Team Introduction

The team was composed of six (6) students from the Manuela Toro Morice High School (MTM HS) located in Caguas, PR (See picture 1). The team mission was to apply technology and engineering in a real project in an enterprise and teach about it to other students. The MTM HS vision is to be the most efficient group in the creation and promotion of technology to develop technological tools for our daily lives. During the current period, the República de Costa Rica Vocational High School participated with the MTM HS in the construction of the project body; the teacher, Rodriguez, with five (5) students of the body shop course contributed successfully to the development of this project.

Also, the group had the mentorship of the student enterprise Innovatronics from the Hispanic Entrepreneurial Program for Innovation. The student José Gonzalez graduated from the MTU HSE program (2010) and members of this UT Company worked closely with the HS team in the development of its project.

Picture 1. Members of Robotic Club Alliance team

Project Introduction and Summary

At the beginning of the year, the team focused on two projects: a solar boat and a Hexapod. Given the reduction in the number of students, the team decided to finish only the solar boat. With this prototype, the team wanted to continue with the construction of inspection devices for marine applications. The main concern for the team was to replace the use of gas oil for solar panels to avoid toxic waste materials in the sea.

The goals of the construction of a solar boat were:

- The boat will move with four (4) motors powered by solar energy.
- The boat will have integrated cameras for marine inspections,
- Remotely controlled and with good appearance and functional

**Accomplishments**

The team finished the solar boat with four integrated motors and powered by solar energy. The boat’s frame was built in PVC tubes, several drawings were evaluated to choose the final design (See Picture 2 and 3). At the same time, the team was mentored by Innovatronics, UT student enterprise, and the Puerto Rico Energy Center (PREC) in the assembling of the circuit to move remotely the boat and to connect the solar panels. Pictures 4 and 5 show the electric circuit used in the boat.

Once the boat frame was finished, the República de Costa Rica Vocational High School collaborated in the construction of the boat body. This was assembled in fiber glass to give it a good appearance and durability in water.

![Picture2. Solar boat drawings.](image) ![Picture3. Solar boat construction.](image)

![Picture4. Details of the boat circuit](image) ![Picture5. Details of the electric parts](image)

Finally, a flexible solar panel used to sailing applications was inserted in the boat. The prototype was successfully constructed and tested. Table 1 shows the boat specifications and Pictures 6, 7, 8 and 9 show the boat details.
Table 1. Solar Boat Specifications.

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>39”</td>
</tr>
<tr>
<td>Height</td>
<td>7”</td>
</tr>
<tr>
<td>Weight</td>
<td>28 lbs</td>
</tr>
<tr>
<td>Width</td>
<td>29 3/8 “</td>
</tr>
<tr>
<td>Materials</td>
<td>PVC, Motors, cameras, wires, straps, foam, plastic grills</td>
</tr>
</tbody>
</table>


Picture 7. Final Prototype.

Picture 8. Prototype testing.

Picture 9. Prototype testing.
In addition, other programmatic outcomes were established for the current period. Among the accomplished outcomes were:

1. **The student will develop entrepreneurial skills to manage projects**

In order to achieve this outcome, the entrepreneurial skills of the HSE participants were evaluated using the UT student enterprise model. Students evaluated their own entrepreneurial skills with scores options from 5 (the highest) to 1 (the lowest). The results (Figure 1) showed students' perceptions related to their entrepreneurial and management skills were high; they understood to have the ability of planning, developing, and evaluating a project. Also, the survey showed that they valued their creative talent and that they are looking for opportunities for their personal growth.

Although students received workshops to develop entrepreneurial skills, the survey showed aspects that the program needs to focus on such as: promote the respect for the others opinions, improve the disposition to work in a team and exploring the alternative to be entrepreneurs and develop their own company in a future.

Finally, an achievement of this outcome was to finish the proposed project within the academic year. This shows the technical skills and abilities of project management of the team.

2. **Students will be motivated to pursue STEM careers.**

Two students obtained their degrees this year. Both are women and one of them was admitted to Universidad del Turabo, School of Science and Technology, Chemistry Department. This student will participate in the MEPI program (Turabo’s Student Enterprise Program). The second student will follow a career in Social Sciences in the University of Puerto Rico.

3. **Students will know basic concepts of electricity and electronic components**

The Students assembled the remote control for the solar boat. They received seminars and mentorship from students of Innovatronics (Turabo’s student enterprise).

4. **Student will learn the advantages of the renewal energy for the development of new products.**

The students received mentorship from the Puerto Rico Energy Center (PREC), for the assembling and technical requirements of the solar panels, they learned about the solar panels specifications and usefulness of renewal energy in several applications.
Figure 1: Students Entrepreneurial Skills Evaluation
**Team Challenges**

The team decided to work on two projects: a Solar Boat and a Hexapod. Given the reduction in the number of participants and the difficulty in finishing both prototypes in the frame time, the group decided to focus on the Solar Boat. The group worked hardly in the boat assembling with PVC tubes the design changed three times. The purchase of materials was other aspect that delayed the project. Most of the suppliers are not in Puerto Rico and although the supplies were bought, the materials did not arrive on time.

On other hand, the presentation in the HSE Expo Enterprise was another challenge. None of the students had experience presenting, moreover in English. The teacher and the program staff prepared students to present at the expo. They finally accepted the challenge and did a good job at MTU (Picture 11). All technical issues were solved with the advisory of teachers, UT students and engineers.

![Manuela Toro HS presentation in HSE MTU Expo Enterprise 2011](image)

**Team Plans**

For the period 2011-2012 the group has the following goals:

- Increase the number of students to 10.
- Work in the construction of Super Mileage Car, a single-person, fuel-efficient vehicle. This is powered by a small four-cycle engine. This is a project with students of UT interested in developing it. Students will receive training in design software and the use of machines such as milling, welding equipment among others.

In addition, the program will:

- Evaluate the students’ professional skills to guide them to choose their superior education.
- Strengthen the students entrepreneurial skills with activities and seminars.