all astronauts (maintaince, crew and construction), the ground control personel salaries and the manpower required to facilitate all operations. The operational cost as presented in Table 2. The Crew and Astronatus costs are based on the salary and the training costs and facilities required. Both are based on what ESA spends on their human spaceflight programme and their amount of current astronauts. The ground control is based on astronaut salary and the personel required given by the Operations team.

Table 1: Total Construction Cost

	Cost [FY2016M$]	%
Modules	1210	45
Payloads	770	30
Launhces	630	25
Total	2610	100

Table 2: Yearly Operational Cost

	Cost [FY2016M$]	%
Crew	204	54
Personel	166	43
Ground Control	11	3
Total	381	100

The last section is the total launch cost per year. This includes all the launches required throughout the year. The expected number of visit missions is 25 per year, for supply and upkeep missions this is 1. Note that this supply and upkeep mission are out of the ordinary missions, normal small repairs and supply is done by the visit missions. The Upeek, Supply missions have not directly been scheduled or planned for by any of the groups it is viewed as a contignency in the budget as it is expected that once a year an extra mission is required to repair or upgrade the space hotel. The budget is shown in Table 3. An overview of the costs combined is giving in Table 4

Table 3: Yearly Launch Cost

	Cost [FY2016M$]	%
Visit Mission	2625	96
Upkeep Mission	50	2
Supply mission	40	2
Total	2715	100

Table 4: Yearly Launch Cost

	Cost [FY2016M$]	%
Construction	2610	5
Operations	5715	12
Launchers	40875	83
Total	49215	100

It should be noted that about 80% of the total programme cost is spend on the Dragon

Capsule. After twelve years of operation the break even point is reached. After 15 years of operations the total revenue is 12 B$.

7 Offnominal Case: Launch Failure during Construction

After the second launch a crew of four astronauts will be present in the space hotel until the end of its construction. They stay for a total of 13 weeks. For the off-nominal case, a launch failure while the construction crew is in space is considered.
Each launch brings up modules and components vital for the operation of the space hotel. As such, a launch failure will severely delay the opening of the hotel. Two cases are considered.
The first case is that a launch is delayed due to the weather conditions or technical issues that can be quickly resolved. In this case, the particular launch and each subsequent launch will be delayed for a few days, or until the next launch opportunity.
In the second case, the launch failure results in the loss of the payload. This case is much more serious. The rebuilding of a module is expected to take up to six months. Thus, the four astronauts of the construction crew will return to Earth on board the Dragon capsule that is already docked. They will return to complete the space hotel once the destroyed module is rebuilt. Using the same cost estimations as those for the space hotel budget, the additional cost is expected to be 400-450 million euros.

8 Conclusion and Recommendations

Under the constrains said by the project to design a feasible space hotel, this paper proposes the space hotel programme with. The space hotel programme will last for about 25 with 15 years of operation. The ticket price to the space hotel will be 30 M$. A visit to the space hotel will last for 7 days and 9 people will be present of which 6 are guests. The space hotel is 725 m^3 big, its mass is 80.000 kg and the power required is 50 KW. T The modules and the assembling sequence of the space hotel has been presented as well as the timeschedules on-board. An orbit, a launch site, a launcher and a convenient capsule has been chosen for assembling and resupply. The expected revenue for the whole programme is 12 B$ and the break-even is after 12 years of operation.

The main recommendation for further research is to do further detail the cost analysis and base it on the necessities and the payload per module and it should also account for the development time. Secondly it is advised to make a detailed risk assesment and contingency plans. The risk assesment should account for the technical risks and the development risk.

References

[1] The ISS CRS contract (signed Dec. 23, 2008). http://www.nasa.gov/centers/johnson/pdf/418857main_sec_nnj09ga04b.pdf.

[2] World Wealth report. World wealth report 2015. Technical report, World wealth report.

[3] SRE-PA D-Tec staff. Esa margin philosofy for science assessment studies.

[4] SpaceX. Falcon-heavy. http://www.spacex.com/falcon-heavy.

9 Appendix

Table 5: Cost Estimation table, all cost are in M$

Construction	Cost	Margin	Amount	Total
Modules	120	2	4	960
Inflatable module	125	2	1	250
Payload				770
Heavy Falcon	90	1	7	630
Total	335	5	12	2610
Launch Vehicles	Quantity	Cost	Total	
Supply mission	1	50	50	
Visit mission	25	105	2625	
Crew mission	1	50	50	
Total			2725	
Operations	Quantity	Cost	Total	
Personal	1500	0,11	166	
Astronaut	28	7,28	204	
Ground control	48	0,25	12	
Total			382	
Visitors	6			
Visitors per year	150			
Total cost	49215			
Ticket cost break even 15 y	21,9			
Ticket cost break even 12 y	27,3			
Revenu per flight	32,81			
Revenu life time	12303,75			

Guest visit

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1:00:00	Launch	Sleep	Sleep	Sleep	Sleep	Sleep	Sleep
2:00:00	Launch	Sleep	Sleep	Sleep	Sleep	Sleep	Sleep
3:00:00	Launch	Sleep	Sleep	Sleep	Sleep	Sleep	Sleep
4:00:00	Launch	Sleep	Sleep	Sleep	Sleep	Sleep	Sleep
5:00:00	Launch	Sleep	Sleep	Sleep	Sleep	Sleep	Sleep
6:00:00	Launch	Sleep	Sleep	Sleep	Sleep	Sleep	Sleep
7:00:00	Launch	Sleep	Sleep	Sleep	Sleep	Sleep	Sleep
8:00:00	Launch	Sleep	Sleep	Sleep	Sleep	Sleep	Sleep
9:00:00	Launch	Dressing/eating	Dressing/eating	Dressing/eating	Dressing/eating	Dressing/eating	Dressing eating
10:00:00	Orbiting to Space hotel	Personal hygiene	Personal hygiene	Personal hygiene	Personal hygiene	Personal hygiene	Dressing eating
11:00:00	Orbiting to Space hotel	Earth/star telescope watching	Microgravity Games	Space Gym	Music cafe	Free time	Personal hygiene
12:00:00	Orbiting to Space hotel	Earth/star telescope watching	Microgravity Games	Space Gym	Music cafe	Free time	Packing
13:00:00	Docking	Lunch	Lunch	Lunch	Lunch	Lunch	Packing
14:00:00	Arrival to Space Hotel/lunch	Guided Tour	EVA (2 tourist), Mock Science	EVA (2 tourist), Movie theatre	EVA (2 tourist), Food tasting	Free time	Lunch
15:00:00	Unpacking	Guided Tour	EVA (2 tourist), Mock Science	EVA (2 tourist), Movie theatre	EVA (2 tourist), Food tasting	Free time	Undocking
16:00:00	Unpacking	Guided Tour	EVA (2 tourist), Mock Science	EVA (2 tourist), Movie theatre	EVA (2 tourist), Food tasting	Free time	Orbiting in space
17:00:00	Earth	Guided Tour	EVA (2 tourist), Mock Science	EVA (2 tourist), Movie theatre	EVA (2 tourist), Food tasting	Free time	Orbiting in space
18:00:00	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Re-entry
19:00:00	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Recovery of crew
20:00:00	Check-up/communication	Check-up/communication	Check-up/communication	Check-up/communication	Check-up/communication	Check-up/communication	
21:00:00	Idle	Idle	Idle	Idle	Idle	Idle	Post-flight medical check-up
22:00:00	Idle	Idle	Idle	Idle	Idle	Idle	
23:00:00	Personal hygiene	Personal hygiene	Personal hygiene	Personal hygiene	Personal hygiene	Personal hygiene	
24:00:00	Sleep	Sleep	Sleep	Sleep	Sleep	Sleep	

Figure 5: Guests Schedule

Crew schedule

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1:00:00	Launch	Sleep	Sleep	Sleep	Sleep	Sleep	Sleep
2:00:00	Launch	Sleep	Sleep	Sleep	Sleep	Sleep	Sleep
3:00:00	Launch	Sleep	Sleep	Sleep	Sleep	Sleep	Sleep
4:00:00	Launch	Sleep	Sleep	Sleep	Sleep	Sleep	Sleep
5:00:00	Launch	Sleep	Sleep	Sleep	Sleep	Sleep	Sleep
6:00:00	Launch	Sleep	Sleep	Sleep	Sleep	Sleep	Sleep
7:00:00	Launch	Sleep	Sleep	Sleep	Sleep	Sleep	Sleep
8:00:00	Launch	Dressing/eating	Dressing/eating	Dressing/eating	Dressing/eating	Dressing/eating	Dressing eating
9:00:00	Launch	Personal hygiene	Personal hygiene	Personal hygiene	Personal hygiene	Personal hygiene	Personal hygiene
10:00:00	Orbiting to Space hotel	Prepare day's activities & Briefin	Prepare day's activities & Briefing	Prepare day's activities & Briefing	Prepare day's activities & Briefing	Prepare day's activities & Briefing	Departure briefing
11:00:00	Orbiting to Space hotel	Activity 1 & Waste management	Activity 2 & Waste management	Activity 3 & Waste management	Activity 4 & Waste management	Activity 5 & Waste management	Departure preparations
12:00:00	Orbiting to Space hotel	Activity 1 & Food Preparation	Activity 2 & Food Preparation	Activity 3 & Food Preparation	Activity 4 & Food Preparation	Activity 5 & Food Preparation	Packing
13:00:00	Docking	Lunch with the guests	Lunch with the guests	Lunch with the guests	Lunch with the guests	Lunch with the guests	Packing & Food preparation
14:00:00	Arrival to Space Hotel/lunch	Manage Big Activity 1	Manage Big Activity 2	Manage Big Activity 3	Manage Big Activity 4	Manage Big Activity 5	Lunch with the guests
15:00:00	Unpacking	Manage Big Activity 1	Manage Big Activity 2	Manage Big Activity 3	Manage Big Activity 4	Manage Big Activity 5	Undocking
16:00:00	Unpacking	Big Activity 1 & Cleaning	Big Activity 2 & Cleaning	Big Activity 3 & Cleaning	Big Activity 4 & Cleaning	Big Activity 5 & Cleaning	Orbiting in space
17:00:00	Briefing about the whole wee	Big Activity 1 & Food Preparation	Big Activity 2 & Food Preparation	Big Activity 3 & Food Preparation	Big Activity 4 & Food Preparation	Big Activity 5 & Food Preparation	Orbiting in space
18:00:00	Food preparation	Dinner with the guests	Dinner with the guests	Dinner with the guests	Dinner with the guests	Dinner with the guests	Re-entry
19:00:00	Dinner with the guests	Dinner with the guests	Dinner with the guests	Dinner with the guests	Dinner with the guests	Dinner with the guests	Recovery of crew
20:00:00	Check-up/communication	Check-up/communication	Check-up/communication	Check-up/communication	Check-up/communication	Check-up/communication	
21:00:00	Exercise	Exercise	Exercise	Exercise	Exercise	Exercise	Post-flight medical check-up
22:00:00	Exercise	Exercise	Exercise	Exercise	Exercise	Exercise	
23:00:00	Report of the day	Report of the day	Report of the day	Report of the day	Report of the day	Report of the day	
24:00:00	Personal hygiene	Personal hygiene	Personal hygiene	Personal hygiene	Personal hygiene	Personal hygiene	

Figure 6: Crew Schedule