SP Hybrids
Project Plan

IPRO 356 – Fall 2006
Plug-In Hybrid Electric Vehicles: Simulation, Design, and Commercialization

Team Name: SP Hybrids

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Mission Statement

To complete the final stage in the assembly of a Plug-In Hybrid Electric Vehicle (PHEV) and commercialize the technology on a large scale.

Objectives

The following are the objectives for the SP Hybrids Project this semester:

1) Develop a business plan around Plug – In Hybrid Electric Vehicles
    a) Market Analysis - Conduct market research to identify a market for PHEV
    b) Cost Analysis - Perform cost analysis for a simple model or unit and extending the analysis to more than 100 units
    c) Performance Tests - Perform trial simulations and tests on several types of batteries to determine which conditions provide the highest efficiency

2) Meet IPRO objectives
    a) Submit a midterm report outlining any changes in this plan for use for the rest of the semester
    b) Give a presentation on IPRO day including:
        i. a power point lecture,
        ii. a poster that explains the technology and outlines the business plan,
        iii. a website including necessary information for potential partners / investors,
        iv. a physical model of the technology
    c) Use the IPRO iGROUPS to update and track progress of project

3) Create a team-based learning environment in which students from various concentrations and disciplines work together to solve a real-world problem.

Background

It is projected that automobile ownership and use will significantly increase over the next few decades. Along with this comes the obligatory increased consumption of fuel. However, it is believed that oil production will reach its peak by 2025 and the increase will not be able to meet the demands of world use. Prices will skyrocket and tensions will heighten in the Middle East. It is thus imperative to find a way to reduce petroleum-based fuel use without compromising the automotive industry markets. One solution is to create more electric vehicles (MEVs). With sales of hybrids jumping 81% in 2005, the electric-combustion hybrid technology has already proven itself both in terms of usability and marketability. The benefits of reduced emissions, improved performance, and higher fuel efficiency these vehicles offer is making the increased price more attractive than ever before.

The Plug-in Hybrid Electric Vehicle (PHEV) is a hybrid car with an additional battery which has the ability to be recharged at home or anywhere an electrical outlet exists. There are several crucial advantages to PHEV. The most important being Affordability. Although the retail price is higher than conventional vehicles, the operating cost is substantially lower. Fuel costs for conventional vehicles stand on 6 cents per mile while for plug-ins the cost is only 3 cents per mile including the cost of electricity (IAGS, Institute for the analysis of global security). Moreover, the government will provide tax credits for alternatively fueled vehicles (The Energy Policy Act of 2005 (EPACT)). Secondly, PHEV is an environment-oriented vehicle. PHEV is known as a 'gas-optional hybrid' because it doesn't need to use gasoline for typical commuter distances. This reduces emissions to zero for typical vehicle usage. Government studies have found that PHEVs reduce greenhouse gases by 46 to 61 percent (Electric Power Research Institute). Because of these benefits, consumers are willing to pay more money for PHEVs. A study(1) by the Electric Power Research Institute (EPRI(2),) found that consumers like plug-ins because they would offer the best of both worlds: the reliability of a traditional hybrid and the efficiency and performance of an electric car.

SP Hybrids has been involved in Hybrid research for over 5 years. The preliminary research has determined that the PHEV concept can be a very successful and profitable alternative to conventionally powered automobiles as well as capture the market from traditional Hybrid manufacturers. The initial designs for SP Hybrid's system has been completed and thoroughly tested for consistent results. The parallel research being conducted on batteries, engines, breaking systems, etc. allows SP Hybrids to produce our PHEV entirely in-house.

Research Methodology

- **Technical**

  The main purpose of the technical team is finding out the components which would be required for a given application by using a simulation tool. Advanced Vehicle Simulator (ADVISOR) is vehicle analysis software released from the National Renewable Energy Laboratory (NREL). ADVISOR has many different design options to get the proper size of components (e.g. an engine, an electric motor, a transmission, a battery, and a power train control strategy). In the output section, ADVISOR displays fuel efficiency, overall efficiency, a battery state of charge (SOC), an emission map. ADVISOR is reliable software used widely in the industry as a vehicle simulation tool. ADVISOR has been used successfully to evaluate many different conceptual vehicles and new test procedures and driving cycles. The technical team will simulate three different modes of a vehicle prototype, (i.e. a conventional vehicle, a hybrid electric vehicle, and a plug in hybrid vehicle) with ADVISOR. The mechanical designs for the vehicle prototype will be done to achieve the best possible performance and the maximum efficiency of the vehicle. The power control strategy will be adjusted differently depending on the vehicle operation types. Finally, by comparing results from ADVISOR, the technical team will determine the optimal hybridization factor for each vehicle component.

- **Business**

The business team will work in two phases to ensure clarity of operations.

Phase I *Data Acquisition and Analysis*

Phase II *Developing a Marketing Strategy, Formulation and Finalization of the Business Plan*

Data acquisition will be done through surveying relevant companies and dealers in the plug-in hybrid electric vehicles field. The surveys are expected to be revealing in the following areas:

- New and current technology trends
- Untapped market and its attitude towards plug-in hybrid electric vehicles
- Current customers and their expectations
- Degree of competition and competitors
- Fixed and recurring costs

The team will also seek to incorporate research results by the technical team if any such result is deemed to affect the overall outcome of the surveys. The data acquired will also be used to edit subsequent surveys if the team determines such an action would reveal more about the market.

Once the team decides that sufficient data is available, an in-depth analysis will be carried out. The results of this analysis are expected to give an insight into:

- Technology changes that need to be considered
- Percentage of market that can be tapped
- Barriers to entry
- Our position to deliver customer expectations
- Investment costs and cash flow
- Risks

More information would be acquired if the team decides as such. This analysis will be the platform upon which our marketing strategy would be formulated. The business plan will be finalized to include the recommendations and results of both *(business and technical)* teams and will be subject to a joint team approval.

The business team will be composed of two sub-teams. One team will work on data acquisition. The other team will work on analyzing the results to determine if the surveys can be modified to reveal more about the market. Both sub-teams will regularly update the business team leader on progress made or difficulties encountered. The business team leader will collaborate with the technical team leader and update his team as required. He will also formally report the progress made to the project team leader. Meetings with the technical team and between the sub-teams will be arranged as and when necessary. The sub-teams will pair up once sufficient information is gathered and work together to analyze the results. The team will work together during Phase - II as well.

Expected Results

The technical team expects to have come up with the most optimal simulation of a plug-in hybrid vehicle. This prototype is meant to be an additional system for an existing hybrid vehicle, which would easily and seamlessly install into the existing system.

The business team expects to have performed a Market Analysis to identify the existing market for PHEV, a Cost Analysis to determine the financial risk or gain of the product, and the development of a detailed business plan.

SP Hybrid's goal is to meet the IPRO objectives, including submission of all the deliverables, the completion of the presentation for IPRO day, which includes a power point lecture, a poster outlining the project, a website, and a physical model of the technology.

Budget

Item	Description	Cost ($)
Hybrid car model		200
Website domain		10
Food for meetings	$5/Large Pizza, $3/Pack of Doughnuts	120
Cost of printing	300 surveys	15
	30 brochures	48
Binders	For 4 copies of the business plan	60
Custom Candy; for distribution during IPRO day	Pack of 100	31
Business Cards	Pack of 100	38
Apparel for the group	10 polos at $12/polo	120
Total		**$642**

Schedule of Tasks

Events:	**Dates:**
IPRO Team Briefings (individual teams):	August 24th - September 1st
IPRO Games	August 26th
Project Management Workshop	September 8th and 9th
Mid-Term Reviews (optional):	October 16th- 18th
IPRO Day Guidelines and Tips Session	November 13th
IPRO Projects Day Conference:	Friday, December 1st, HUB
IPRO Team Debriefings	December 4th- 15th

Deliverable:	**Deadline Date:**
Syllabus (Faculty Responsible)	September 1st
Pre-IPRO Experience Survey (w/briefing)	Week of August 24th and September 5th
Project Plan	September 22nd
Mid-Term Progress Report (w/ optional presentation)	October 20th
Exhibit / Poster	November 22nd
Project Abstract	November 22nd
Web Site	November 27th
Final Oral Presentation	November 29th
Final Report	November 30th
Team Information	November 30th
Comprehensive Deliverables CD	December 1st

Individual Assignments

CEO: Jason Fuglestad
VP of Operations: Dolapo Popoola

CTO: Julie Patti
Technical Team:
This team handles the technical aspects of the company. This team concentrates mostly on simulations for prototyping, but they can handle any other technical tasks.

- Julie Patti
- Jae Suk Lee
- Hassan Ali

CFO: Sujit Thomas
Business Team:
This team handles all the business aspects of the company. These responsibilities range from surveys, planning, market analysis, and other tasks. For this reason, this team is much larger than the tech team.

- Sujit Thomas
- Dolapo Popoola
- Mary Cyriac
- Seung Baek
- Matt Anderson
- Yin Zhao

Webmasters: Jason Fuglestad and Mary Cyriac