| ID | Type of Risk | Risk Item | Effect | Cause | Likelihood | Severity | Importance | Action to Minimize Risk | Owner |
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| | *Technical or Non-Technical* | *Describe the risk briefly* | *What is the effect on any or all of the project deliverables if the cause actually happens?* | *What are the possible cause(s) of this risk?* | | | *L*S* | *What action(s) will you take (and by when) to prevent, reduce the impact of, or transfer the risk of this occurring?* | *Who is responsible for following through on mitigation?* |
| 1 | Non- Technical | Necessary parts are not available within budget constraints | We might not be able to make the budget as required by the design specifications | Did not keep budget in mind enough during design review and assessment | 3 | 3 | 9 | Do cost analysis at each step. Reduce cost if possible and insure that the technology considered is available (within the budget). Analyze tradeoffs between cost and other specifications. | Amina |
| 2 | Technical | Generator cannot be efficiently designed and manufactured in-house. | The design cannot be completed without this main part | Inadequate expertise, equipment, and materials | 3 | 3 | 9 | Purchase commercially available generator or hire a consultant. | Flora |
| 3 | Technical | Design does not work with all bicycle types | The usefulness of the design is lessened | Large array of bicycle types/sizes in the market. Cost for making universal solution may exceed budget. | 3 | 3 | 9 | Test design on at least 5 different bicycles that are within the specified size requirements. Check before prototype construction that the solution theoretically works. Utilize CAD programs as appropriate. Research the most common types & sizes of bikes in target countries. | Aaron |
| 4 | Technical | Devices does not work with every possible type of cell phone (and other small electronic devices) | The device will not be useful to people with those phones and devices | Large number of incompatible proprietary electronic devices not compatible with universal charger. | 3 | 3 | 9 | As many devices as possible need to be tested with the solution (minimum 10), Design needs to be monitored every few weeks to check to make sure that solution is theoretically working. | Brenda |

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| 5 | Technical | Water proofing is not absolute | The device may short | Bike may need to remain outdoors during heavy rain. May be exposed to severe elements. | 3 | 3 | 9 | Conduct waterproofing test prior to installation of electronics conduct according to IEC60529 | Dan |
| 6 | Technical | Roads in target country are not paved/level. | Device may snap off holder | Cannot go to those countries Inappropriate approximation/experiments | 2 | 3 | 6 | Experiment on different road conditions Pick the one that is closest to the target countries. Ensure device works at same effectiveness when charged on smooth and rough terrain. | Brenda |
| 7 | Technical | Device casing does not prevent vibration damage | The device will no longer function | Bike may ride over rough, uneven terrain. | 2 | 3 | 6 | Prior to electronics install conduct tests/calculations until desired level of damping is achieved | Dan |
| 8 | Technical | Device does not generate enough power | Phone will not charge, device failure | Inferior friction between roller and bike wheel | 3 | 3 | 9 | Conduct many tests to insure that proper power is generated | Flora |
| 9 | Technical | Device damages cell phone battery | Cell phone rendered unusable. Project Failure | Inadequate circuit design. Including lack of surge protection. | 2 | 3 | 6 | Test protection mechanisms to insure phone is charged sufficiently and safely | Flora |
| 10 | Non- Technical | Parts are ordered too late | Design cannot be built and tested on time | Lack of overall planning Not identified and ordered on time. Lead-time longer than manufacturer stated. | 2 | 3 | 6 | Utilize Gantt chart, plan and understand anticipated lead times and delivery constraints. Have multiple manufacturers who can supply part. | Amina |
| 11 | Non- Technical | UI is not easily viewable by user | The user will not have a pleasant experience and may be unaware if the device is working | Through vigorous riding, the UI dislodges. Initial placement may not be favorable to all users. | 2 | 2 | 4 | Need to consult with ergonomics expert and test with several people. Design needs to take into consideration the user. | Amina |
| 12 | Technical | Device cannot be installed without professional tools | Increase the cost, time, and number of | Inappropriate technology selection. Single tool installation not possible. | 2 | 2 | 4 | Concept/technology selection process to avoid designs that need extra tools | Aaron |

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| | | or people | people required for installation | | | | | or people | |
| 13 | Non- Technical | Only one electrical engineering student on team | This may delay some electrical engineering aspects of the design. | This is a constraint of the team environment and senior design class | 2 | 2 | 4 | Insure that additional assistance is sought for issues from experts or ask for help as soon as possible. Possibly hire a consultant | Flora |
| 14 | Non- Technical | Device is not aesthetically pleasing | Device works, but not attractive to user. | Lack of time spent on aesthetics. | 3 | 1 | 3 | Spend time making the device attractive. Possibly team up with Industrial Design students. Loosen restrictions for this criterion to reduce cost (if necessary). | Dan |
| 15 | Technical | Phone dislodges during testing | The phone may be damaged | Phone attachment not strong enough | 1 | 3 | 3 | Test phone attachments prior to attaching phone itself | Aaron |
| 16 | Technical | Device cannot stand temperature changes | Additional time and money may be required in order to find replacement parts. | Wires bend and break in cold, solder melts in heat. | 2 | 1 | 2 | Make sure extra parts are available to pick up in stores, not online. test bike in hot and cold temps, rapidly | Aaron |
| 17 | Technical | Poor Device Alignment on Bike | May add cost and require special installation, i.e. hub generator | Vibration, user, and impact dislodge generator from optimal intended energy recovery position. | 1 | 2 | 2 | Use hub generator initially, use a more robust method of attachment after testing | Aaron |
| 19 | Technical | Device produces too much power | Added cost, will have to redesign circuits, cause device not to work at all due to overload | Gearing for generator too high, insufficient circuitry, too large a generator | 1 | 2 | 2 | Conduct tests for proper power generation; see if rerouting power to another storage device is possible. | Flora + Aaron |
| 19 | Technical | Device breaks/becomes unusable due to particulate matter | Increased cost due to need for a guard. | Rocks or mud jam gears or cause roller to lose friction | 2 | 1 | 2 | Conduct tests in which generator experiences harsh off road conditions. Test according to IEC60529. | Dan |
| 20 | Technical | The device | Unsafe for use, | Poor choice of materials, | 1 | 2 | 2 | Test prototype before mass | Flora |

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| | | collects static electricity during a ride and shocks user | urgent safety hazard, Project Failure | poor design without a ground | | | | production to ensure safety of user is maintained, static discharge testing | |
| 21 | Technical | Wires detach | Device will not charge the cell phone and may break other components when pulled. This would make the project more expensive by having to replace parts | User becomes entangled in loose wires. Device is not secure enough and the road vibrations pull on the wires. | 2 | 1 | 2 | Create quick connect/ quick release end to wires to be easily reconnected. Purchase thicker wire ahead of assembly. Ensure plan to secure wires properly. | Brenda |
| 22 | Technical | Device can be easily stolen | Presents need for professional install. Adds extra cost to design. | Easy and nonpermanent attachment method. | 1 | 1 | 1 | Decide if it is necessary to have a professional install the device | Dan |

| **Likelihood scale** | **Severity scale** |
|---|---|
| 1 - This cause is unlikely to happen | 1 - The impact on the project is very minor. We will still meet deliverables on time and within budget, but it will cause extra work |
| 2 - This cause could conceivably happen | 2 - The impact on the project is noticeable. We will deliver reduced functionality, go over budget, or fail to meet some of our Engineering Specifications. |
| 3 - This cause is very likely to happen | 3 - The impact on the project is severe. We will not be able to deliver, or what we deliver will not meet the customer's needs. |

| **"Importance Score" (Likelihood x Severity)** | |
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| – use this to guide your preference for a risk management strategy | |
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| Prevent | Action will be taken to prevent the cause(s) from occurring in the first place. |
| Reduce | Action will be taken to reduce the likelihood of the cause and/or the severity of the effect on the project, should the cause occur |
| Transfer | Action will be taken to transfer the risk to something else. Insurance is an example of this. You purchase an insurance policy that contractually binds an insurance company to pay for your loss in the event of accident. This transfers the financial consequences of the accident to someone else. Your car is still a wreck, of course. |
| Accept | Low importance risks may not justify any action at all. If they happen, you simply accept the consequences. |