**Problem Statement**

- The calculations to find the axial force of the turbocharger are complex and time consuming.
- This project seeks to develop a user-friendly interface program to input previously created performance maps and additional geometry data to calculate axial force and accurately graph it.
- The benefits of solving this problem are providing a working interface to the customer that is future proof, and practice working on a real-world problem.

**Requirements**

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<tr>
<th>Req #</th>
<th>Requirement</th>
<th>Description</th>
<th>Verification Method</th>
<th>Requirement Type</th>
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<tbody>
<tr>
<td>1</td>
<td>Develop Program</td>
<td>Develop program to input SAE performance maps and geometry data to calculate axial force</td>
<td>Observation</td>
<td>Functional</td>
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<tr>
<td>2</td>
<td>Code input (vba)</td>
<td>Agree upon coding language between WSU Captains Team and BorgWarner</td>
<td>Verification with BorgWarner Team</td>
<td>Interface</td>
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<td>3</td>
<td>Input test data</td>
<td>Must be able to manually input data or upload data file</td>
<td>Demonstration</td>
<td>Qualification</td>
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<td>4</td>
<td>Accuracy of Interface</td>
<td>Data test results must be comparable and verify known axial force calculation</td>
<td>Analyze and compare test results</td>
<td>Performance</td>
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<td>5</td>
<td>&quot;Try to break it&quot;</td>
<td>Must make interface recognize invalid inputs or input files and be able to give diagnostic help</td>
<td>Test</td>
<td>Performance</td>
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<td>6</td>
<td>More complex Calculations</td>
<td>Make more complex calculations with variable data input files and graph input data with turbocharger geometry</td>
<td>Demonstration</td>
<td>Performance</td>
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<td>7</td>
<td>Graphical Output</td>
<td>Interface will provide graphical output based on given inputs</td>
<td>Test</td>
<td>Functional</td>
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</table>

**Concepts**

- **Concept #1**: Visual Basic Program
- **Concept #2**: C++ Program

**Results**

- The program works with current file and data formats and is set up to be adaptable to future formats.
- The subroutines can be converted to run in different syntaxes.
- We are receiving correct data from the axial force calculator.
- The code can use exception blocks to output proper data with improper inputs.
- The program can accept and process inputs other than the expected SAE data maps and geometrical data, then map graphical depictions of data accordingly.
- The graphical outputs produced were compared to previous graphs provided by BorgWarner and were found to be accurate.

**Summary**

- User Interface of the program is very user friendly and functional.
- The calculator provides outputs that are very accurate and exception block for inaccurate inputs.
- The graphical output matches BorgWarner’s graphs that were provided.

**Team & Acknowledgements**

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