**Solution Alternative Analysis**

**V.E.R.Y SAD Crates Solution Alternatives Summary**

There are five possible solutions for the V.E.R.Y SAD Crates company in which could improve their current system of locating and identifying their fish crates and reduce the percentage of fish crates in which are lost and stolen, this system should also provide the company with an easier method of billing the party responsible for damaging or not returning the fish crates, these solutions are as follows –

1. A Manual System
2. Bar Codes
3. Radio Frequency Identification
4. Global Positioning System
5. QR Codes

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| Alternative | Description |
| Manual System | The status quo for the V.E.R.Y SAD Crates company is currently a manual system of tracking the fish crates which they have in stock and for those which have been leased out, this current system is considered inadequate for the company as a large portion of their fish crates are currently being lost or stolen, thus the reason the company is looking to improve upon this manual system of maintaining their fish crate stock and leasing information. This system is the baseline for which is required to be improved upon. The company wishes to reduce the percentage of fish crates lost and to be able to maintain all records of their fish crates regarding to whom they have been released to, so in the case of lost or damaged crates the company will have sufficient knowledge of the amount of crates which were damaged or stolen and can then produce a bill to the liable offender. |
| Bar Codes | Implementing a barcode system would require each fish crate to contain a unique barcode in which the fish crate can be identified by whether the fish crate is large, small, green or brown. This system would require scanners for the fish crates at each collection and distribution point for the company in order to maintain a knowledge of which crate was being leased out and which crates were being returned. With the use of this system the company could then identify which crates haven’t been return based on the barcodes of the fish crates which were returned to a collection point. If the company found that there was damages to a number of crates or that a number of crates were stolen, the barcode system would allow the company to accurately bill the offending party who has lost or damaged the crates. |
| Radio Frequency Identification (RFID) | A Radio Frequency Identification System would require each crate to be equipped with a passive RFID tag which can be read by a RFID reader in which can read multiples of passive RFID tags simultaneously using Ultra-High Frequency Waves through the antenna of the RFID reader sending a radio signal to the tag in which the tag uses the signal to turn on and return the signal to the reader. This system like the barcode system would require a collection point and distribution point to identify the number of crates and the type of crate which is being leased out, upon return of the crates the system would allow the company to identify if there were stolen goods and how many were stolen. |
| Global Positioning System (GPS) | Using a GPS system would allow the company to determine which crates have been leased out and the location of each crate. With the ability to track the location of each crate, the percentage of lost crates could be drastically decreased. This system would allow the company to provide the leasee with a bill, along with the retrieval of the crate depending on it’s location which can be seen through the use of the GPS tracking. |
| QR Codes | Providing each crate with their own QR Code and similarly to barcode and RFID systems, the QR code system would allow the company to maintain knowledge of which crates are currently being leased out and which crates have been returned, allowing the company to determine if all the crates leased out were returned or not. Depending on the outcome the company can produce a bill to the offending party |

**Solution Alternative Effectiveness**

Each of the alternatives provide different angles on which the current manual system can be improved upon, the systems all have varying degrees of effectiveness and the cost of implementation for each of these systems all contrast.

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| Alternatives | Effectiveness |
| Manual System | The system in which the company uses currently is considered inadequate due to the lose of fish crates, maintaining a manual system won’t yield an decrease in the percentage of lost crates due to a manual system lacking the potential of tracking the identity of each and every crate which is leased out to their customers. A paper trail is highly ineffective for maintaining the stock belonging to the Fish Crate company as a paper trail is liable to be lost and illegible. A paper trail also doesn’t allow the company to provide a unique identifier for each crate. |
| Bar Codes | In comparison with the original manual system the barcode system would be a significant upgrade to the manual system as the company would be able to maintain a record for each crate as each crate would have a unique barcode assigned to it. Using barcodes each code has to be scanned individually and the scanner must have a direct line of sight on the barcode itself. Thus making the barcode more prone to damage in harsh environments where many of the companies clients will be using the crates. |
| Radio Frequency Identification (RFID) | The RFID tagging in comparison with a barcode system, the RFID reader doesn’t require a direct line of sight with the RFID tag which is much more efficient and effective than the barcode scanner which requires direct sight with the barcode. Another advantage of using RFID tags is that multiples of the crates can be identified simultaneously which is more effective than the other methods mentioned as it can drastically reduce the amount of time required to process orders of crates and the return of crates. As the RFID reader doesn’t require a direct line of sight with RFID tag, the reader can be attached to a stationery object within the warehouse and remove the need for human involvement with the scanning of the crates. With the use of passive RFID tags the company can reduce the cost and size of the tags by using ultra-high frequency(UHF) passive RFID tags opposed to active RFID tags. Active tags would provide them with the ability to read the tags from a longer range and active tags would be more reliable to endure the harsher climates, but the use of the UHF passive tags which can be purchased for approximately .004 times the price of active tags and the passive tags do not require any battery maintenance like the active tags. The reduction in cost and maintenance time by using UHF passive tags is more beneficial for the V.E.R.Y SAD Crates company and still provides them with the necessary requirements they need to be able to identify how many crates a company orders and returns. Another advantage of using RFID is that the reader requires |
| QR Codes | Similarly to the Bar Code the QR Code requires direct sight with either a QR Scanner or a mobile phone camera to have the ability to read the QR code, this type of functionality would require the crates to be read one by one like the bar code system. While the QR code may not be as durable in harsh environments as an RFID tag, and unlike a bar code, the QR code can be read providing that a majority of the QR code is identifiable by the scanner or mobile phone. |
| Global Positioning System (GPS) | The advantage of using a GPS system would be to provide the company with the ability to track where each crate is at all times, thus if crates are lost the liable party can be fined and the V.E.R.Y SAD Crates company can locate and retrieve the lost crates if they are found to be in a feasible location for the company to retrieve them. GPS like RFID system is highly durable and can work effectively in harsh environments. A problem with using a GPS chip in the fish crates is that a GPS chip requires a battery which would need to be changed regularly to avoid the loss of power which could inevitably cause the loss of the crate as the company would lose the ability to track the crate. |

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| Alternatives | Cost |
| Manual System | The cost of the maintenance of the manual system is minimal as the company already has the system implemented, their only cost is the paper in which they need to maintain their records and their backup records in the case of damage to their primary records |
| Bar Codes | To implement a barcode system would require the company to invest in a barcode scanner, purchase each barcode and to invest in a computer in which they can store all these records. The company would also have to apply each barcode to all their fish crates. |
| Radio Frequency Identification (RFID) | The cost of the implementation of the Radio Frequency Identification System would be for the company to purchase each tag along with the purchase of a fixed RFID reader along with a mount, so that the company can avoid having to man the reader with an employee while scanning the crates. The company would also have the cost of applying each RFID tag to each crate. By purchasing pre-printed tags the company can avoid paying the cost of purchasing a RFID printer. The software used for maintaining the RFID information and records can come at a large cost depending on the complexity of the software they require, a cloud based system would be preferred as an on-site application wouldn’t require the cloud maintenance cost but if the application had to be updated or altered, an on-site application would be more costly as the application wouldn’t have the option for upgrading or altering remotely. |
| QR Code | To implement a QR Code system, the biggest cost would be the implementation of an application similar to the application which would be required for the RFID system, so that the company could maintain and track all the information regarding their crates through their QR codes. As the QR codes could be read using a smartphone, the company can reduce the cost of having to purchase a QR Code Scanner by using the application in which was made for them and the camera which is already integrated into a smartphone. They would also be required to pay for the generation of the QR codes along with the implementation of the QR codes onto the fish crates. |
| Global Positioning System (GPS) | For the GPS system to be implemented, the V.E.R.Y SAD Fish Crate company would be required to pay for the GPS chips for each of the crates along with a GPS tracker. The cost of the GPS chips in comparison with RFID tags, bar codes and QR codes is much more expensive. Similarly to the other systems, an application in which can be used to maintain and update information regarding the crates and their GPS equipment. There would also be a cost for applying each GPS chip to the crate. |

**Feasibility Matrix**

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| Feasibility Criteria | Wt. | Manual System | Bar Code | RFID | QR Code | GPS |
| Operational Feasibility | 30% | This solution doesn’t support the required functionality of the company  **Score: 50** | This system does meet the required functionality but isn’t the preferred solution  **Score: 75** | Of all the systems suggested, RFID is the preferred system and matches all the requirements  **Score: 95** | The QR Code system matches the requirements but isn’t the most effective solution  **Score: 80** | This system would meet the requirements but would be too costly and wouldn’t be the most effective solution  **Score: 70** |
| Technical Feasibility | 30% | The manual system is easily accessible and doesn’t require major technological upgrades  **Score: 90** | Implementing this barcode system would require new equipment along with new computers in order to maintain the system, but the components required for this system can be easily accessed  **Score: 80** | Ultra-High Frequency RFID tags can be easily purchased but would require computers to maintain the information along with a software to maintain and track the orders of crates  **Score: 75** | The QR Code system is a newer system but the software needed for this system is readily available, and much of the QR code work can be done through already created applications. A computer would be required to maintain these applications  **Score: 85** | Implementing the GPS system would require the company to have to develop an application in which could record the transmissions from the GPS chips. This would require them to build the application along with acquire a computer.  **Score: 70** |
| Schedule Feasibility | 10% | 0 – 3 Months  **Score: 90** | 3 – 6 Months  **Score: 85** | 9 – 12 Months  **Score: 75** | 3 – 6 Months  **Score: 85** | 9 – 12 Months  **Score: 75** |
| Economic Feasibility -  Development Cost:  Payback Period:  Net Present Value: | 30% | €2,000  2 Months  €1,200 | €17,500  5 Months  €10,000 | €25,000  4 Months  €22,500 | €20,000  6 Months  €15,000 | €45,000  12 Months  €25,000 |

**Recommendation with Justification**

Taking the five systems(Manual System, Bar Code System, Radio Frequency Identification System, QR Code System, Global Positioning System) into consideration, the system which has the most advantages for the V.E.R.Y SAD Fish Crate company is the Radio Frequency Identification(RFID) system. The RFID system allows the company to read multiple crates simultaneously at a fast rate without a direct line of sight with each crate’s UHF passive RFID tag. In comparison with some of the other systems which requires a direct line of sight and can read only one crate at a time per scanner. The RFID system, similarly to the GPS chip is durable in harsher weather environments, but the RFID tags come at a significantly less cost than the GPS chip, the cost of a barcode or a QR code is also cheaper than that of a GPS chip but the bar code and QR code are at risk of damage in harsh environments, as they require a direct line of sight they are at a higher risk of damage as a QR code needs to have a majority of the code for it to be readable, thus as far as durability the RFID has the edge as it is cheaper than GPS for a similar level of durability and the RFID tag is much more durable barcodes and QR codes for a slight price increase. Another advantage of the RFID system is that the RFID reader can be mounted to a wall or a warehouse door and track the crates which have been sent out and which crates are returned without the need for an employee to be present for each crate which is scanned, this system can drastically reduce the time and cost over time of maintaining the orders as unlike the other systems which all have to have the crates be monitored individually and the bar code and QR codes require a person to be present to individually scan each crate that leaves the warehouse and again when those crates are returned. Without the need for an employee to scan each crate, there is no need for a wage to be paid for that particular job and if there is a large number of crates moving in and out of the warehouse, the company may have needed multiple employee using scanners to track the crates if the bar code or QR code system was chosen.

In conclusion I would recommend the company to use the Radio Frequency Identification System based on the advantages mentioned above despite the possibility of a higher initial cost, the company would save time and money from employment over time through the use of the RFID system.

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