The following is a brief mid year synopsis of the progress made toward the 2009-2010 goals for the MTU-HSE underwater ROV engineering project, Traverse City Central Senior High, Traverse City Michigan.

**Team Bios:** The Traverse City Central Enterprise Team is currently made of approximately 20 students. The Enterprise group consists of three teams from the high school (grades 9-12) each working on a separate goal or challenge. Only one Enterprise team has chosen to compete in regional ROV competitions, surprisingly, the remaining two have elected to work and resolve some of the unique challenges offered by the sub marine environment. Teams meet every Thursday after school, most Fridays (depending on the school's social calendar) and weekends as needed. Specific goals for the 2010-2011 are presented below as well as individual successes, challenges, and unintended pathways (presented at the end of this document) as well an acknowledgement for those who have supported this project.

**Progress Toward Goals:** The emphasis for the 2010-2011 was to focus on three primary areas. Each goal is listed with specific comments given immediately following.

1) *Increase the use of technology into the ROV system and building process. Possible areas may include:*

   a) Integrating microcontrollers (Basic Stamp®) into the ROV control system  
   b) Interlacing text and sensor information into the video output display  
   c) Developing microcontroller based sensors that can relay information back to the surface

Significant and steady progress has been made in all aspects of this goal. Although not tested underwater, prototyping has produced a temperature sensor and interfaced a digital compass. Three different pressure sensors (for depth measurement) are currently under evaluation. Sensors have been successfully interfaced with a microcontroller (Basic Stamp®), which is used to interpret the changes in electric potential produced by the sensor. Sensor information was then translated by the microcontroller and been displayed on a LCD screen or interlaced into the video signal.

In preparation for the MATE ROV competition, the 9th grade team has used a microcontroller to interpret movements of an analog joystick and initiate very simple motor control functions. Although the learning curve has been very steep, students continue to increase their knowledge and control sophistication every day.
2) Design, engineer, build and evaluate a ROV that uses a “wireless control system”. The ROV may include the following:

   a) Internal power supply
   b) Wireless motion control
   c) Wireless transition of video and audio

Significant and steady progress has been made in all aspects of this goal. Although not tested underwater, students have a working prototype that includes on board power and wireless control. The video and audio wireless system is on sight but has not been tested.

3) Design, engineer, build and evaluate a ROV that is capable of reaching 200’ of depth. The ROV may include the following:

   a) Internal power supply
   b) RC control
   c) External lighting
   d) An optical system suitable for a no light environment

Significant and steady progress has been made in all aspects of this goal. Although not tested underwater, students have a working prototype that includes on board power, wireless RC control and an assembled 300’ tether. The video and RC control has successfully been tested through all 300’ of tether. The on board power system has proven to provide ample power to both the submerged RC system as well as the ROV 4 motors. Housings for external lighting and a low light level BW camera have been built but remain untested underwater. (See challenges listed below)
4) Compete in the regional Great Lakes MATE competition for those who wish.

The 9th grade team has assembled a working prototype of a “vectoring” ROV. It has been successfully tank tested and preformed well. Progress on joystick control has been slow but steady (see goal #1).

5) Make a concentrated effort to support and mentor a ROV engineering teams at the middle school level. Evidence suggests that students, when exposed to the novelty of ROV building at an early grade level, will stay together and continue ROV engineering as they progress through future grade levels. One anticipated problem would be finding competent parent mentors to stay with each team.

Although not as aggressive as last year, Traverse City Central Enterprise continues to support students from East Middle School. This year the students are given the opportunity to build a ROV or similar related projects (RC gas powered race car, autonomous plane) during a 40 minute resource period during the school day. Although students maintain some interest in the ROV aspect, unfortunately the majority are drawn to the RC gas powered race car and autonomous plane.

Challenges: One of the greatest challenges has been the weather. Finding a suitable place for authentic testing of an ROV and related systems has been very difficult. Although small scale tank testing provides some evaluation opportunity, it is difficult to simulate the depth and pressure environment in which the ROV will be working within the confines of a classroom setting.
Another logistical problem has been trying to foresee the material needs of each team. Although the ordering process is as efficient as possible, it will often be two weeks between placing an order and receiving the material. This becomes problematic, as certain tasks must be accomplished before other challenges can be resolved. This delay will often times hinder a team’s progress and make it difficult to stay to a timeline.

Lastly working around student’s social and extra curricular schedule has been frustrating for coaches and team members alike. However given the fact that students continue to return, this challenge may have to be taken “with a grain of salt”, to preserve the value of the experience.

**Student Learning:** This by far has been one of the most (in my opinion) successful parts of the project. With each group building their own ROV, each student on a team has the opportunity to be involved as an active participant. The students are unaware that the ROV is simply the platform, which provides them a vehicle of learning. Although hard data is difficult to obtain, the following list are just some of the learning experiences that students have had while involved in this project: Circuit building and analysis, motor control, resolution of forces, optical systems, power management, building materials, project design, machine tool, electrical soldering, attempts a mathematical modeling, and safety in the workplace.

Another aspect of learning has been the social demands of working in a group, and a team. The measurement of this learning category is extremely difficult to obtain, however students have had, almost daily, to deal with issues such as; time management, the social interactions of presenting and evaluating ideas, materials management, and how to handle failure.

**Public Outreach:** One of the highlights for the year so far has been receiving an invitation for students to present at the Grand Traverse Bay Underwater Preserve Summit meeting and dinner and participation in Super Science Saturday. Efforts at public outreach are ongoing.
Acknowledgements: As with all projects of this size, many people and organizations are at work behind the scenes, directly or indirectly. The students of Central High Enterprise gratefully wish to acknowledge the following:

- Than Dykstra, assistant coach, Traverse City East Middle School
- Norton Bretz, assistant coach, Three Lakes Association
- Doug Oppliger, Paige Hackney and Felicia Chong, Michigan Technological University High School Enterprise Program
- Karl Klimek, Barb Land, Square One Education Network (formally the Convergence Education Foundation)
- John Failor, Michael George and Matt Cauchy, Hal Lalone, Traverse City Area Public Schools

Respectfully submitted,
Traverse City Central Enterprise