**PARKme System**

**Business Case**

George Mason University

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# Introduction

## Subject

This business case examines the need for and benefits from the development of a new parking system for the George Mason University campus. This system would be designed to provide real time parking information to users reducing the time needed to find an available parking space as well as collection of data associated with the usage of parking spaces. This case will examine the estimated costs associated with the hardware for the system and the estimated software development costs. The document will also provide business objectives met by entering this market and how the technologies used in this market can be utilized and leveraged to enter new markets.

## Background

Interest in this system is derived from the inefficient parking system currently in place at the George Mason campus. Overcrowded parking lots and logistical aspect of having multiple parking lots spread out around the campus makes finding spaces difficult and does not provide a method for helping users find the best available space to suit their needs. The George Mason parking system has identified a customer need that is not limited to George Mason University but is apparent many other locations where there is a high demand for limited parking.

## Problem Statement

Problem Statement:

"Finding a parking space at the university is a common frustration for commuters at the GMU campus. Finding the parking space that best suits your needs can be very time consuming and often times the “drive around looking method” does not result in the best space. Campus parking lots are often overcrowded during certain times of the day and week making parking a guessing game and a matter of luck."

University parking areas are not sufficient to handle the abundance of commuters that frequent GMU on an everyday basis. The parking process involves driving around the parking lots until you find an available space. This process works for small lots but at the university driving form lot to lot wastes time and resources and usually does not result in the user finding the best space for their needs.

The PARKme system will provide a method for those wishing to park at the university a tool to search the real-time availability of spaces from multiple locations.

## Scope

The scope of this system is focused on the George Mason University campus parking lots and parking garages. This system is modular in design and could therefore be marketed to a larger section of the market once the design has been proofed out. As this system is modular in design it can be proofed out on a much smaller scale than the entire campus. The intent for this system is to provide a quality system to handle parking for the entire campus but to prove the concept only 2 parking spaces are needed along with the hardware and software of the PARKme system. Primary customer has identified the major areas of concern that should be the focus of the initial delivery of such a system. The University has a ring of parking lots that surround the immediate campus and are the most heavily used and provide the most resource contention. As the major parking shortage is for GMU students the focus should be on student/general lots that are nearest to the campus. Lots farther away from campus have a much higher availability and are usually not competed for. Although initial entrance into this market is focused on GMU as the primary stakeholder other market and business opportunities will be identified as well as the technology strategy employed to protect property rights and the financial analysis to show the way ahead.

## Overview of Functionality

This PARKme system is concerned with providing real-time data to its users using a variety of different methods to deliver this information. The PARKme will monitor parking spaces and relay their occupancy status (occupied vs. unoccupied) to a system that will track them and relay the information to the user. Users are provided multiple methods of receiving this information to include: Cell phone text messages, Emails, on campus kiosks and on campus information signs. The user would be able to schedule when to receive text messages and emails based on their needs. With this systems ability to monitor parking spaces it will also be adapted to monitor loading zones and areas with parking restrictions such as fires lanes and will have the capability to notify campus authorities when violations are occurring. Another important aspect of this system is its capability to track the usage associated with every parking space. This data can be collected and analyzed for possible parking space optimization by viewing usages and adjusting course offerings.

Figure 1 OV-1 DODAF Diagram

The design of this system is focused on using COTS components that provide a modular design which enables the system to be deployed on different measures of scale. This system can be deployed for as little as 1 parking space or for as many as tens of thousands.

# Value Mapping

This portion of the document will discuss the goals and objectives of the PARKme system and why entering the market will benefit the developers of the systems as well as how GMU as an initial investor can benefit from investing early in the development of the system as well as the utility that will be gained from implementing the system into the GMU parking architecture.

## Utility

### George Mason University

As the primary purpose of this system was conceived to alleviate the parking issues associated with parking at George Mason University, the primary function of reducing the time spent searching for an open parking space will provide the most utility to the GMU as the customer. By reducing the frustration associated with parking GMU will be addressing one the most areas of dissatisfaction with the University. Addressing the issue will lead to increased stakeholder satisfaction (stakeholder being the students using the parking facilities). The primary function and benefits combined with the secondary benefits stated in the next section of this document all play an important role in increasing stakeholder satisfaction. Stakeholders using the parking facilities with the PARKme system are more likely to arrive to classes on time, less stressed, and be more likely to spread positive press through word of mouth.

#### Secondary Benefits

Although the PARKme system is primarily focused on addressing the parking issues on campus the system itself provides other forms of utility to the customer.

* Data Collection – the ability of the system to track parking space usage and store this data can provide a potentially valuable resource when looking into expanding parking facilities or adjusting course scheduling. Data can be analyzed to and evaluated to see where and at what times the most congestion occurs and how the impact of additional parking or course schedule adjustments would impact the parking situation.
* Automated monitoring – illegal parking in fire lanes and loading zones can now be monitored automatically and the proper authorities notified when abuse is occurring. This can reduce man power needed to patrol campus.
* Wi-Fi – The PARKme system utilizes wireless networking components to transfer data and this network can also be configured to provide Wi-Fi access to many of the areas on campus that are near the parking facilities, or can be expanded to provide Wi-Fi to the entire campus.
* Security – Another benefit of the PARKme system is its ability to provide additional COTS components to the customer. One such component is security monitoring. The wireless network provides sufficient bandwidth that connecting security cameras to the wireless access points allows video data to be transmitted to the main server where it can be recorded or monitored. Additional security can provide another selling point for potential students.
* Green – Reduction of the time spent looking for parking spaces directly equates to less fuel used by patrons to park on campus. While this does not have a monetary value to the campus they can promote the go green imitative.
* Expandability – As the PARKme system utilizes a variety of COTS components that are nearly plug and play the PARKme system can grow as the parking facilities at GMU grow.
* Innovator Role – In terms of the technology consumer role GMU would be able to assume the role of innovator. As a university they would be at the forefront of automated and informational parking technologies aimed at increasing stakeholder satisfaction. This role can enhance GMU’s reputation as a leader in the academic industry in terms of systems design and management.

### PARKme Product Integrators

The primary benefit provided to PARKme members is the ability to enter into a market that is still in early phases of exploration. In most cases parking facilities can not justify adding technology to their facilities as increasing the price of parking will drive customers away. For this reason not much technology has been developed to assist with parking issues. As the PARKme system is looking to enter the market with George Mason University as its primary customer parking is not park of their core business but is a necessity for stakeholder satisfaction and parking technological advances are needed.

Entrance into the parking technology market is not the only business objective for designing a system for initial use with George Mason University. Initial development will provide a product that can then be marketed toward facilities with similar parking related needs as those at GMU; however the development process itself will provide availability into other market areas as well. Potential business opportunities provided through PARKme development are listed below:

* Wireless Networking – Gaining the experience from using the advance wireless networking technologies with the PARKme system will allow for movement into setting up large scale wireless networks for a number of different uses. Uses include, wifi access, security monitoring, and data transmission.
* Automated Meters – As much of the COTS technology being utilized has been used for parking meter systems it is a logical transition to enter this market as well.
* Expansion – Further software development can provide expansion into other closely related markets. An example would be hospital usage. Users could drive up to a kiosks and enter in where they are going (ER, X-Ray…) and our software would be able to tell them exactly what parking space they should pursue in order to provide the nearest space to their destination.
* Customer Support – As a large portion of the PARKme system involves software some level of customer support will be required, but this could be expanded into a monthly contract much like buying extended service warranties.

# Cost Analysis

This section will focus on the cost associated with the PARKme system and the future outlook it will provide towards the overall business model.

## George Mason Options

George Mason has several options available when it comes to addressing the problem at hand.

* Do nothing – This is by far the least expensive of all the options. This does not however address the problem. If GMU were to choose to do this then the PARKme development team would need to perform additional market analysis to find another potential customer.
* Provide Investment – This option would involve GMU providing investment funds for the development and testing of the PARKme system. Development includes all the software portions of the system and the integration of the hardware components. This option will provide incremental deployment of the system into the GMU parking facilities. This approach will provide GMU with a small initial investment into the technology and will provide them with small scale insertion as proof of concept. This option is beneficial for PARKme as it would provide start up funds for development and testing. This approach would involve GMU providing funds to develop the software and upon completion they would not be charged for the software license and during development there would be some shared cost for hardware along with discounted installation costs and GMU would not incur set up fees. This option would then cease after a set number of parking spaces had been equipped with the system after which point standard rates would apply. In addition to having start up funds, this option provides PARKme with the ability to shop out other markets and set up additional contracts during development.
* Buy the system – This option would involve GMU buying the system after develop and testing has concluded. In this option all standards rates and costs would be applied.

Cost analysis and financial impact on GMU are provided for each alternative.

### Do nothing

For this option the cost to GMU is zero dollars, but the problem would not be addressed.

### Buy Completed

This option involves buying the completed product from PARKme. As gathered from the customer this would initially involve installation for the major general parking facilities closest to campus and would only focus on general parking spaces. The Lots that would be the focus are listed in the table in Appendix A. This table breaks the individual cost for each component grouped by parking lots. Total cost to GMU for the PARKme system utilizing this option is $1,060,737.

### Provide Investment

This option would involve entering into a contract with PARKme developers and the cost analysis/benefits are detailed below.

For this option GMU would provide an initial investment of $14,000. This money would be applied toward the development of the software and testing of the system. As part of this contract PARKme would wave installation and setup cost associated with the system. GMU would still need to purchase the hardware components and installation fees would be incurred for the parking sensors as that portion is not performed by PARKme. In this option when development is complete GMU would not be charged the $10,000 for the software license. This contract would benefit GMU in that they would be able to have direct communication during development in order to provide input to better angle the software toward their needs. Would save money in the long run and would provide GMU with an extended training and support period during the development. The contract terms would be for 6 months and would only focus on lots J and M after which standards rates would then apply. Appendix B contains a table that breaks down all the costs and breaks them out by lot and equipment. With the waiving of setup fees and installation fees along with not having the software licensing fees the total cost to GMU for this option is $1,014,066. This is a savings of $46,671 to GMU over the previous option.

## PARKme Analysis

This section will discuss the cost and returns for the PARKme business model. All options are assuming that after development of the system there will be a demand of 4 similar sized systems the following year followed by 3 then 2 then 1 and cycling between 2 and 1 for the remainder of the first 10 years. The reason for the decreased market demand is due to the introduction of similar systems. Another factor affecting the dispersion of the PARKme systems is the need for 2-3 months to deploy the system.

### Cost Analysis for GMU

As detailed in section 3.1 GMU has two options with the PARKme and this will discuss the financials associated with each as they pertain to PARKme.

#### Option 2 Buy Completed

In this option it would cost GMU $1,060,737 to purchase the system. In order for this option to be valid, PARKme would first need to have the system developed and ready for deployment. Appendix E contains a table that shows the expected development cost associated with the development of the PARKme system. We estimate 7 months to ready the system for deployment and would need $68,950 at start up to develop the PARKme software and purchase hardware components for testing.

In this option PARKme would earn $2,990,435 over the first 10 years as shown in the table provided in appendix G. Breakeven would occur in the eighth month of the first year.

#### Option 3 Invest with PARKme

In this option it would cost GMU $1,014,066 to purchase the system. In order for this option to be valid PARKme would first need to enter into an agreement with George Mason University. Appendix F shows the development cost associated with the development of the PARKme system with GMU provided investment funds. We estimate 7 months to ready the system for deployment and would need $27,000 for development of which $14,000 would be provided by GMU as investment leaving $13,000 out of pocket expenses.

Appendix H shows the cash flows for this option. With this option profits would increase slightly for PARKme to $3,018,749 and would provide a net present value of $1,932,235

## Sensitivity Analysis and Variance

As many of the estimates and financial data for this business case are based on what is expected is was important to investigate the impact of variance for the major factors. Appendix I contain a tornado diagram showing which of our variables are the most sensitive to change. As expected as we are dealing with a system that will see very few sales, variance in these sales will have the biggest impact on our bottom line, this is followed by the profit expectations we have for each of the systems sold.

In addition to sensitivity analysis we also investigated the impact that differing scenarios would have on our returns using decision trees. As we have several variables that could vary the tree itself grew to be very large and portions of it are pictured in appendix J. The tree was able to provide confidence in our decision to proceed with our system and when taking the most pessimistic paths possible still resulted in positive net gains and positive net present values for those gains.

# Strategy

This plan is only focused on the introduction of PARKme into a defined scope. The development of the technologies associated with this system would open up other opportunities in new markets that could leverage off of our experience. These other markets are not included in the scope of this document but do provide additional incentive for introducing the PARKme system.

**APPENDIX A** – GMU cost no investment

|  |
| --- |
| **Shows the expenses GMU would incur from the purchase of the PARKme system (no investment)** |
|  |  |  |  |  |
| **Location** | **General Spaces Total** | **Sensor Cost $150 Per Unit** | **Sensor Install Cost $45 per unit** | **Total** |
| Lot A | 1040 | 150 | 45 | 202,800 |
| Lot C | 601 | 150 | 45 | 117,195 |
| Lot J | 389 | 150 | 45 | 75,855 |
| Lot K | 1485 | 150 | 45 | 289,575 |
| Lot L | 337 | 150 | 45 | 65,715 |
| Lot M | 159 | 150 | 45 | 31,005 |
| Lot O | 223 | 150 | 45 | 43,485 |
| Lot P | 228 | 150 | 45 | 44,460 |
| **Totals** | **4462** |  |  | **870,090** |
|  |  |  | Equipment Fee for install | 500 |
|  |  |  |  | **870,590** |
| **Directional Signs** | **3@10,000K per plus $500 each installation**  | **31,500** |  |  |
|  |  |  |  |  |
| **Location** | **Access Points @ $3000** | **LAN Controllers @ 14K** |  |  |
| Lot A | 3 | 1 |  |  |
| Lot C | 1 | 1 |  |  |
| Lot J | 1 | 1 |  |  |
| Lot K | 3 | 1 |  |  |
| Lot L | 1 | 1 |  |  |
| Lot M | 1 | 0 |  |  |
| Lot O | 1 | 1 |  |  |
| Lot P | 1 | 1 |  |  |
|  | **12** | **7** |  |  |
|  | **36,000** | **98000** |  |  |
|  | install costs @ $125 per | install costs @ $200 per |  |  |
| **Totals** | **37,500** | **99,400** |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| **Server Cost** | **8,200** |  |  |  |
| Server Set up | 200 |  |  |  |
|  | **8,400** |  |  |  |
|  |  |  |  |  |
| **Software Cost** | **10,000** |  |  |  |
|  |  |  |  |  |
| Initial Setup Cost | <5000>1000 Spaces @ .75 Per Space |  |  |  |
|  | **3,346.50** |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| **Total Cost to GMU** | **1,060,737** |  |  |  |

**APPENDIX B** – GMU cost with investment

|  |
| --- |
| **Shows the expenses GMU would incur from the purchase of the PARKme system as an investor** |
|  |  |  |  |  |
| **Location** | **General Spaces Total** | **Sensor Cost $150 Per Unit** | **Sensor Install Cost $45 per unit. Cost waived** | **Total** |
| Lot J | 389 | 150 | 0 | 58,350 |
| Lot M | 159 | 150 | 0 | 23,850 |
| **Totals** | **548** |  |  | **82,200** |
|  |  |  |  |  |
| **Location** | **General Spaces Total** | **Sensor Cost $150 Per Unit** | **Sensor Install Cost $45 per unit.**  | **Total** |
| Lot A | 1040 | 150 | 45 | 202,800 |
| Lot C | 601 | 150 | 45 | 117,195 |
| Lot K | 1485 | 150 | 45 | 289,575 |
| Lot L | 337 | 150 | 45 | 65,715 |
| Lot O | 223 | 150 | 45 | 43,485 |
| Lot P | 228 | 150 | 45 | 44,460 |
| **Totals** | **3914** |  |  | **845,430** |
|  |  |  | Equipment Fee for install | 500 |
|  |  |  |  | **845,930** |
| **Directional Signs** | 3@10,000K per plus $500 each installation. Install cost waived for 1st unit  | **31,000** |  |  |
|  |  |  |  |  |
| **Location** | **Access Points @ $3000** | **LAN Controllers @ 14K** |  |  |
| Lot J | 1 | 1 | installation costs waived |  |
| Lot M | 1 | 0 |  |
|  |  |  |  |  |
| Lot A | 3 | 1 |  |  |
| Lot C | 1 | 1 |  |  |
| Lot K | 3 | 1 |  |  |
| Lot L | 1 | 1 |  |  |
| Lot O | 1 | 1 |  |  |
| Lot P | 1 | 1 |  |  |
|  | **10** | **6** |  |  |
|  | **30,000** | **84,000** |  |  |
|  | install costs @ $125 per | install costs @ $200 per |  |  |
| **Totals** | **31,000** | **85,000** |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| **Server Cost** | **8,200** |  |  |  |
| Server Set up | 200 | waived |  |  |
|  | **8,200** |  |  |  |
|  |  |  |  |  |
| **Software Cost** | **10,000** | waived |  |  |
|  |  |  |  |  |
| Initial Setup Cost | <5000>1000 Spaces @ .75 Per Space | Lots J and M cost waived |  |  |
|  | **2,935.50** |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| **Total Cost to GMU** | **1,014,066** |  |  |  |

**APPENDIX C** – PARKme profits without an investor

Shows the profit PARKme expects with GMU not as an investor.

|  |
| --- |
| **Shows the income associated with GMU purchasing the PARKme system** |
|  |  |  |  |  |
| **Location** | **General Spaces Total** | **Sensor Cost markup (profit) $25 per unit** | **Sensor Install Cost $45 per unit. Economies of scale after 100 units. After 100 units 25% of install fee is profit** | **Total** |
| Lot A | 1040 | 25 | 10,575.00 | 36,575 |
| Lot C | 601 | 25 | 5,636.25 | 20,661 |
| Lot J | 389 | 25 | 3,251.25 | 12,976 |
| Lot K | 1485 | 25 | 15,581.25 | 52,706 |
| Lot L | 337 | 25 | 2,666.25 | 11,091 |
| Lot M | 159 | 25 | 663.75 | 4,639 |
| Lot O | 223 | 25 | 1,383.75 | 6,959 |
| Lot P | 228 | 25 | 1,440.00 | 7,140 |
| **Totals** | **4462** |  | **41,197.50** | **152,748** |
|  |  |  |  |  |
|  |  |  | **Profit from Sensors** | **152,748** |
|  |  |  | **Software License** | **10,000** |
|  |  |  |  |  |
|  |  |  | **Initial Setup Cost. Software set up is time intensive and therefore realized profit is only 5% of actual cost charged** | <5000>1000 Spaces @ .75 Per Space |
|  |  |  |  | **167.33** |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  | **Total Net** | **162,914.83** |

**APPENDIX D** – PARKme profits with an investor

Shows the profit PARKme expects with GMU as an investor.

|  |  |
| --- | --- |
| **Shows the income associated with GMU investing and purchasing the PARKme system** |  |
|  |  |  |  |  |  |
| **Location** | **General Spaces Total** | **Sensor Cost markup (profit) $25 per unit** | **Sensor Install Cost $45 per unit. Economies of scale after 100 units. After 100 units 25% of install fee is profit** | **Total** |  |
| Lot J | 389 | 25 | 3,251.25 | 12,976 | installed at cost |
| Lot M | 159 | 25 | 663.75 | 4,639 |
|  |  |  |  |  |  |
| Lot A | 1040 | 25 | 10,575.00 | 36,575 |  |
| Lot C | 601 | 25 | 5,636.25 | 20,661 |  |
| Lot K | 1485 | 25 | 15,581.25 | 52,706 |  |
| Lot L | 337 | 25 | 2,666.25 | 11,091 |  |
| Lot O | 223 | 25 | 1,383.75 | 6,959 |  |
| Lot P | 228 | 25 | 1,440.00 | 7,140 |  |
| **Totals** | **3914** |  | **37,282.50** | **135,133** |  |
|  |  |  |  |  |  |
|  |  |  | **Profit from Sensors** | **135,133** |  |
|  |  |  | **Software License** | **10,000** | Waived |
|  |  |  |  |  |  |
|  |  |  | **Initial Setup Cost. Software set up is time intensive and therefore realized profit is only 5% of actual cost charged** | <5000>1000 Spaces @ .75 Per Space |  |
|  |  |  |  | **146.78** |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  | **Total Net** | **135,279.28** |  |

**APPENDIX E** – Development Cost with no investor

Shows the cost of development without GMU as an investor.

|  |
| --- |
| **Shows the cost to develop the PARKme system** |
|  |  |  |  |
| **Expenses** |  | **Month** | **Cost** |
| **Software Development** | Coding | 1 | 2,800.00 |
|  | Coding | 2 | 2,800.00 |
|  | Coding | 3 | 2,800.00 |
|  | Coding | 4 | 2,800.00 |
|  | Coding | 5 | 2,800.00 |
| Total |  |  | **14,000.00** |
|  |  |  |  |
| **Software Testing** | Testing | 4 | 2,000.00 |
|  | Testing | 5 | 2,000.00 |
|  | Testing | 6 | 2,000.00 |
| Total |  |  | **6,000.00** |
|  |  |  |  |
| **Hardware Components** | Server | 1 | 8,200.00 |
|  | LAN Controller | 2 | 14,000.00 |
|  | Access Points 3 units @ $3000 | 2 | 9,000.00 |
|  | Parking Sensors Purchase 5 units @ $150 | 2 | 750.00 |
|  | Directional Sign | 3 | 10,000.00 |
| Total |  |  | **41,950.00** |
|  |  |  |  |
| **Hardware Testing** | Server Testing | 2 | 500.00 |
|  | Hardware integration | 2 | 1,000.00 |
|  | Hardware integration | 3 | 1,000.00 |
|  | Hardware integration | 4 | 1,000.00 |
| Total |  |  | **3,500.00** |
|  |  |  |  |
| **Integration Testing** | SW/HW integration | 5 | 2,000.00 |
|  | SW/HW integration | 6 | 1,000.00 |
|  | SW/HW integration | 7 | 500.00 |
| Total |  |  | **3,500.00** |
|  |  |  |  |
|  |  |  |  |
| **Total needed for development** |  |  | **68,950.00** |

**APPENDIX F** - Development Cost with investor

Shows the cost of development with GMU as an investor.

|  |
| --- |
| **Shows the cost to PARKme to develop the PARKme system with GMU as an investor** |
|  |  |  |  |  |
| **Expenses** |  | **Month** | **Cost** |  |
| **Software Development** | Coding | 1 | 2,800.00 |  |
|  | Coding | 2 | 2,800.00 |  |
|  | Coding | 3 | 2,800.00 |  |
|  | Coding | 4 | 2,800.00 |  |
|  | Coding | 5 | 2,800.00 |  |
| Total |  |  | **14,000.00** |  |
|  |  |  |  |  |
| **Software Testing** | Testing | 4 | 2,000.00 |  |
|  | Testing | 5 | 2,000.00 |  |
|  | Testing | 6 | 2,000.00 |  |
| Total |  |  | **6,000.00** |  |
|  |  |  |  |  |
| **Hardware Components** | Server | 1 | 8,200.00 | GMU Cost |
|  | LAN Controller | 2 | 14,000.00 | GMU Cost |
|  | Access Points 3 units @ $3000 | 2 | 9,000.00 | GMU Cost |
|  | Parking Sensors Purchase 5 units @ $150 | 2 | 750.00 | GMU Cost |
|  | Directional Sign | 3 | 10,000.00 | GMU Cost |
| Total |  |  | **41,950.00** | GMU Cost |
|  |  |  |  |  |
| **Hardware Testing** | Server Testing | 2 | 500.00 |  |
|  | Hardware integration | 2 | 1,000.00 |  |
|  | Hardware integration | 3 | 1,000.00 |  |
|  | Hardware integration | 4 | 1,000.00 |  |
| Total |  |  | **3,500.00** |  |
|  |  |  |  |  |
| **Integration Testing** | SW/HW integration | 5 | 2,000.00 |  |
|  | SW/HW integration | 6 | 1,000.00 |  |
|  | SW/HW integration | 7 | 500.00 |  |
| Total |  |  | **3,500.00** |  |
|  |  |  |  |  |
|  |  |  |  |  |
| **Total needed for development** |   |   | **27,000.00** |  |

**APPENDIX G** – Cash flows without investor

Describes the cash flows for the PARKme system without an investor.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Month** | **Expenses** | **Income** | **Net** | **Total Net**  |  | **# of Systems** |
| 1 | 11,000.00 | 0.00 | 11,000.00 | 11,000.00 |  | 1 |
| 2 | 28,050.00 | 0.00 | 28,050.00 | 39,050.00 |  |  |
| 3 | 13,800.00 | 0.00 | 13,800.00 | 52,850.00 |  |  |
| 4 | 5,800.00 | 0.00 | 5,800.00 | 58,650.00 |  |  |
| 5 | 6,800.00 | 0.00 | 6,800.00 | 65,450.00 |  |  |
| 6 | 3,000.00 | 0.00 | 3,000.00 | 68,450.00 |  |  |
| 7 | 500.00 | 0.00 | 500.00 | 68,950.00 |  |  |
| 8 | 0.00 | 54,305.00 | 54,305.00 | 14,645.00 |  |  |
| 9 | 0.00 | 54,305.00 | 54,305.00 | 39,660.00 |  |  |
| 10 | 0.00 | 54,305.00 | 54,305.00 | 93,965.00 |  |  |
| 11 | 0.00 | 0.00 | 0.00 | 93,965.00 |  |  |
| 12 | 0.00 | 0.00 | 0.00 | 93,965.00 |  |  |
| Year |  |  |  |  |  |  |
| 1 | 68,950.00 | 162,915.00 | 93,965.00 | 93,965.00 |  |  |
| 2 | 8,000.00 | 651,660.00 | 643,660.00 | 737,625.00 |  | 4 |
| 3 | 6,000.00 | 488,745.00 | 482,745.00 | 1,220,370.00 |  | 3 |
| 4 | 4,000.00 | 325,830.00 | 321,830.00 | 1,542,200.00 |  | 2 |
| 5 | 2,000.00 | 162,915.00 | 160,915.00 | 1,703,115.00 |  | 1 |
| 6 | 4,000.00 | 325,830.00 | 321,830.00 | 2,024,945.00 |  | 2 |
| 7 | 2,000.00 | 162,915.00 | 160,915.00 | 2,185,860.00 |  | 1 |
| 8 | 4,000.00 | 325,830.00 | 321,830.00 | 2,507,690.00 |  | 2 |
| 9 | 2,000.00 | 162,915.00 | 160,915.00 | 2,668,605.00 |  | 1 |
| 10 | 4,000.00 | 325,830.00 | 321,830.00 | 2,990,435.00 |  | 2 |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| **Rate** |  | **NPV Over 10 years** |  |  |  |
| 10% |  | 1,906,495.00 |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| Estimate $2000 worth of Software Mods per system  |  |  |  |  |  |

**APPENDIX H** – Cash flows with investor

Describes the cash flows for the PARKme system with GMU as an investor.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Month** | **Expenses** | **Income** | **Net** | **Total Net** |  | **# of Systems** |
| 0 | 0.00 | 14,000.00 | 14,000.00 | 14,000.00 |  | 1 |
| 1 | 2,800.00 | 0.00 | 2,800.00 | 11,200.00 |  |  |
| 2 | 4,300.00 | 0.00 | 4,300.00 | 6,900.00 |  |  |
| 3 | 3,800.00 | 0.00 | 3,800.00 | 3,100.00 |  |  |
| 4 | 5,800.00 | 0.00 | 5,800.00 | -2,700.00 |  |  |
| 5 | 6,800.00 | 0.00 | 6,800.00 | -9,500.00 |  |  |
| 6 | 3,000.00 | 0.00 | 3,000.00 | -12,500.00 |  |  |
| 7 | 500.00 | 0.00 | 500.00 | -13,000.00 |  |  |
| 8 | 0.00 | 45,093.00 | 45,093.00 | 32,093.00 |  |  |
| 9 | 0.00 | 45,093.00 | 45,093.00 | 77,186.00 |  |  |
| 10 | 0.00 | 45,093.00 | 45,093.00 | 122,279.00 |  |  |
| 11 | 0.00 | 0.00 | 0.00 | 122,279.00 |  |  |
| 12 | 0.00 | 0.00 | 0.00 | 122,279.00 |  |  |
| **Year** |  |  |  |  |  |  |
| 2 | 8,000.00 | 651,660.00 | 643,660.00 | 765,939.00 |  | 4 |
| 3 | 6,000.00 | 488,745.00 | 482,745.00 | 1,248,684.00 |  | 3 |
| 4 | 4,000.00 | 325,830.00 | 321,830.00 | 1,570,514.00 |  | 2 |
| 5 | 2,000.00 | 162,915.00 | 160,915.00 | 1,731,429.00 |  | 1 |
| 6 | 4,000.00 | 325,830.00 | 321,830.00 | 2,053,259.00 |  | 2 |
| 7 | 2,000.00 | 162,915.00 | 160,915.00 | 2,214,174.00 |  | 1 |
| 8 | 4,000.00 | 325,830.00 | 321,830.00 | 2,536,004.00 |  | 2 |
| 9 | 2,000.00 | 162,915.00 | 160,915.00 | 2,696,919.00 |  | 1 |
| 10 | 4,000.00 | 325,830.00 | 321,830.00 | 3,018,749.00 |  | 2 |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| **Rate** |  | **NPV Over 10 years** |  |  |  |
| 10% |  | 1,932,235.00 |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| Estimate $2000 worth of Software Mods per system  |  |  |  |  |  |  |

**APPENDIX I** – Tornado Diagram

The following is a tornado diagram used for sensitivity and variance analysis.

**APPENDIX J** – Decision trees

The following graphs are taking from the decision tree designed for the PARKme system. As the tree is extremely only pieces of it will be shown. The first section is from the side of the tree where GMU provides investments. The second section is from the section where no investors are used.

