Marketing the 2000 WPI Formula SAE Racecar

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Abstract

This project encompasses the presentation event as well as the marketing plan for the 2000 WPI Formula SAE racecar. The presentation event involves communicating all the features and benefits of the AX-600 as if potential customers and managers were in attendance. The team is allotted ten minutes to convince upper-level management that they can profit by selling our product. By first demonstrating that a market exists for a recreational autocross vehicle, the presentation will prove that it is possible to sell 1000 cars per year. A marketing analysis is essential in determining whether or not this task is feasible. Factors such as market size, similar products from competitors, determination of who the target customer is, what his or her needs are, and methods of advertising are most likely to attract potential customers are all vital aspects of this project. Similarly, emphasizing the car's qualities to meet the needs of the target customer, selecting locations for factories and dealerships in order to maximize efficiency, and determining a price that is affordable are likewise crucial to the success of the project. Data generated from an existing racecar market provides useful information in determining the aforementioned factors.

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Key: JC = Jacob Coolberth, GE = George Enriquez, DH = David Henry, JS = Jon Suchecki

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1. Introduction and Competition Overview

1.1 Introduction

The Formula Society of Automotive Engineers (SAE) conducts an annual competition where students at colleges and universities around the world design and build small formula-style racecars [1.1]. The vehicles are rated according to their showing in static and dynamic events. Students work all year to prepare their vehicles for the main event: the timed race against the other participants, where the quality of the car is judged by its performance on the track. Secondly, a cost analysis presentation is made. Here it must be proven that the car is affordable while maintaining superior quality. Also a presentation event is created, where students use the specifications of the car to create a theoretical marketing campaign to sell and service one thousand cars a year. Ultimately, the car is judged on the accuracy of the design requirements as well as the practicality of the cost and manufacturing process.

The Formula SAE competition allows students to gain experience and valuable insight in the automotive engineering and design field by allowing them to work as a team and take the project from start to finish. Students are encouraged to not only develop a quality product, but to also design it at minimal cost, ensuring the vehicle's practicality in today's society and also in a given market.

1.2 FSAE Presentation Event

The FSAE presentation event is divided into three components, which are marketing, design/manufacturing, and technical aspects. The manufacturing component deals with the production plans of the car. Within this component, setup for the factory floor layout, production plans, and materials needs will be discussed [1.1]. The marketing event deals mainly on the target market at hand, attempting to address the needs or demands of the customer [1.1]. The potential market is analyzed using different techniques of market research. With the use of cost analysis, the sales price of the car can be determined using such factors like parts, labor, and overhead costs. The technical aspects of the car deal with the unique features that make the AX600 Turbo different from the competition.

The marketing event deals with the sale of the car to its target market in a theoretical sense. The project group must assume that the car is built for sale to the weekend autocross racer. Guidelines for the competition entail that the suggested retail price of the car must be under $9,000 and 1000 cars must be produced and sold per year [1.1]. With this taken into consideration, the car must be inexpensive, durable, and easy to maintain. In order to improve the marketing aspect of the car, there must be financing options, warranties, and availability of parts, etc.

The entire presentation is given no more than ten minutes [1.1]. The marketing presentation will be given four to six minutes, which gives the manufacturing presentation four to five minutes depending on the length of the marketing group. In this way, both groups are able to represent their part equally. The judges for the presentation are upper-level executives from different car producing companies [1.1]. These judges

will determine if our business plan is acceptable for the actual sale and manufacturing of our racecar. Included in the presentation is a television commercial that shows the car in action, a colored brochure and a magazine article will also be available to the judges, which summarizes the technical aspects of the 2000 WPI Formula SAE Racecar. In order to sell the AX 600 Turbo, we must establish a marketing strategy that would increase our sales in the racecar market. In the sections following, we will address the different components of the presentation event.

1.3 Presentation Event: Marketing Component

The questions that must be answered for the marketing component of the presentation event are as follows:

- What is the target market? [1.3]
- How can we address the needs of the customer? [1.2]
- Do we have a detailed cost analysis for the potential customer? [1.2]
- What are our options packages? [1.4]
- Can we show marketing techniques? [1.2]
- How can we maintain customer interest for all audiences? [1.2]

In order to make the marketing aspect of the presentation most effective, the team needs to demonstrate that they have accomplished several objectives. The first is identifying the target market, and then addressing the needs of this market [1.2]. This can be done through market research. The team must demonstrate analysis of their target market; just simply stating the market will not suffice [1.2].

The next issue that must be addressed is the cost analysis of the car. Here the team needs to show why the car costs what it does, by thoroughly going through the costs of the raw materials and the production [1.2]. The focus of our cost analysis is our customer. Therefore, we should come up with some realistic option packages to satisfy customer needs, both economic needs and performance needs. The team then needs to address the concerns of the potential producer. Here we need to come up with an estimate of what it would cost for a company to produce 1,000 of our cars per year [1.2]. We must make this as cost effective as possible, and this will be stressed in our design for manufacturability. The team will attempt to provide realistic economic figures for production.

We will also introduce our various marketing techniques, such as a television commercial, magazine advertisement, web page, etc [1.3]. This will provide a means for the team to demonstrate some of the competitive distinctions of the car, and also highlight improvements and innovations.

Part of what will make the presentation event successful from a marketing standpoint will be creating the presentation in such a way that it appeals not only to the technical individuals but also to potential managers. By giving a presentation that captures the interest and enthusiasm of all levels of the Formula One audience, we can set our car apart from the competition.

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IQP/MQP SCANNING PROJECT

pressure-map the design for a seat, giving maximum comfort throughout [1.6]. Maintenance and adjustability are not a mechanics nightmare with the WPI racecar. The WPI racecar features many easily adjusted components as shocks, pedal cluster, chain tension, to name a few, and they body removes quickly for getting at the hard to reach areas [1.6]. Not only are these parts easily adjusted, but most people already have the necessary tools for the job. These tools are a set of box or socket wrenches in the following sizes: ¼", 3/8", 5/16", 7/16"; along with this is a set of Allen wrenches is necessary to accomplish any adjustments and most repairs [1.6]. This year's model features a CRO-MOLY frame, a newly designed aerodynamic shell, and a new steering box, just to name a few of the improvements [1.6].

1.5 Presentation Event: Design and Manufacturing Component

The questions that must be answered for the design and manufacturing component of the presentation even t are as follows:

- What will it take for the manufacturer to get it all started? [1.2]
- Why makes our car better than the competition? [1.2]
- How is the customer service after the purchase?
- Are there any adjustable parts? [1.3]
- How can I pay for the car? [1.2]
- If the customer has experienced car trouble, where does he/she go?
- What are the concerns of the potential producer?

We can mention the low start up costs. A table, flow chart, would help to show how much it costs to produce, how much to sell for and profit he/she gets back. Also, we can specify the machines it would take to start the factory and how many people it takes to build 1000 per month [1.2]. We must touch base on the production of spare parts. A monthly schedule that states what and when each major assembly will take place could help in explaining the factory setup.

Another aspect that must be focused are the unique features of our car. We can focus on the interchangeability of the parts from left to the right [1.3]. We can stress the idea of modifications and upgrades. In the brochure, a list of possible upgrades with MSRPs could be placed. With the ability to modify and upgrade, we can increase our demographic, which can lead to more sales. If we are able to create a financing option, we won't have to focus on the upper class, weekend racer. A great warranty can be a positive feature to our presentation. Create a warranty that would benefit the customer as well as the manufacturer. The car's ease of maintenance can be mentioned, but we need to stress on the why and how instead of just saying so [1.2].

Finally, we must have a strong support group that could offer general racing advice and also technical support. Race locations, local racing clubs and updates could be shown in a monthly newsletter sent to customers. Not only can this be sent in the mail, but electronically as well. We could find examples of other news clubs and follow a similar format in the production of ours. These ideas may result in the increase of costs but it is very crucial. We have to show that we are a people company. A "first name" basis to sales, tech help and advice would give the customer a feeling of closeness. We can recommend places to take the car or create a factory door-to-door service.

1.6 Objectives of the IQP

1. To determine if a market exists for a Formula SAE racecar.
2. To locate that market.
3. To determine what the market wants.
4. To find solutions that will help sell the car in its market.
5. To show the unique features of the WPI AX600 Turbo.
6. To analyze the cost of the WPI AX600 Turbo.
7. To market the AX600 Turbo to upper-level executives in Detroit, Michigan.
8. To rank #1 in the presentation event.

The first chapter deals with the components of the presentation event and the actual competition that takes place in Detroit, Michigan. For the presentation event, we have chosen to divide it into three areas: marketing, technical, and design and manufacturing component. In this chapter, we address the main requirements needed for a successful presentation.

Chapter two is for our entire business package. In here, we have included a detailed business plan that incorporates the goals of the company. It describes our mission statement, our business card layouts, and a comprehensive quality function deployment that compares our customer's needs to the technical requirements.

The third chapter incorporates all of our marketing materials used for advertising. In this chapter, we describe the development of the AX600 Turbo logo, our website, our informative colored brochure, several poster designs, and magazine advertisements. Information for the television advertisement is included, which describes the layout of the

actual commercial. Also, we explain how to market the AX600 Turbo, showing the lucrative markets available to sell 1000 cars annually.

Chapter four includes all of the slides that are used for the presentation event, including the supporting slides. Not only are pictures of the slides shown, but brief descriptions of the bullets are included as well.

The fifth chapter deals with all of the design for manufacturing components done for the manufacturing group. In here, we include how the warehouse was designed, the overall site plan, and the entire layout of the factory.

Finally, we wrap up the entire project with a conclusion and several future recommendations. We also have several appendices which provides relevant backup information for each chapter of the IQP.

2. The Business Package

This chapter contains sections common to any business. The first section is an overview of the business plan, which is contained in Appendix A. A business plan is a detailed look at company. Section 2.2, is dedicated to the development of the WPI Motorsports Mission statement. Mission statements can establish a corporate identity, and instill a sense of values in employees. Another crucial element to establish an identity is the development of business cards, as discussed in Section 2.3. The final section, 2.4, is a look at manufacturing based on the customer feedback, by means of Quality Functions Deployment.

2.1 Business Plan

A business plan is a report about a company that contains pertinent information organized into separate sections. Companies write business plans for a variety of reasons. The initial reason may be to procure a loan from a bank. By demonstrating all of the relevant information about a business, the bank can choose either to grant or deny a loan. Another purpose of a business plan is to provide information for potential investors. Business plans contain a wide variety of information, and each business must decide which components are necessary for their business plan. Crucial elements of a business plan include those that address concepts, customers, and cash [2.1]. These are very broad elements; so many different sections may fall under each. The concept is basically what the business does, the customer area addresses issues such as who is the target market and

what are their needs, and finally the cash section demonstrates the financial details of the company. The WPI Motorsports business plan covers these three categories well, and the information is divided into the following sections: executive summary, vision/mission statement, features of the car, current status of the business, market demographics, marketing techniques, competitive distinctions, comparison to competition, projected usage, long-term development strategy, market share, balance sheet, pricing strategy, and support and service plan.

The executive summary basically describes the purpose of WPI Motorsports, which is the design, manufacture, marketing, and sale of Formula SAE racecars. The next section, the vision/mission statement, states the vision of the organization, and also provides insight on the principals and values of the organization. More information on the vision/mission statement is provided later in this chapter. The features of the car section highlights some of the unique and outstanding factors of the car. The next section is the current status of the business. This describes the history and present status of WPI Motorsports. The market demographics section contains information about our target market. The information describes the demographics of our target market, and also gives some information about the overall market. Various methods of marketing are discussed in the marketing techniques section. The methods include: a magazine advertisement, a website, a television commercial, a radio commercial, promotional events, a brochure, and a 1-800 number for information. Another important aspect is the competitive distinctions section. This part describes the aspects of WPI Motorsports that make the team excel. This includes information about the organization itself, and the also the product, the AX600 Turbo. This section prepares the reader well for the next section, the

comparison to competition. This part describes the AX600 model in comparison to other models. Projected usage is the next section in the business report. This describes the useful life of our product, the AX600. This section also gives information about the warranties offered with the product. The next section, long-term development strategy, is very important information for potential investors. This includes information such as product life cycle, budgets, and future profits. Market share, balance sheet, and pricing strategy are important sections for potential investors. The potential market share for the vehicle is discussed in the market share section. The balance sheet is a table of the business's current assets and liabilities. The pricing strategy section of the report is an explanation of the price, and also insight about the price trends in the market. Support and service plan is a small section describing the support services offered by WPI Motorsports. The complete business plan is contained in Appendix A.

2.2. The WPI FSAE Racing Division Mission/Vision Statement

A corporate mission statement serves to define a corporation's purpose for existence. Corporations are formed to accomplish something that did not exist in the marketplace, or perform a service better than the existing companies. When a corporation establishes a mission statement, it helps the corporation remained focused on their purpose, which is often called a vision statement, and enables the corporation to set goals to achieve this vision. A study of randomly selected business firms showed that firms with mission statements increased shareholder equity to an average return of 16.1% as opposed to a 9.7% return from companies without mission statements [2.2]. Corporations

may undergo changes over the years, but with a well-formed mission statement the values of the corporation will remain the same. Or, if need be, a mission statement can be revised to show a corporation's dedication to refocusing the mission. The WPI FSAE Racing Division would benefit greatly from a mission statement, as it would be instrumental in establishing a corporate identity, which may be viewed as a source of pride for employees.

Corporations can use mission statements to install a sense of purpose of business but also a sense of values and motivation in their employees. A statement should elicit an emotional response and be easily transferred into everyday activities. Another important aspect is that the goals should be measurable and tangible. "To be the best!" would not be a very tangible mission statement, something like, "To achieve dominance over competitors" is more practical as it can be measured. The WPI FSAE Racing Division statement has phrases such as "maintain open and productive communication" and "be the industry leader…" These phrases are intended to motivate the employees of WPI FSAE Racing Division to achieve great results.

Bryson and Alston [2.3] provide an excellent set of questions from which a mission statement can be formed. By answering the following questions, a company can gain a clear sense of what they want to include in their mission statement. There is also a set of questions regarding the values of the company. Basically from these questions, a company can identify what their values are, and also they can be applied.

Mission Statement [2.3]:

1. Who are we? What is our purpose? What business are we in?
2. In general what are the basic social and political needs we exist to fill? Or: What are the basic social or political problems we exist to address?
3. In general, what to do we want to do to recognize or anticipate and respond to these needs or problems?
4. How should we respond to our key stakeholders?
5. What is our philosophy and what are our core values?
6. What makes us distinct or unique?
7. What is our organization's current mission?
8. Is our current mission dated, and if so, why?
9. What changes in the mission would I propose?

Values Statement [2.3]:

1. List what you consider to be your organization's key values at the present time.
2. What additional values would you like your organization to adopt, to guide the conduct of its business and its relationships with key stakeholders?
3. Drawing on group consensus, develop working definitions of these values.
4. Now consider how you want to reflect these values in your strategic plan.

Another element often included in mission statements is a commitment to survival, growth and profitability. This should convey the company's long-term commitment to financial success. It should also make mention of a company's goals of

innovation in the field. For WPI, this value is expressed by the phrase, "Plan for the future, while keeping in mind the principals that have lead to our success."

Quality in product and service are also very important. This should show how important quality is to the company. Xerox makes a strong statement about quality in their mission statement. "Xerox is a quality company. Quality is the basic business principal for Xerox. Quality means providing our external and internal customer with innovative products and services that fully satisfy their requirements. Quality improvement is the job of every Xerox employee…Leadership Through Quality" [2.4]. In their statement, they not only stresses the importance of quality, they actually give a working definition of the expectation and the means by which this may be accomplished.

Customer focus is also very important. Ford's mission statement is a good example of a company dedicated to serving its customers. "Customers are the focus of everything we do- Our work must be done with our customers in mind, providing better products and services than our competition." [2.4] An important aspect of customer service is instilling a proper sense of ethics in employees. Employees must have a sense of values in their daily interactions with customers. Otherwise they will not continue to receive business from customers. In addition, the company should strive to meet customer expectations fully and continue to support their customers after the sale is made. These sentiments are expressed in the phrase, "Seek to fulfill customer needs as well as possible, including providing industry leading support." Another part of customer focus is realizing that while the company is in business to make money, they must consider the needs of their customers. Therefore a mission statement should address

clarify that the goals of the company are to meet the needs of the customers, not just to sell products.

Another key element is a competitive attitude. The business world is very competitive, and part of the mission of the company should be to stay on top. DuPont's mission statement contains the line… "To be more successful than our competitors, we must never be satisfied with the status quo." [2.4] Certainly an important part of business is maintaining a competitive edge over competitors. An integral part of this is product innovation.

The mission statement of WPI FSAE will start by stating the company objective, by the means of a vision statement. The statement reads: Our Vision: To be the worldwide leader in the design, production, and marketing of Formula SAE Racecars. Essentially this is goal of the WPI FSAE Racing Division, and by keeping this goal in mind, the company will remain competitive and innovative. After the vision statement comes the mission, which is:

Mission: To achieve our vision, we shall:

- Continually seek to improve all of the aspects of our business, including our design, production and business processes.
- Maintain open and productive communication between all members of our organization.
- Seek to fulfill customer needs as well as possible, including providing industry-leading support.
- Plan for the future, while keeping in mind the principals that have lead to our success.

The first statement conveys the competitive and innovative approach that the company wishes to take. The next statement describes the corporate culture of the company, stressing the value of communication. For the mission statement to be successfully integrated into the company, customer needs are addressed in the third part, where the goal is to become an industry leader in support. The final part of the statement describes the plan for the future, while reflecting on what has made the company successful.

Mission statements can be an important and influential part of business today. They can inspire employees and managers to achieve great levels of effectiveness and also encourage innovation. The effectiveness of mission statements is based on awareness and integration into day-to-day activities. By addressing all of the elements that make a corporation successful both financially and publicly, mission statements set guidelines for every aspect of business.

2.3. WPI FSAE Business Cards

The marketing team wanted a more professional approach in producing the 2000 edition of the WPI FSAE business card. We've decided to include two pieces of clipart, one being the Twin Towers, and the other being the WPI seal having a racecar in the center. The business card needs to have a crisp, vivid look while including WPI and its automotive industry reputation. These business cards will be given out at the presentation event and other FSAE events by team members to promote future job opportunities.

After determining the two pictures, it was decided that the three colors to be used are crimson, gray, and black. In the top left, the name and job title heading will be placed so that the reader will first see the name when reading from left to write. The top right has the most useful information in order to contact the person. The phone numbers, fax, e-mail address, and web site (if needed) are placed here for ease of access. This is very different from the previous years, having all the information in one block, which can be difficult to read at a quick glance. In this way, it separates the less needed information such as the school address from the more useful information. The bottom left contains the important graphics, which include the WPI logo, the Twin Towers, a symbol of WPI tradition, and FSAE racing division. The left middle of the card has the WPI seal to show some sense of authenticity, along with a FSAE racecar inside to include the racing and the school together. Finally, on the very bottom of the car in the gray color is WPI spelled out and the WPI FSAE website follows it. This subdued manner allows it not to stand out but to also have the information provided if needed.

In deciding which business card layout was to be used, a vote was taken among the MQP group using voting ballots. On the day of voting, there were 10 responses from the MQP group. The voting ballot had four business card layouts to choose from, giving a 1 to the least favorite and a 4 to being the best. The results were that the number 2 layout came out on top. The number 4 layout came in second place and then the number 3 followed by the number 1 layout. The four different layouts are displayed below in Figures 2.1 to 2.4. The final business card layout is displayed in Figure 2.5

Figure 2.1. Business Card Layout #1

In Figure 2.1, the Twin towers on the left and the Motorsports label are gray in color along with WPI spelled out with the website next to it.

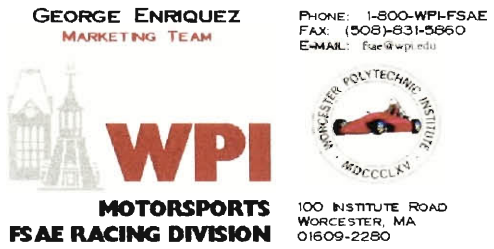


Figure 2.2. Business Card Layout #2

In Figure 2.2, the Twin towers remain gray but the Motorsports and FSAE Racing Division are both all black.

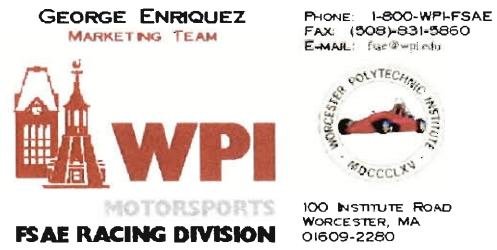


Figure 2.3. Business Card Layout #3

In Figure 2.3, the Twin towers are changed to a red color to match the WPI letters. The Motorsports color stays gray but the FSAE Racing Division remains black.

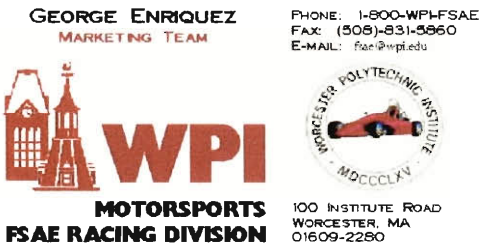


Figure 2.4 Business Card Layout #4

In Figure 2.4, the Twin towers are still red but all the font underneath WPI is changed to all black. This includes the Motorsports and the FSAE Racing Division.

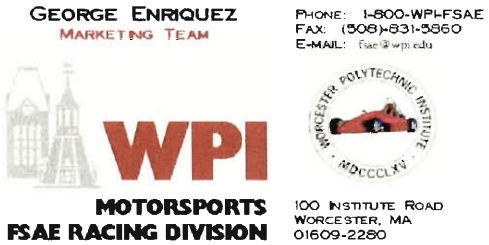


Figure 2.5. Final Business Card Layout (#2)

After the MQP took the vote on the final business card layout, the final decision was on number 2, which had the gray Twin towers, and all the font underneath WPI was all black, as shown in Figure 2.5.

2.4. Quality Function Deployment/House of Quality

One approach to getting the voice of the customer into the design specification of a product is quality function deployment (QFD). This approach, which uses interfunctional teams from marketing, design engineering, and manufacturing, has been

credited by Toyota Motor Corporation for reducing costs on its cars by more than 60 percent by significantly shortening design times [2.5].

The QFD process begins with studying and listening to customers to determine the characteristics of a superior product. Through market research, the consumer's product needs and preferences are defined and broken down into categories called customer requirements or demands [2.6]. One example is an auto manufacturer that would like to improve the ergonomics of the cockpit. Through customer surveys and interviews, it determines that two important customer requirements in a cockpit are that it "remains comfortable after many hours" and is "appealing to the eye." After the customer requirements are defined, they are weighted based on their relative importance to the customer. Next, the consumer is asked to compare and rate the company's products with the products of competitors. This process helps the company determine the product characteristics that are important to the consumer and to evaluate its product in relation to others. The end result is a better understanding and focus on product characteristics that require improvement.

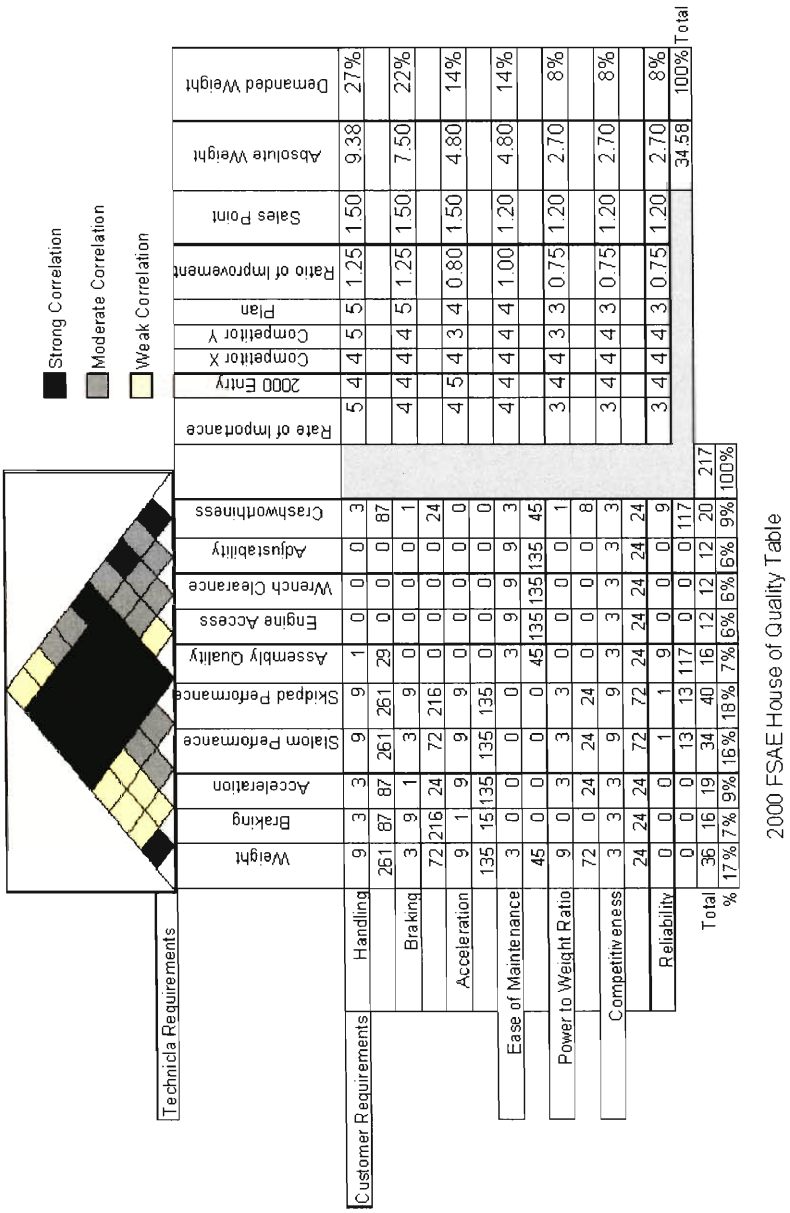


Figure 2.6, Quality House

Customer requirement information forms the basis for a matrix called the house of quality and can also be referred to as a quality table (Figure 2.6). By building a house-of-quality matrix, the cross-functional QFD team can use customer feedback to make engineering, marketing, and design decisions [2.6]. The matrix helps the team to translate customer requirements into concrete operating or engineering goals. The important product characteristics and goals for improvement are jointly agreed on and detailed in the house. This process encourages the different departments to work closely together, and it results in a better understanding of one another's goals and issues [2.6]. However, the most important benefit of the house of quality is that it helps the team to focus on building a product that satisfies the customers.

The first step in building the house of quality is to develop a list of customer requirements for the product. They are placed on the left side of the house. The list of features along the top are the technical requirements that have been addressed for this year. On the right side, the table begins with the rate of importance, the 2000 entry, the 1999 entry, the 1998 entry, and plan. These areas are ranked according to importance by giving them a number ranging from 1 to 5, with 5 being of high importance. The ratio of improvement is determined by taking the plan and dividing by the 2000 entry. The sales point is given a rank by using the numbers 1.5, 1.2, or 1 depending on its importance. The absolute weight is determined by multiplying the rate of importance, ratio of improvement, and sales point. The demanded weight is found by dividing the absolute weight by the sum total of the absolute weights. Next, a set of technical characteristics of the product is developed. The customer demands are given a 1, 3, or 9 depending on how much of a correlation the quality characteristics have with such demands. These technical

characteristics should support or refute customer perception of the product [2.6]. By finding a percentage in rating the importance, the house of quality is used to find which characteristics need to be improved. This data is then used to evaluate the strengths and weaknesses of the product in terms of technical characteristics.

2.5. Presentation Event: Marketing Component

The Formula SAE Presentation Event is composed of aspects in marketing as well as manufacturing. The manufacturing component encompasses technical aspects of production such as factory layout and production plan. The marketing element of the presentation must prove that a demand exists for our product, determine who the target customer is, and devise a plan to convince the customer that the WPI FSAE racecar suits his needs. The price of the vehicle is determined by manufacturing costs, which derived from a cost analysis, as well as overhead costs and the suggested retail price of under $9000 set by the rules of the competition. By means of a survey and extensive market research, customer demands are determined which provides the framework for marketing and selling our product efficiently.

Although the marketing event is completely fictional and the car will not be manufactured to meet the estimated demand, it is nevertheless important as it proves our product can compete in a real-world scenario. The vehicle is designed and marketed for the recreational autocross racer. The demographics compiled about our target customer reveal that it is a middle-aged male, earning an upper-middle class paycheck [2.7]. Hence, our product must be affordable and maintainable to this market.

The Target Market

By examining the results of the survey conducted in last year's IQP as well as extensive market research, several facts were determined about our target market. First of all, over fifty thousand people across the United States are members of the Sports Car Club of America. These recreational drivers are located in every region of the country with the two largest clubs located on opposite coasts in San Francisco and New England [2.7]. For this reason, our factories and dealerships must be distributed across the country in order to rapidly meet demand as well as promote further interest in autocross racing.

Furthermore, since we are targeting the recreational driver, our marketing plan must focus on the desires of the customer, rather than the needs of a professional. From the surveys, it was determined that our customers want a reliable vehicle that is easy to maintain. Likewise, it is essential that our car perform well in competition. It must handle corners well, and also accelerate and brake efficiently. Lastly, the body must be aesthetically pleasing.

Features of the 2000 AX-600 Turbo

This year's model comes complete with a number of features that should make it attractive to the weekend autocross driver. The 2000 AX-600 has considerably more power than previous models due to its turbocharger enhancements. The racecar also boasts a Honda CBR600 F3 motorcycle engine with an intercooler that lowers the intake charge temperature. This year's prototype is also equipped with a stiffer frame and a higher power-to-weight ratio than ever before. To maximize performance on the

racetrack, the AX600 comes with the Quick-Shift System (QSS), which eliminates wasteful time and energy when changing gears. It allows the driver to race without using the clutch so he or she can concentrate more on navigating the course. Increased safety features such as crumple zone, and eased braking power address health concerns for the customer, while an ergonomic cockpit, customized seating, and ease of maintenance make the car enjoyable to drive [2.8].

The Marketing Campaign

In order to sell the desired one thousand cars per year, it is necessary to deliver the information about our product to the target customers through as many channels as possible. By studying the demographics of our customer, we can predict the methods of advertising that are most likely to penetrate that segment of the population. Like most companies, WPI Motorsports plans to air a commercial that is appealing to our target market. This will most likely be in the form of depicting a middle-aged male in somewhat of a frustrating situation, and then showing how our product can alleviate those frustrations with power and performance on the racetrack. Logically, we will air our commercial during NASCAR and other racing events as well as extreme sporting events such as skateboarding, cycling, snowboarding etc. Secondly, we plan to run advertisements in magazines that encompass any type of racing, and also be run in health and sporting magazines that our target customers tend to purchase.

On a smaller scale we will develop a brochure detailing all the specifications of our product and contact information to WPI Motorsports. We have also developed a web page (http://www.ax600.com) that has comprehensive information about the AX-600 as well as WPI Motorsports. In addition, we have a poster or our product with basic

information and specifics that will be displayed at the aforementioned sporting events as well as dealerships that sell recreational vehicles such as ATV's, motorcycles, jet ski's etc. Other techniques such as newspaper advertising and radio commercials will be used in our marketing campaign to a lesser degree. These methods will help to promote our car, however, they do not single out the target market, nor do they provide a color picture of our product, which tends to stimulate interest. Lastly, WPI Motorsports intends to sponsor races as well as offer merchandise and test-drives to those who join our mailing list. Further details about this category can be found in the promotion plan.

Financing, Warranty and Support Services

To ensure that our customers feel secure racing with WPI Motorsports, we must provide comprehensive service and support. In order to have repeat customers, as well as good references, we must be sure that our customers are satisfied with our product long after the point of sale. Because of this fact, the AX600 comes complete with a 12-month unlimited hours powertrain warranty. Longer-term warranty packages can also be purchased for fees yet to be determined. Likewise, we offer 24-hour support from our web site and our experienced engineers (1-800-WPI-FSAE). Lastly, repairs can be made at any WPI authorized dealership across the country.

2.6 S.W.O.T. Analysis

A useful aid for identifying relevant screening criteria and for zeroing in on a feasible strategy is S.W.O.T analysis – which identifies and lists the company's strengths and weaknesses and its opportunities and threats. The name S.W.O.T is simply an

abbreviation for the first letters of the words strengths, weaknesses, opportunities and threats. A good S.W.O.T. analysis helps the manager focus on a strategy that takes advantages of the firm's opportunities and strengths while avoiding its weaknesses and threats to its success [2.9].

For example, if a firm is considering a strategy that focuses on a target market that is already being served by several strong competitors, success will usually be dependent on some sort of competitive advantage [2.9]. Such a competitive advantage might be based on a better marketing mix – perhaps an innovative new product, improved distribution, more effective promotion, or a better price. Just offering a marketing mix that is like what is available from competitors usually doesn't provide superior value – or any real basis for the firm to position or differentiate its marketing mix better for customers [2.9].

S.W.O.T. Analysis for WPI Motorsports

When doing an effective S.WO.T. analysis for a company, it is better to be detailed for the positive aspects and minimize all negative aspects. Here is a S.WO.T. analysis done for WPI Motorsports [2.9].

- **STRENGTHS**: Overall outstanding performance and acceleration, excellent customer support, low manufacturing cost, annual profit of $0.5 M to $1.5 M, fully documented testing, fifteen years of racing experience, engineering and design tools.
- **WEAKNESSES**: Only one model to sell, high start-up cost
- **OPPORTUNITIES**: Untapped markets, racing schools, SCCA, NASCAR fans, extreme sports and motorcycle enthusiasts
- **THREATS**: Other companies in market

3. Marketing Materials

For our company to successfully sell our car, we must develop good marketing materials. As such, we have developed a logo to represent our product, a Web Site to display our product to the masses over the World Wide Web, a brochure to give out at showrooms, events, and by mail request, posters to display in showrooms, events, and other prominent places, a magazine advertisement, and a television commercial. Each of these marketing materials will be discussed in this chapter about their creation and relevance to hitting our target audience.

3.1 Development of the AX600 Turbo Logo

This year we, the IQP group along with our advisor, chose to redesign the old AX600 (the title of our FSAE racecar) logo. This was done to allow representation of the new turbo in the design, but also to give the car a new look for the new century. The logo is a key feature of the look of our car on the race track, as such it will be placed on prominent locations of the car, such as the nose and side-pods. It will also be tied into our commercial, advertisements, brochure, and almost any other print media we generate.

The logo design and selection process was not done under any assigned method, rather we developed our own guidelines, these were:

1: design eight plus logos using various font types and styles

a) the logos should be primarily of new design

b) the logos should be visible regardless of paint scheme

c) the logos should reflect the turbo-charged nature of the car

d) the logos should include our school colors if possible, if not then they should be of a basic black and white nature

e) the side-pod logo must have numbering at least six inches high [3.1]

2: voting was done in the following way by members of the FSAE race car team

a) voting cards will be created

b) the logos were presented both in print form and on a Power-Point slide show

c) each voter could vote for up to three options including the old logo or the 8 new concepts, if they chose to abstain or wanted an alteration it would be reflected on their voting card

d) the tabulation was carried out by doing a waited sum method, each vote of 1st place was valued at 3 points, each 2nd place score was valued at 2 points, and third place at 1 point. The sum of these for each design was calculated and the highest sum designated the winning design.

The eight designs made are shown in Figures 3.1 through 3.8.

Figure 3.1. Logo Design Option Number 1.

Figure 3.2. Logo Design Option Number 2.

Figure 3.3. Logo Design Option Number 3.

Figure 3.4. Logo Design Option Number 4.

Figure 3.5. Logo Design Option Number 5.

Figure 3.6. Logo Design Option Number 6.

Figure 3.7. Logo Design Option Number 7.

Figure 3.8. Logo Design Option Number 8.

Figure 3.9. Final Logo Design.

Voting on the logo was done by members of the WPI FSAE race car team. Out of these people, there were thirteen voting cards returned. Of the designs, number four with the modification of the removal of the "googly eyes" was the winner, as shown in Figure 3.9. It won by a little more then double the points of last year's design (Table 3.1). One of the most prevalent comments was the need for a sloped look for the text of the logo, which was not common on the designs made.

Table 3.1 Tabulation of the voting for the logo with weighting.

Weighting: 3 for first choice, 2 for 2nd and 1 for third choice, each row represents one person's votes

	DESIGN 1	DESIGN 2	DESIGN 3	DESIGN 4	DESIGN 5	DESIGN 6	DESIGN 7	DESIGN 8	last year
			3		1			2	
				2					3
				3					
				3					2
									3
	3			2	1				
	2			3	1				
	1			2					3
	2			3			1		
				3					
	1	2				3			
			3						
				3	2			1	
Total	9	2	6	24	5	3	1	3	11

Once the logo was determined, the next step was to determine size and placement on the car. Size testing is accomplished by photocopying the original logo graphic in the following sizes: 75%, 125%, 150%, 175%, and 200%, and then holding each one up to the car. In case any 2 sizes bracket the optimal size, enlargements in the specific size range can be made and testing re-done.

Two different sizes will be need to be made, one to go on the side-pods and one to go somewhere on the front of the vehicle. For the side-pods, the size was determined by the by Formula SAE rules, which required the numbering to be a minimum of 6 inches high. As such, the copy size comparison method was not used, in favor of measuring the available space on the pod and generating the AX600 turbo graphic so it would be under the 28" length of the pod and have a minimum height of six inches for the numbers, this translated into a 24" wide logo, which makes quite a statement about the car.

For the nose we had a few choices for positioning the logo, for it to be at the low/front part of the nose either the original size of 10.5" x 2.75" or the 75% copy, which is 7.9" x 2.1", looked quite nice, however due to the fact that this year's car has a little broader nose, the original size logo works a little better. The second placement option is to move it up to the top/rear of the nose piece, in which case we can use the 100% or 125% sizes. We opted for the third option, one logo on each side of the nose, just forward of the front suspension at the original size. To add to the titling logo, a WPI Motorsports decal was added high up on the nose along with a school seal and the SAE decal.

Once size has been determined, and final confirmation of paint color received, we start to look at companies that can print decals using our requirements of size and colors. In the local area, the following shops have been polled for price, time to completion, and what file format they can take off the computer (Table 3.2).

Table 3.2. Polling of Print Shops for Logo Decal Printing

NAME	ADDRESS	PHONE	Cost: 1 set
Techprint	137 Marston St., Lawrence, MA	800-225-2538	$250 for nose and pods w/ setup fee
First Impression	East Brookfield, MA	800-232-5945	$186 for decals + $10 shipping

We opted to use First Impression, for a number of factors, first, that they were the cheapest, second, they could deliver more quickly, and third, they have been our decal supplier for the two previous years. They came through once again for us with speed and quality in their product, and we would recommend their use in the future. It is also recommended in the future that we continue to do silver lettering with a white border as opposed to the reverse, as it looks much better on the car.

3.2 Development of the Web Page

During our research as to how to market our car, we found that a web site was a cheap and potentially effective method. To have a web site and to have an effective web page are vastly different things, firstly to have an effective web site, the IQP group determined it should be: 1) fast to load (with a few minor exceptions), 2) convey all the necessary information in an easy to read format, 3) it should be easy to navigate, 4) be backwards compliant with older browsers, 5) have at most a limited amount of scripts or applets running, preferably scripts only whenever possible, 6) be visually pleasing, and 7) have an easy to remember and type in name.

Our goal was to design a web site to meet these exact criteria. Due to a number of factors we opted to create our site using a basic text editor and use HTML 2 and HTML 3

compliant scripting when possible. This allows for more compatibility, faster load time, and much cleaner HTML in the files. It also reduces the chance that an editor will accidentally mess up a link (i.e. going from relational to logical), or move picture files to where they shouldn't be. These factors are all key in meeting the goals we have made.

Our site uses a fairly common, if not older design for navigation, which we have found to be effective for our task. As the users loads our web site, they are greeted with a page almost exclusively covered by our WPI Motorsports FSAE Racing Division logo, so as to identify our site to the customer. When they click on either the link or the logo they are brought onto our first page.

Firstly this page consists of a three frame setup of which two remain unchanging from here on out in the site. These three frames consist of one full screen width frame at the top which contains our logo yet again, then two frames on the bottom, one skinny frame on the left containing the navigation controls and the other frame contains our content. Initially the content frame is loaded up with out slideshow which says: Introducing (new screen) The Redesigned For 2000 (new screen) WPI Motor Sports (new screen) AX600 Turbo (new screen) at this point a slide show of three different pictures of the car is displayed and then the slideshow cycles.

Probably the best way to convey the layout would be a diagram, which is as follows:

1. Index page with logo

2. First page with slideshow

3. Control Frame (the following are links to other pages)

3.1. About the Car (the following are links to other pages)

3.1.1. Specifications

3.1.2. Available Options and Accessories

3.1.3. Warranty Information

3.1.4. Pictures of the Car

3.2. About the Company

3.3. News (on same page)

3.3.1. News From WPI MOTORSPORTS

3.3.2. Race Results Involving the WPI AX600 Series Cars

3.4. Ordering (the following are links to other pages)

3.4.1. Our Online Order Form

3.4.2. Call Us (links to contact us page)

3.4.3 Visit One of Our Dealerships (links to an image-map which contains dealership information)

3.4.4. Mail in our order form (links to a printer ready copy of our form)

3.4.5. Fax in our order form (same as above, note: address and fax # are on the form)

3.4.6 View our Part/Price list

3.5. Contact Us

3.5.1. E-mail Address

3.5.2. Telephone Number

3.5.3. Fax Number

3.5.4. Mailing Address

3.6. Technical Support

3.6.1. List of information needed during a technical support inquiry

3.6.2. Our technical support hotline

3.6.3. E-mail our technical support group

3.6.4. Use our information fax-back system

3.6.5. View our online documentation

3.6.6. Call the dealer you purchased the car from.

Now with the site hierarchy in place, it is quite visible that all major aspects of selling and maintaining the car are encompassed in our site. We have met the goal of conveying all necessary information, having an easy to read layout, having it easy to operate, and have used an extreme minimum of Javascript which is in place merely to add a little bit of flavor to our control buttons and create our online order form. This site while it is not on the same level as the big automobile manufacturers, is not nearly as taxing on computer resources while at the same time trying to convey much of the same type of information. This is evident when looking at sites like: www.4adodge.com, www.hummer.com, and www.fordvehicles.com which just under half of the time crash my browser while I'm viewing them.

During our decision making processes about what content should be conveyed on the page we looked at our previous years' web pages, car manufacturers web pages, and extreme vehicle manufacturers (snowmobile, wave runners, ATV's, etc.) web pages. From these we chose the best aspects of each that were applicable for our use, such as having company information that makes the viewer feel better about dealing with us, information about our car, its accessories, and its warranty. We also include an online customer service section, which usually is limited to conveying contact information, or

having JAVA based chats at best. But in our case, we actually include helpful troubleshooting documents. The ordering section is also quite unique as we allow the user to send in an order directly to our main dealership where a sales representative will help them with their purchase at our no haggle, no hassle pricing, and giving them the direct buyers price. This is unique in that, the online buying from car companies sends a letter to your local dealer where you haggle over cost, because the cost online showed MSRP or options packages that aren't available on their lot or any number of factors.

Using a Javascript over a JAVA applet is a logical choice for us as we do not have intensive computations, interactive games, or other such intensive items incorporated on our web site. The only conceivable place to use something like JAVA applets would be in the ordering systems or parts lists with dynamic databases, but those could also be accomplished by many other means. In the future, I would recommend the use of JAVA, CGI (common gateway interface), DSS (dynamic style sheets), flash/shockwave, or any number of other flashy web site enhancements once higher bandwidth connections and more powerful computers are available to more households.

Last but not least we must choose and register a domain name. The process for this is relatively simple, first we must generate a list of possible names that we think suit our business, such as www.WPIMS.com which stands for WPI Motor Sports. Next we will have to check the candidate domain names against the database of already claimed names, and if someone has claimed a similar domain name, we will want to view that site to make sure it contains no offensive material (we do not want an errant typo to send one of our customers to a pornographic or hate group Web site). Once the final list of candidates has been created, we voted on the best one of the group of names. The

tabulation of the voting is in table 3.3. It was decided by unanimous vote that our URL (uniform resource locator) would be www.ax600.com.

Table 3.3 Voting on our Domain Name

Domain Name	Description/Explanation	Number of Votes
www.wpims.com	Stands for **WPI** (as is easily seen) and **M**otor**S**ports	0
www.fsaecars.com	This is to show that we build **F**ormula **SAE Cars**	0
www.wpicars.com	This is to show **WPI** builds **cars**	0
www.wpi-ms.com	A variation of www.wpims.com to separate the two words.	0
www.wpi-cars.com	A variation of www.wpicars.com to separate the two words.	0
www.fsae-cars.com	A variation of www.fsaecars.com to separate the two words.	0
www.ax600.com	Shows the product line directly to the viewer	4
www.wpi-motorsports.com	A written out version of www.wpims.com	0
www.wpimotorsports.com	A written out version of www.wpims.com	0

3.3 Development of the Brochure

The brochure was created to market the 2000 model year FSAE racecar to the weekend autocross racer. Our intention is to show how our car differs from, and is therefore better, then its competition. The intended features to showcase include price, performance, durability, and ease of maintenance. The goal of the brochure is to allow the autocross racer a chance to review what features and philosophies make the WPI AX600 turbo racecar a champion on the track. The weekend autocross racer wants performance [3.2] (e.g. acceleration, braking, and handling), a car that's durable and easy to maintain and repair. A few more issues of great importance to the weekend autocross racer include the build quality of the car, what new design innovations are incorporated, and what beliefs and philosophies, we the manufacturer put into each racecar that we build. These will prove to the weekend autocross racer that we are better than the competition.

The brochure is made up of an easy to read full-color multi-page format with pictures and descriptions of key and/or unique features of the WPI FSAE racecar, the AX600 turbo. Our cover page (shown in Figure 3.10) incorporates our name, logo, slogan, and of course a picture of the WPI FSAE car. This page is key to a good first impression from a potential buyer, it identifies our product to him/her and shows just how good a well made car can look. To do this we set the car on a dark background and then put a highlight around the car to grab their attention. Because we want continuity between advertising elements, this cover will also be the first slide in our presentation.

Figure 3.10. Brochure Cover.

As the page is turned, the second and third pages are revealed (as shown in Figure 3.11). This is a full page spread with a subdued background image of the car and the title of: WPI FSAE Race Technology and Innovations. These two pages showcase exactly what the title says, eight different items are concentrated on, as well as a list of a few other items of interest are displayed. Each item that is concentrated on has a picture and a short description to give the reader more information on what makes the WPI AX600 turbo a winner on the race track.

Figure 3.11. Pages two and three of the brochure, technology and innovations.

The fourth page (Figure 3.12) opens to reveal a picture of the car, again on a black background, but this time the scenery is left in the picture. The picture is surrounded by the typical buzz words of: Power, Performance, Dependable, and Affordable. These words are set in a high impact font and in a bright white to contrast the background and grab the readers attention. We do this so as to keep the reader glued to our brochure because he/she now knows that we will be discussing the issues he/she desires.

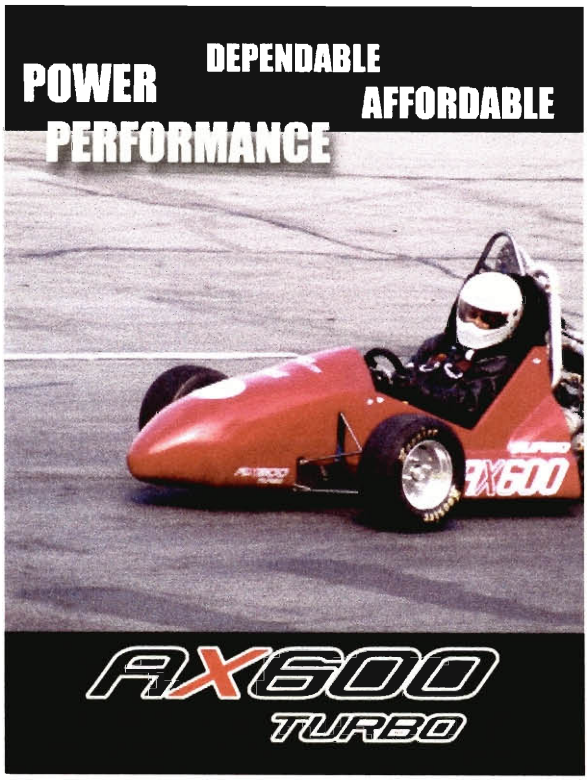


Figure 3.12. Page four of the brochure.

The fifth page (Figure 3.13) of the brochure lists some of the different options and accessories available for the car and their prices. This allows the reader to see just how much customization can be done at the factory of their car at time of purchase and that we have most items needed for a racer to get started. Starting racers will appreciate the one-stop shopping that we provide, from car to trailer and from racing gear to tools for the car.

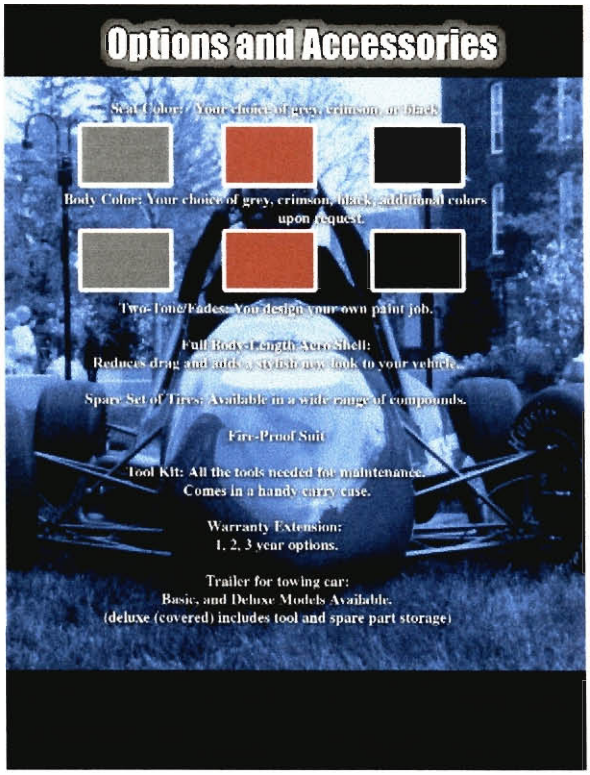


Figure 3.13. Page five of the brochure, options and accessories.

As the reader flips the page one last time they are greeted by our specification and information page (Figure 3.14) which contains the critical specifications for the car, warranty information, and information about financing and safety. We feel that the safety section is very important as autocross racing is meant to be a safe, fun sport, but what is more likely to have an impact on the reader is our power-train warranty and our financing options.

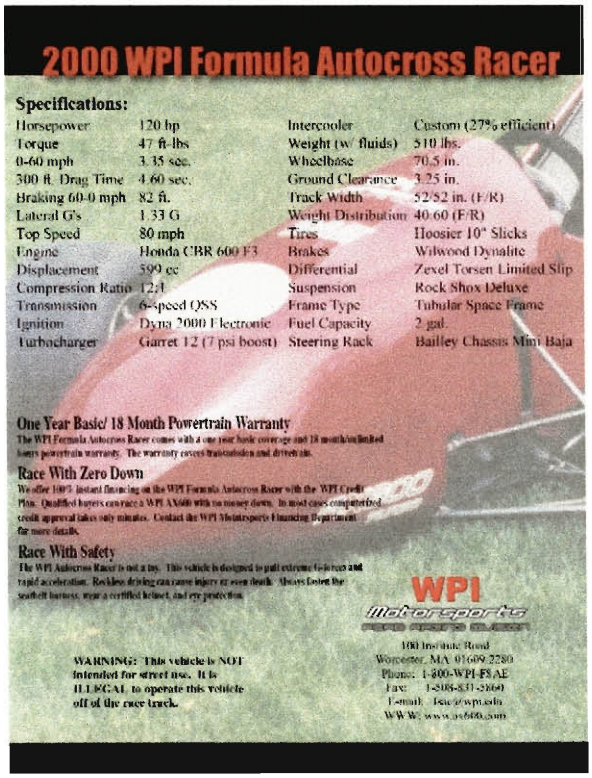


Figure 3.14. Page six of the brochure, back cover, specifications.

The final version of this brochure will be printed on a high gloss heavy-weight paper with high resolution pictures. It will contain updated pictures of the car and updated specifications on the vital systems. Brochures will be available at all our dealerships and parts distributors, they will also be available by request either online, phone, or by mail response cards that we will include with our magazine advertisement.

The brochure will allow our potential customers to review our car and company and review it with our competition. What is most important however is that it will let our customer know exactly what he/she is buying and what kind of quality and values it is based on.

To create this brochure, various car, ATV, snowmobile, and wrater-craft brochures [3.3] were read through and analyzed in an effort to find the best aspects of

each. In every case the manufacturer used full color formats and tried to make an impact by using contrasting colors when necessary. One medium that one manufacturer used was to post their brochure online in a .pdf format for easy downloading and reproduction, this is something that should be proposed for our own usage as not everyone will be able to get to get to one of our approved dealerships or events, this will also save us the cost of printing and mailing brochures to people who have internet connections.

3.4 Development of the Posters

The wall poster is a means for us to display our car at dealerships, events, trade shows, and more. While it does not make as much of an impact as the actual car, it still serves as "eye candy" for the prospective buyer. For a poster to be effective it has to make a bold statement in a small space. This is evident at car dealerships where all the posters are designed to showcase the product or event and show nothing else.

This effectiveness is achieved by placing a picture of the product either in it's natural surroundings or on a single color background and usually the wording is of a high contrast color to the background, in some instances black boxes are used with white text to accentuate the text on the poster when the background color does not allow a good contrasting color for the text [3.4]. In the case of signs at dealerships, no contact information is required on the poster, nor is the company name, rather this space is used to give the name of the vehicle and the car's slogan.

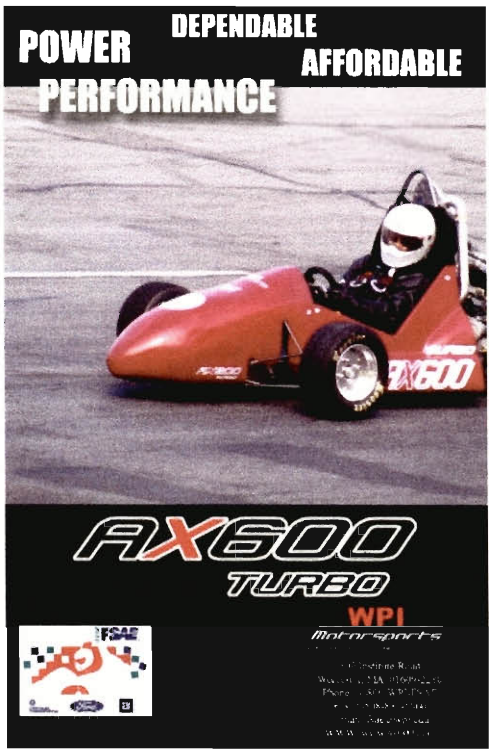


Figure 3.15. Poster design #1.

These aspects are noticeable in Figure 3.15, a picture of our poster. It contains an exciting picture of our car, buzzwords about the nature of the car, and contact information. These are all shown in a high contrast manner with the text in white over a black background to allow for maximum impact. Also the buzzword text is shown in different sizes to stress each aspect differently.

Figure 3.16. poster design #2.

Figure 3.16 shows a poster design highly suitable for use in our showrooms and at display booths at conventions, tradeshows, and races. It is a basic picture of our car over a simple black background with the car name, company name, and a catchy phrase. It makes a powerful statement that our car is fast, which is a key selling point of our vehicle.

3.5 Development of the Magazine Advertisement

One aspect of our marketing plan is a magazine advertisement. By placing the advertisement in the magazines widely read by our target market, we are using the magazine as a showcase for our car, and we can also use this as a means to demonstrate the distinguishing aspects of car.

The plan for the advertisement came from an advertisement of a Chrysler 300M automobile [3.5]. The ad is exceptional because it is not only visually pleasing but it includes all of the essential information, including contact information. After looking at

many different advertisements for automobiles such as: the Nissan X-Terra, [3.6] the Toyota Tundra [3.7], the Subaru Outback [3.8], and the Panoz GTS [3.9], from the SCCA class, which is the same class as the AX-6000; it was clear that this would be an effective way to present our car to potential customers.

The advertisement is divided into three sections, the product shot, a product description, and a column containing the technical data. In addition, the backside of the advertisement will be a business mail reply section. This will allow WPI FSAE Racing to directly mail information to potential customer. The product shot is essentially a wide shot of the car that clearly shows the product, in this case, the WPI FSAE racecar. It is important not to present the car in a photo that is very cluttered, for this will have a negative effect on the viewer. By advertising in ways such as this, the WPI Motorsports FSAE Racing Division can achieve high brand equity over its competitors, which is the value of brand's overall strength in the market [3.10]. High brand equity almost guarantees profits, as customers recognize the brand name and know that the name stands for quality and dependability.

The final section of the advertisement is a column on the left-hand side that is a list of the more technical aspects of the car. This part of the ad gives information about the more specific aspects of the car, such as: 600 cc Honda CBR Engine, Garret T2 Turbocharger, Hoosier Tires, a customized seat, a one-year warranty, and the MSRP, $8,200.

On the right side is contact information including: address, phone, fax, email, and

Internet address. This provides a way for potential customers to get more information, or contact WPI to purchase the vehicle. Figure 3.17 shows the advertisement, in a smaller scale; the true scale would be 17 X 11 in, the size of two open pages.

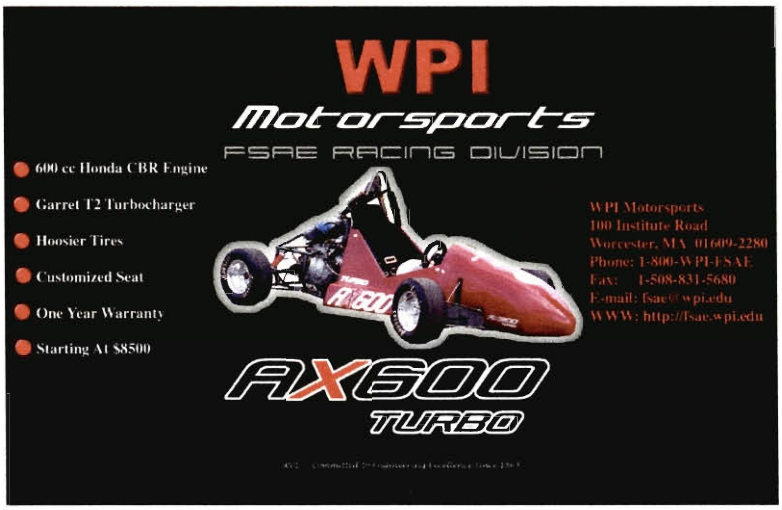


Figure 3.17. The 2000 AX600 Advertisement.

The advertisement would be published in car and mechanics magazines such as Car and Driver, Motor Trend, Popular Mechanics, Road and Track, Auto Trend, Auto Week, and any SCCA Publications. In addition to marketing the car to auto enthusiasts, we would also take aim at the rest of our market by placing ads in men's magazines such as Maxim, Playboy, Details, GQ, and Esquire. We can also place the advertisement on the websites of the magazines, as each of the magazines has a web site that offers ad space. Knowing that our target market is 92% [3.11] male, we intend to aim the ad at our advertising campaign at male auto enthusiasts, and by placing our advertisement in these publications, we should reach this market well. Initially, we will place the advertisement in smaller publications, such as the New England Dragway News. A full page, full color advertisement in this publication would be $400 per month, and $2,750 for a full season

[3.12]. The next level would be national publications such as SportsCar, where an advertisement would be $2,400 per month, $25,320 for a full year. [3.13] When sales improve, and the marketing budget grows stronger, ads may be placed in magazines such as Men's Health, where full color; full-page advertisements are $100,380 per month, and $900,345 for 9 months [3.14].

Table 3.4: Possible Web Sites where the Advertisement can be placed.

Website Name	URL Address
CART	http://www.cart.com
Nascar	http://www.nascar.com
SCCA	http://www.scca.com
Formula 1	http://www.formula1.com
The Racesite	http://theracesite.com

3.6 Television Advertisement

The 2000 AX600 commercial is the most professional commercial yet, as we have gotten help from Johanna Jenkins, a film student at the Rhode Island School of Design. With her expertise in this field, we developed the commercial. Had we not been able to receive help from student filmmaker, and we had a budget for the project, we would have contacted a professional video production company.

The first step was to brainstorm a concept. Many ideas were discussed, including ones from commercials for automobiles such as the Volkswagen Bug, and the Nissan X-terra. In addition, we also viewed and critiqued last year's commercial. After we agreed upon an idea, we presented the idea to the filmmaker. The concept is a dramatic interpretation of the motivation of our audience to buy the vehicle. While 1998's

commercial opened with text screens reading, "Tired of your long work week…falling into the same routine... pull out of it in first gear." [3.15] Our concept is to display the same frustration visually. The commercial begins with a man driving in a minivan, and his wife and kids are arguing. The frustration of the driver is captured through close-up on his face. We selected our actor based on our demographics information. The actor is 39, while the average age of our target market is 36. The next scene shows the man looking out his window and viewing the AX600, parked at a service station. His face lights up with enthusiasm, and the shot dissolves into a daydream, which is the man driving the AX600 on a racetrack. Back in reality, the man is pretending to drive a racecar while he is stopped at a stop sign, while his family looks on disapprovingly. Realizing he is being watched, the driver chuckles, apologizes to his family and drives out of the shot. The commercial will end with a black screen displaying the AX600 logo and some financial information. The filmmaker developed a storyboard, which is a pictorial summary of the concept. The format of the storyboard is similar to a comic book, with a drawing of the scene in a small box, and a description of the shot, and any other important notes are placed under the drawing. The storyboard is contained in Appendix E.

Since the concept is dramatic, we chose to get professional actors. This was accomplished by placing the following posting on www.nefilm.com and www.indieclub.com, web site dedicated to independent film projects.

Actors urgently needed for a commercial to be produced in Worcester, MA. The position will be unpaid, but the experience will be fun, and the actors will get to drive a racecar. Looking for:

1: Middle Aged Man, slender build

1: Middle Aged Woman

The two actors will playing a husband and wife. The project is the production of a TV commercial for WPI Motorsports, which produces a FSAE Racecar. Please send email to jjs01@wpi.edu or call Jon Suchecki at 508.754.1582 **(added 3/28/00)**

The response to the posting was very good, and after speaking to a few different people, Doug MacDonald, was selected for the main character, and Linda Strano was selected to play his wife. James Suchecki, 15, and Hanna Hitchcock, 13, played the roles of the children.

A television commercial will be aired during specific broadcasts that our target audience often watches. By reviewing Nielsen ratings, the target audience can be correctly identified and the ad can be placed during programs that the demographic often watches. For an national ratings estimate, the Nielsen Media Research uses a sample of more than 5,000 households, containing over 13,000 people who have agreed to participate. They measure who is watching by installing meters called the Nielsen People Meter. The People Meter has a button for each member of the household, and as they begin watching TV they push their button. Each member of the household has a button, and there are additional buttons for guests. Another way that Nielsen Media Research tracks viewing information is through TV Diaries, which are booklets in which viewers

record their television records. This information and the ratings are used in the negotiation for advertising. The amount charged for advertising is usually a negotiated rate per thousand viewers multiplied by the Nielsen Media Research audience estimate [3.16]. As the marketing budget increases, the ad will aired nationwide, but at first the ad will be shown on local cable airtime.

3.7 Promoting WPI Motorsports

In conjunction with our marketing plan, it is essential to promote WPI Motorsports on a small scale that penetrates the market effectively. By promoting our company in venues where our target customers are most likely to be in attendance, our advertising dollars will be maximized. It is logical to assume that consumers that would be interested in our product would also be interested in similar sporting events. Therefore, WPI Motorsports will sponsor many types of racing events that include Formula SAE, NASCAR, as well as skateboarding, snowboarding and other extreme sporting events.

When purchasing a product, most consumers select brands by impulse according to preconceived notions about a particular brand. That is, consumers are more likely to purchase a product that is made by a brand that they are familiar with, rather than a new one [3.17]. For this reason, it is essential that the WPI Motorsports logo be as visible as possible at sporting events. By sponsoring racing events, we will be able to place our logo on billboards throughout the racetrack, and hence engrave our company name in the minds of the spectators. As a result of this promotion, customers will be more likely to buy from WPI in the event they are in the market for a Formula SAE racecar.

In addition to distributing our logo as much as possible, we will offer incentives to potential customers. By setting up a booth at different racing events, we will be able to interact with customers on a one-to-one basis. Consumers will be able to ask questions and learn more about what WPI Motorsports has to offer. In an attempt to get people interested in Formula SAE racing, we will offer free shirts with the WPI Motorsports logo if they join our mailing list. This is a relatively cheap method of advertising as the cost of making shirts is under five dollars and those potential customers will then advertise for us by wearing our shirt. Also, potential customers will be allowed to test drive the prototype so that they can experience first hand the power and performance in our vehicle.

It is our goal at WPI Motorsports to penetrate the extreme sports market by this series of promotions. It is important for consumers to become familiar with the brand so that it is recognizable amongst its competitors. By emphasizing our logo and dealing one-on-one with potential customers, we can start to build a trust with the target market. Along with national advertising, these promotions should generate ever-growing sales as the general population slowly embraces FSAE racing as well as WPI Motorsports.

4. Presentation Event Slides

4.1. Primary Presentation Slides

Our presentation is geared at maximizing out limited time with a balance of marketing and manufacturing information. It is also geared for minimum waste of time and little clutter. One thing that we take some pride in is that we are able to keep a common look in our presentation and major marketing materials.

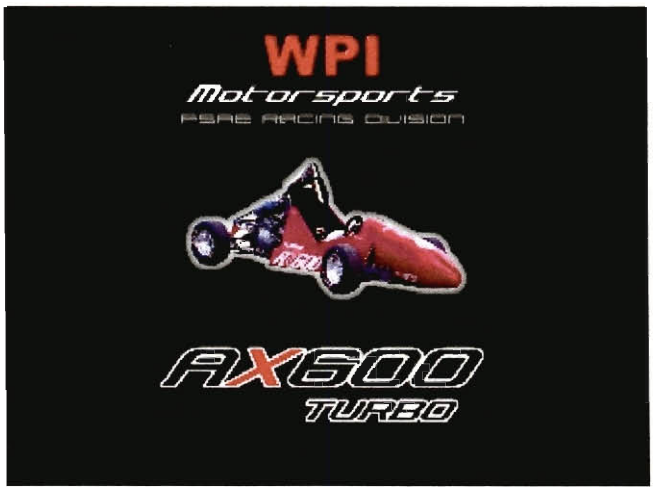


Figure 4.1. Slide 1: WPI Motorsports opening slide.

This slide features a copy of our brochure cover for graphics re-use and to maintain commonality of design, as well as it makes a solid statement as to who we are. This slide immediately displays the car in an uncluttered manner, which is important as the presentation event seminars from previous years had mentioned that the judges wanted to see the car a few times in the presentation, preferably early if possible [4.1]. There is no discussion associated with this slide, because as soon as the speaker starts to talk, the second slide has already been put up.

Figure 4.2. Slide 2: Introductions.

We start off our presentation with our introductions (Figure 4.2), we not only introduce ourselves but our company as well. Introductions are key as it tells the judges just who we are, in the past teams have failed to do this [4.1]. Additionally, any member from our team who is introduced may later answer questions during the question and answer phase of the event.

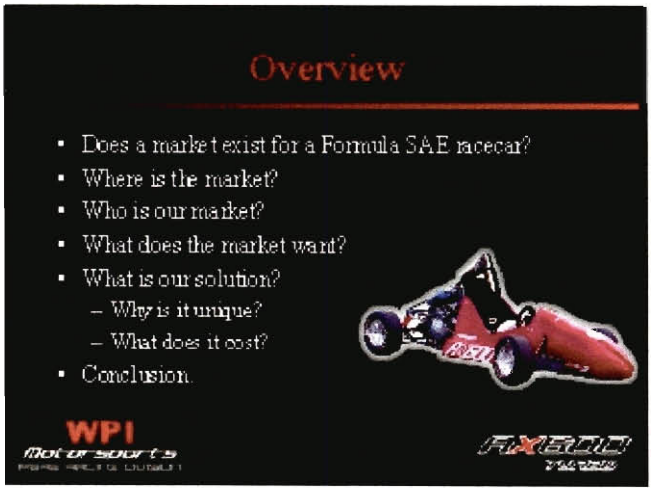


Figure 4.3. Slide 3: Overview.

Our third slide addresses the issue of telling the judges what we intend to do during the presentation. Originally this slide was not a part of our presentation, however, it was added after watching the presentation event video tapes during which the judges mentioned that they would like an overview of the presentation [4.1]. The slide merely mentions the key questions that we intend to answer during our presentation of: 1) Is there a market for a Formula SAE racecar? 2) If so, where is it? 3) What does that market want in their racecar (features)? 4) What is our solution? How is it unique? What does it cost? After answering these questions in as much detail as we have the time for, we hand over the presentation to the manufacturing group.

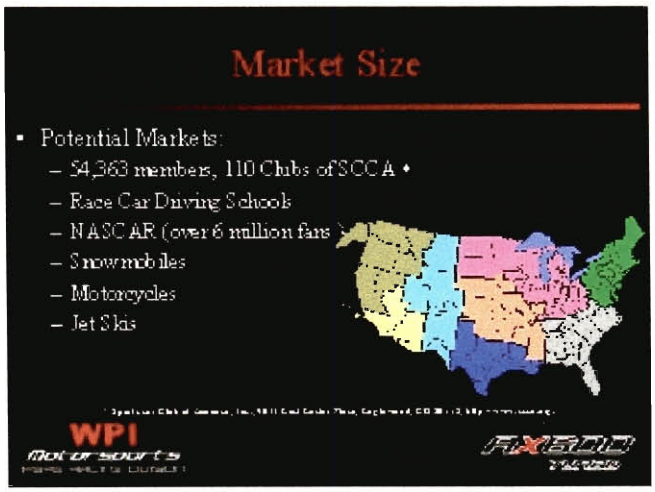


Figure 4.4. Slide 4: Market size and potential markets.

Our fourth slide addresses the first question in our overview of "Is there a market…?" We address this question by using numbers from the Sports Car Club of America (SCCA) membership database which says that there are over fifty four thousand (54,000) members which are spread between 110 clubs. We also state that other potential markets include race car driving schools and other extreme vehicle users.

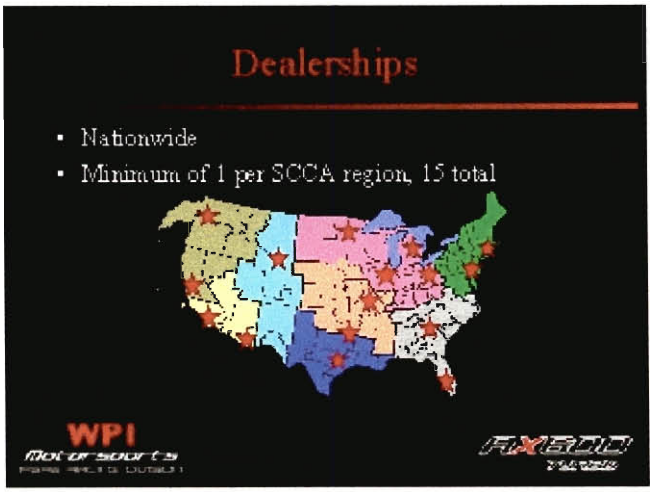


Figure 4.5. Slide 5: Dealership locations.

We have used the data gathered from the SCCA as to location of regions and distribution of members to place our dealerships. No matter the size of the region, there will be a minimum of 1 dealership, and more dealerships will be added should the region have high enough demand. Due to overall demand for the car, we have opted to place 15 dealerships throughout the nation.

Figure 4.6. Slide 6: Marketing Demographics.

After discussing that there is a market for our car, we discus what that market is comprised of, in order to be better able to understand who we are catering to in our vehicle and marketing campaign. We have found that our aver customer is a near middle age man who works in a fairly solid job, with a background in a technology related field. This data was gathered by the 1998-1999 Marketing the FSAE Racecar Interactive Qualifying Project group in a survey they sent out [4.2].

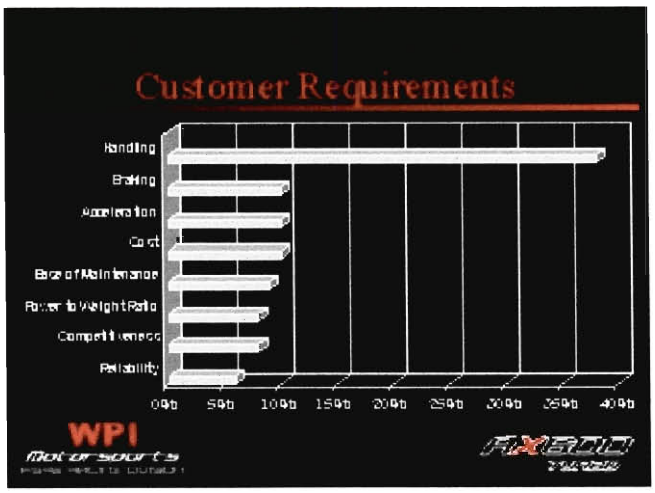


Figure 4.7. Slide 7: Customer requirements breakdown.

This slide provides information about the characteristics that customers look for when purchasing FSAE racecars. This information was gathered by surveying members of the SCCA, asking these members to rank the characteristics by importance. Out of fourteen characteristics mentioned on the survey, these eight received substantial recognition. Responses to other four characteristics were negligible. The survey was mailed to four mailing lists of SCCA Autocross clubs. The lists consist of approximately 900 members located in different regions of the country. WPI Motorsports received 37 replies to the survey [4.2]. Handling was clearly the most important characteristic, as

38% of those surveyed identified it as most important. 10% of those surveyed said that cost was their top priority.

Acceleration and braking were also pointed out by 10% of those surveyed. The next characteristic was ease of maintenance, identified by 9% as the top characteristic. Competitiveness and Power-to-Weight ratio each received 8%, and finally reliability received 7%. Since these characteristics have been identified, it is important that these wants are reflected in the car itself. WPI Motorsports has taken measures to ensure that each of these has been addressed, as will be explained in the following slides.

Figure 4.8. Slide 8: New Features – Handling.

The rationale for slides 8, 9, and 10 is to respond to the customer satisfaction criteria, proving that the AX600 is designed to meet customer's needs. A more technical explanation of these features is contained in the section of back-up slides, where each bullet has its own slide, and all of the technical details are explained. For the purpose of the presentation event where time is limited, the features of the car are simply introduced.

The highest priority overall was handling, and the 2000 AX600 has made three major design improvements to improve handling. The first is adding a Zexel Torsen torque sensing traction differential. Another improvement is an electronic traction control system. Finally, the 2000 AX600 has been designed with a shorter wheelbase, which facilitates tighter turns.

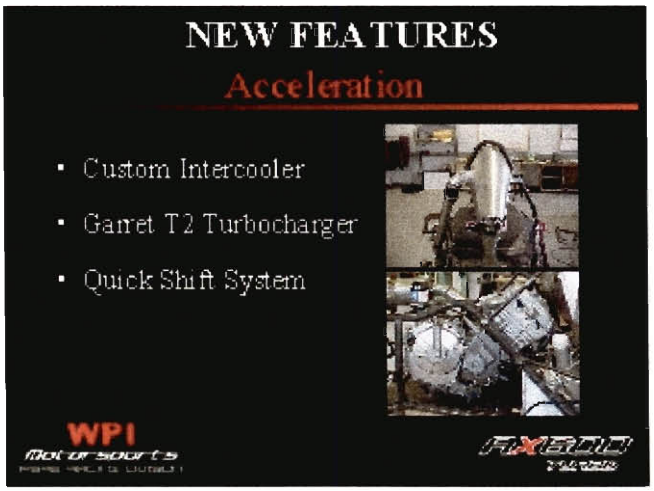


Figure 4.9: Slide 9: New Features – Acceleration.

Another high customer priority is acceleration, and the 2000 AX600 has three major improvements from last year's car that will allow for exceptional acceleration. The first is an Air-to-Air Tube Intercooler custom designed by WPI Motorsports. The next new feature is a Garret T2 Turbocharger. Finally, the 2000 AX600 has a unique Quick Shift System for a shifter.

Figure 4.10. Slide 10: Improved Features.

One of the most outstanding aspects of the 2000 AX600 is the focus on the customer comfort. This is demonstrated through our ergonomically designed cockpit and customized seats. Speaking in terms of safety, the vehicle has been tested statically, dynamically, and through Finite Element Analysis to ensure safety above and beyond FSAE regulations. All of this tested has been fully documented by WPI Motorsports. To conclude the new features section, ease of maintenance is addresses. The 2000 AX600 has been designed so that most repairs can be done with a conventional toolkit.

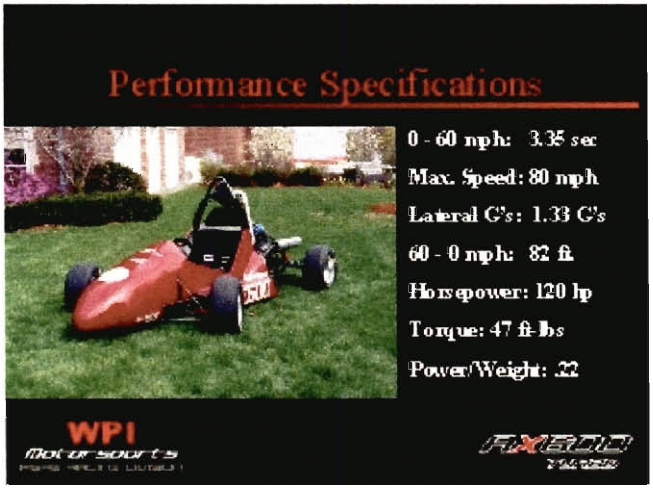


Figure 4.11. Slide 11: Performance Specifications.

After the new and improved features have been addressed, it is time to show the car. This slide is straightforward in design with the picture of the car taking up most of the space. There were several angle choices of the car we could choose from in deciding the final layout. We ended up choosing the 30 degrees off-axis view of the car that was deemed to be the most flattering for the vehicle.

On the right are the car's track performance specifications. This allows a quick glance at the most commonly tested aspects on how a car performs. The list was acquired using similar techniques in car and motorcycle magazines.

Figure 4.12 Slide 12: Marketing Campaign.

- **Newspaper and Magazine Advertisements -** In order to sell the car, we have to address forms of showing it the public. The magazine and newspaper ads will allow the public to view the car and our company in the popular magazines and local newspapers. We plan on purchasing spaces in the literature, using the several design layouts that were created.

- **AX600 Brochure -** The brochure for the AX600 was designed similar to that of automobile brochures that are given away at car dealerships. The colored pamphlet vividly shows the car in many great action shots that may appeal the potential buyer. It gives the details of the car, such as the turbo, the intercooler and other new features of the AX600. It also shows the different options for it such as paint color and towing options. The specifications of its track performance are place in the back cover so it can be seen from the outside.

- **Posters** – We have several poster designs that will be used for advertisement purposes. They were designed to capture the people's attention wherever these are placed. These posters will be placed in all the nationwide dealerships, promotional

events, and other strategically placed areas. They will be included in the presentation folder, following the colored brochure.

Figure 4.13. Slide 13: TV Commercial.

The TV commercial is one form of our advertising. It is a 30-second clip that will be played in the presentation during the marketing campaign slide. With the production aspect of the commercial, Johanna Jenkins who is junior majoring in film at the Rhode Island School of Design is assisting us. She has access to several high quality film equipment that can aid in making a better quality commercial. With her expertise and knowledge, the advertising campaign will be significantly improved from the previous years. The layout of the TV commercial is explained in detail and can be found in Chapter 3.6.

Figure 4.14. Slide 14: Warranty and Support Services.

WPI Motorsports has created a warranty, as well as support services for several reasons. First of all, potential customers want to be sure that if something is wrong with their vehicle, the situation can be rectified with minimal hassle. People want to make sure that they are getting a good deal. A warranty will dissuade any doubts customers have in our product and if all issues are dealt with in a timely manner, it will promote good welfare between us and our customers. Likewise, a satisfied customer is in actuality one of the best marketing tools we could hope for. Lastly a warranty is important for liability reasons. This will cover us so that we don't pay for customers carelessness, yet maintain a good relationship with them if one of our parts fails.

- **12 Month Basic/18 Month Powertrain Warranty with Extension Options** - This statement also demonstrates our flexibility in not only financing, but also in warranty, to meet the needs of many different drivers. We offer 1 and 2 year extension options that can be added on at the time of purchase or at a later date. For the 1 year option, it would

cost $500 and the 2 year option is $800. The entire warranty is further discussed in Appendix D.

- **1-800-WPI-FSAE Support Line, Operator and Fax back Support** - Here we offer several means of communication with customers to answer questions about our product. If a customer is having problems with routine maintenance or any other question, our operators can point them in the right direction. It may be that they just offer advice and talk them through the problem, or send information via fax machine. Our E-mail service provides further support for our customers. It allows a quick response to questions the customers may have at no extra charge.
- **Web Page Help Documents** - Customers will be able to get a parts list/manual on the web, as well as receive maintenance information on our site. They will also be able to find a directory of mechanics capable of servicing our vehicle as well as a directory of race tracks and events. Updates for performance enhancements on the AX600 Turbo will be made available so that the customer will be up-to-date in the technology today.
- **Dealerships/Parts Services -** Since we have dealerships located throughout the country to meet the nationwide demand, they will also be equipped to service our vehicles as well as offer advice. In all of the dealerships, there will be a parts store incorporated so that customers can purchase parts and make repairs.

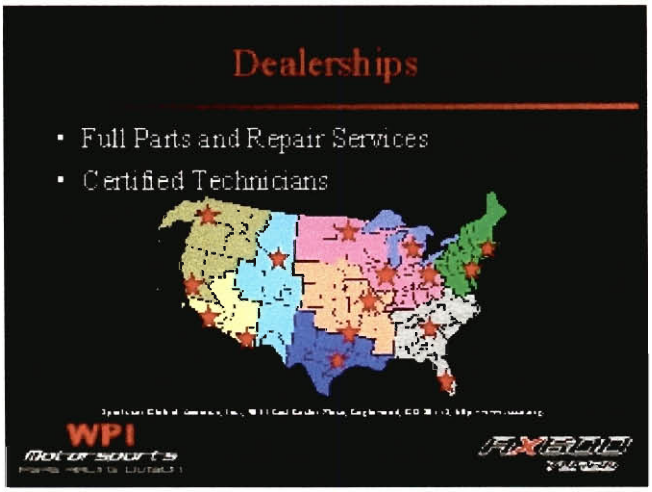


Figure 4.15. Slide 15: Dealership/Repair locations.

This slide was added to emphasize the nationwide dealerships for our warranty and customer support. Once the dealership bullet is mentioned, the slide is quickly changed to the dealership map to point out the nationwide availability. Each of the dealerships contains full parts and repair services, which are staffed by certified technicians.

Figure 4.16. Slide 16: Production Cost Analysis.

This slide gives a cost breakdown for the AX-600 Turbo. The first bullet gives a projected cost for manufacturing one thousand units which includes labor, overhead and fixed costs. This price is much lower than the cost of developing the prototype vehicle. WPI Motorsports offers a discounted price to customers who order directly from the factory, rather than an authorized dealer.

- **Manufacturing……..$6,500** This is the cost per unit to manufacture the AX-600 Turbo when one thousand cars are being produced. By instituting lean manufacturing, WPI Motorsports was able to keep the production cost low, and hence this savings can be passed on to our customers.
- **Direct Sales……$7,700**(cost)**….$1,200**(profit) This bullet shows the cost of the AX-600 Turbo for a customer who orders our product directly from the factory, rather than from an authorized dealer. Customers can order our product either over the phone, or through our online ordering service. In our first year in business, we assume that five hundred units will be sold factory direct to customers. In coming years, we can collect data to determine the optimum amount of units to be sold in this manner. WPI Motorsports realizes the greatest profit through this type of transaction.
- **Sales to Dealers…….$7,000**(cost)**….$500**(profit) Half of the units produced by WPI Motorsports will be sold in this manner. The profit is much less than the factory direct sales however, nation-wide distribution is necessary to promote our product. Many customers may not be using the internet, and hence will not be able to order online. These sales will reach the potential market of customers who see the AX-600 on the

racetrack or at a dealership. Many people like to see a product before the point of purchase. Sales of this kind will cater to their needs.

- **Suggested Retail Price……..$8,200** This is the price suggested by WPI Motorsports for retail sale at the dealerships. The dealers have a right to sell the car for whatever they please. This price includes a profit for the dealer. Transactions of this nature will greatly reduce the shipping costs for the customer.
- **Annualized Profit Range – 1000 Cars: $.5M - $1.2M** If all one thousand units are sold WPI Motorsports will realize an annual profit of anywhere between five million and 1.2 million dollars. It is difficult to determine how many sales will occur directly from the factory without data from previous years. The greater the number of direct sales, the greater the profit will become.

Figure 4.17. Slide 17: Financing Options.

Since our marketing demographics suggest that our target customer is a middle-aged male, earning an upper-middle class income [4.2], WPI Motorsports must cater to the financing needs of this segment of the population. Many of our potential customers

in this age bracket have other expenses such as a mortgage, car payments, and childcare expenses. In turn, we must offer flexible financing options to ensure that our product is affordable to our target market. The AX-600 Turbo is less than half the cost of the closest vehicle to its class, the Modified A class. Thus our price alone is a good marketing tool.

- **12,24, or 36 Month Options** This bullet demonstrates our flexibility in financing. It is possible that some customers will be able to afford the AX-600 Turbo with one lump sum payment. Other customers may take as long as three years to pay for our product.
- **No Money Down** This statement should help convince potential customers that the AX-600 Turbo is the right racecar for them. It is easier from a sales perspective to advertise to customers that they can leave the showroom with our product without paying a cent.
- **Low APR** Here is yet another reason to race with WPI Motorsports rather than a competitor. For those customers that need financing to enjoy FSAE racing, a low annual percentage rate is essential to keeping the cost ascertainable.
- **Same Day Credit Approval** Another feature of our financing options is same day credit approval. This element should help sell more vehicles because customers that are merely browsing will learn that they are capable of leaving the dealership that same day with an AX-600 Turbo. This credit approval system will prevent customers that are unable to pay, or that have a bad credit history from purchasing our product, and hence preventing loss of revenue. This credit approval is done through a credit machine and can only be done on weekdays during regular banking hours.

- **Starts at $235 a Month for 36 Months** This bullet gives potential managers another good selling point. It breaks down the financing options into realistic figures so customers know exactly what they are getting themselves into. From this, they will know immediately whether or not owning our product fits into their budget.

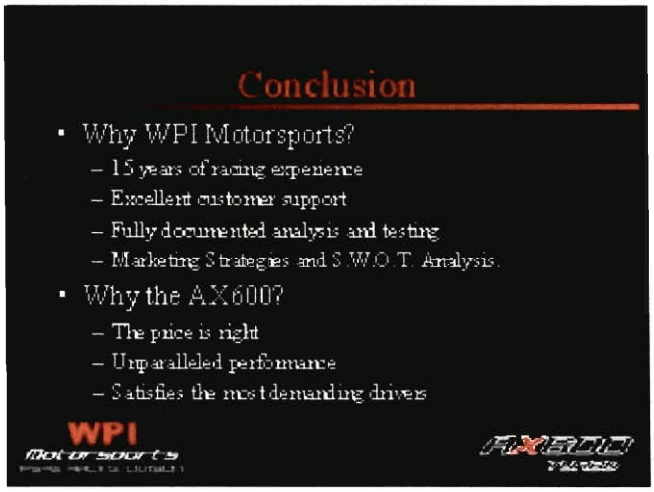


Figure 4.18. Slide 18: Conclusion.

This slide concludes the marketing component of the presentation. Now that we have demonstrated that a market exists for our product, introduced its features and proven its reliability and affordability, we can now move on to the manufacturing aspect of the vehicle. To close, we mention some general information about our company and our product to leave the judges with a positive image of our presentation.

- **Why WPI Motorsports?** Here we try to emphasize what separates WPI Motorsports from the rest of the competition. Potential managers may not yet be convinced to endorse our product rather than a similar one. With fifteen years of racing experience, world class engineers and facilities, excellent customer support and

comprehensive market and S.W.O.T. analysis, managers can feel comfortable that our product is not only safe and reliable, but also a leader in autocross engineering.

- **Why the AX-Turbo?** Without reiterating the entire presentation, we conclude that the performance of the AX-600 Turbo on the racetrack is unparalleled. Secondly, we have addressed the most pressing needs of drivers. And lastly, the AX-600 Turbo is affordable. Not only do we offer an incredible financing package, but we can also boast a price of nearly half that of racecars in a similar class.

4.2 Backup Slides

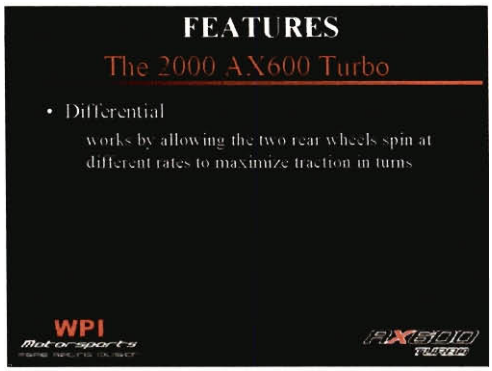


Figure 4.19. Supplementary Slides, Differential.

- **Differential** - This device takes engine rotation and rotates it 90 degrees so it can be used to drive the wheels. The axle is normally contained inside the differential [4.3]. The differential aids the handling of the vehicle by allowing power transfer between the drive wheels during cornering, as well as permitting both drive wheels to turn at the proper speed to maximize traction. The advantages of the differential are smoother cornering as the wheels spin independently of each other, and the ability of the

differential to transfer power to a gripping wheel from a slipping wheel. Some disadvantages are added weight and mechanical complexity of added parts.

Figure 4.20. Supplementary Slide, Traction Control.

- **Traction Control** - WPI Motorsports responds to the customer call for handling by developing traction control. Traction control works by modulating engine power by retarding the spark on certain cylinders. The result is that the spark plug is fired later in the cycle. The engine management system knows when to enable the traction control because of sensors that are placed near the rear wheels. These sensors produce a voltage blip when a mark rotates by them. A counter circuit in the hardware accumulates the number of blips generated in some unit of time, then the software of the engine management system compares these values and cuts engine power when one wheel exceeds the other [4.4]. A team of electrical engineering students designed the traction control system on the AX600. The advantages to the traction control system are reduced wheel slipping, better acceleration and better tire performance during slippery conditions. Some disadvantages are a minor reduction in engine power and the cost of the sensors on the system was $240. The torque from the engine of the AX600 is transmitted through a chain drive system, utilizing steel and aluminum sprockets at the axles.

The components used in the AX600 were chosen because of their lightweight. The tires on the AX600 are 10-inch diameter Hoosier slicks. These small tires enhance the suspension system by bringing the car low to the ground to improve the center of gravity and enhance traction.

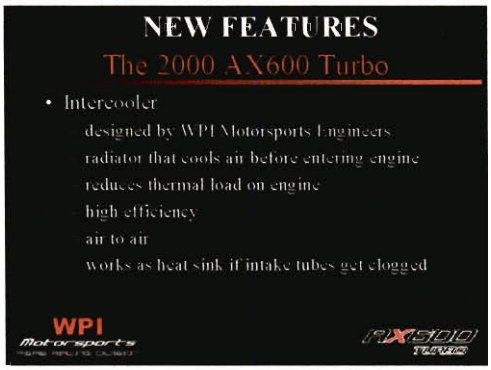


Figure 4.21. Supplementary Slide, Intercooler.

- **Custom Intercooler** - When air is compressed by a turbocharger it gets significantly hotter thus reducing its density (or available oxygen). An intercooler is a sophisticated radiator placed between the turbocharger and inlet manifold to cool this air before it enters the engine allowing more power to be produced than with a turbocharger alone (as much as 15%). An intercooler also reduces the thermal load on an engine and, in the case of a petrol engine, reduces the risk of detonation.

The WPI Motorsports designed intercooler improves the acceleration of the vehicle, and by decreasing the strain on the engine; the intercooler enhances the reliability of the engine [4.4].

Figure 4.22. Supplementary Slide, Garret T2 Turbocharger.

- **Garret T2 Turbocharger** - A turbocharger is an exhaust gas driven supercharger. Exhaust gas from an engine is used to drive a turbine connected by a common shaft to a compressor. This compressor in turn is used to supply air under pressure to the engine which combined with the correct amount of fuel has the effect of increasing the output of the engine over that of an engine of equal size without a turbocharger.

The amount of this increase can vary considerably from 10% to as much as 500% in some isolated cases. The turbocharger is an answer for the customers' request for acceleration. [4.4].

Figure 4.23. Supplementary Slide, Quick Shift System.

- **Quick Shift System-** The Quick Shift System is a unique feature of the AX600 that allows for no loss in acceleration due to shifting. The QSS works by way of a very fast relay wired to the shift lever and to the fuel injector ground wire. When pulled out of gear, the switch connected to the ground lever opens, leaving the injector with no ground reference and unable to inject fuel to the cylinder as normal.

Combustion is temporarily removed from the reference from the engine by lack of fuel, relieving the loads from gears and allowing smooth and quick shifting, until the shifter is moved to the next gear and fuel is again injected into the cylinders and resuming operation [4.4].

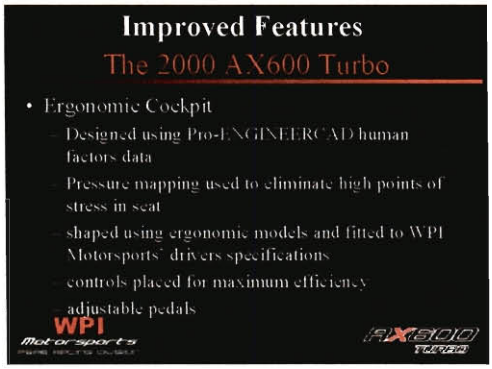


Figure 4.24. Supplementary Slide, Ergonomic Cockpit.

- **Ergonomic Cockpit-** The interior dimensions of the AX600 were determined through a combination of general population anthropometrical data, body dimensions of members of the WPI Motorsports team, and PROEngineer CAD human factors data. The cockpit is designed to fit individuals whose height is between 5' 7" and 6' 1".

The locations and orientations of the seat, gear shifter, steering wheel, and foot pedals, and an ergonomic test setup were used to survey the team for their preferences.

The control locations were determined through the ergonomic test set-up shown in Figure 4.25

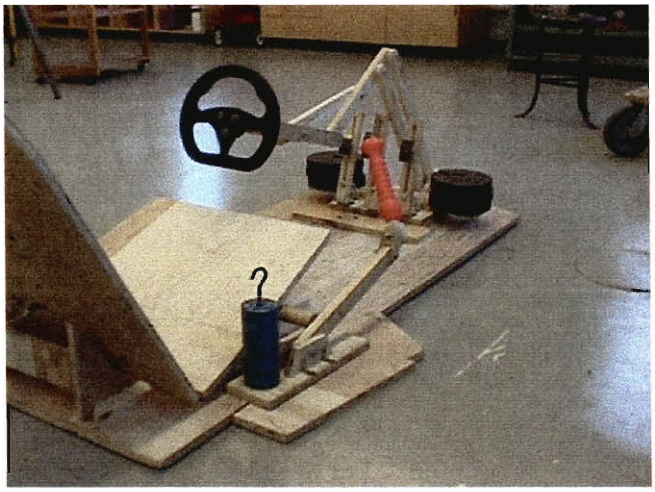


Figure 4.25. The Ergonomic Test Setup.

Pressure mapping was also utilized to eliminate high points of stress in the seat.

Figure 4.26 Supplementary Slides, Customized Seats.

- **Customized Seats**-From a customer standpoint, customized seats offer the utmost in comfort. The seat is made by having the customer sit in molding foam while it hardens, so the result is a seat with the exact shape of the customer. The seat is then covered by a soft cloth covering to cushion the driver.

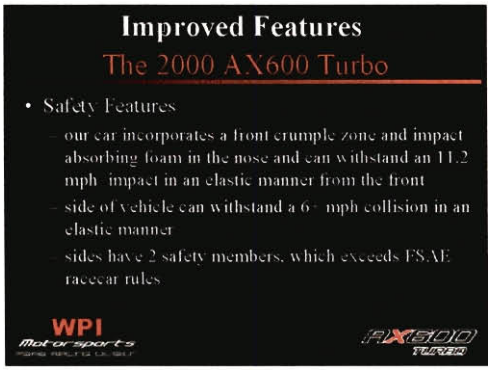


Figure 4.27. Supplementary Slide, Safety Features

- **Safety Features (Crumble Zones)**- The cockpit and frame of the AX600 meet all of the front, side, and rollover impact protection guidelines for FSAE vehicles. Safety tests were preformed using Finite Element Analysis. Six different types of static testing were performed, and a foam crush zone was chosen to protect the driver. One unique aspect about the safety of the Ax600 is that the car was tested dynamically, statically and through Finite Element Analysis. Another way that safety was ensured by making all of the connections in double-shear.

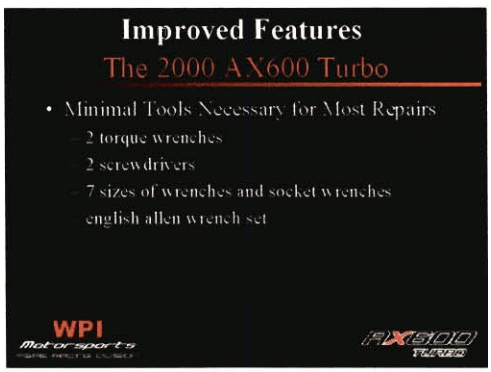


Figure 4.28 Supplementary Slide, Minimal Tools Necessary for Most Repairs.

- **Minimal Tools Necessary for Most Repairs**- The bodywork of the AX600 is held on by Zeus-style fasteners, which allows for easy removal of the bodywork so that the car's powertrain and electronics can be accessed. Most repairs can be done using a conventional tool kit, including two torque wrenches, two screwdrivers, six wrenches and socket wrenches, and an Allan wrench set.

Figure 4.29. Supplementary Slide, Honda 600cc CBR Engine.

- **Honda CBR 600 Engine**- The WPI AX600 features a Honda CBR 600cc engine. This is a highly rated engine, with acclaim such as "nine years of refinement and still the best all-around" from Bike Magazine [4.5]. The top speed of the engine is 151 mph, with the added performance of the turbocharger, the engine should satisfy any customers' need for acceleration, and competitiveness.

Figure 4.30. Supplementary Slide, Rack and Pinion Steering.

- **Rack and Pinion Steering** - Another way that WPI Motorsports has answered customer requests for handling is through rack and pinion steering. The car features conventional front wheel steering. A simplistic rack and pinion gear set facilitates the pivoting of the front uprights by way of connected rods.

The steering rack and pinion has a large ratio of 3, which gives the steering an extremely quick and taut feel. There is sufficient travel in the steering rack to create a sufficient turning radius.

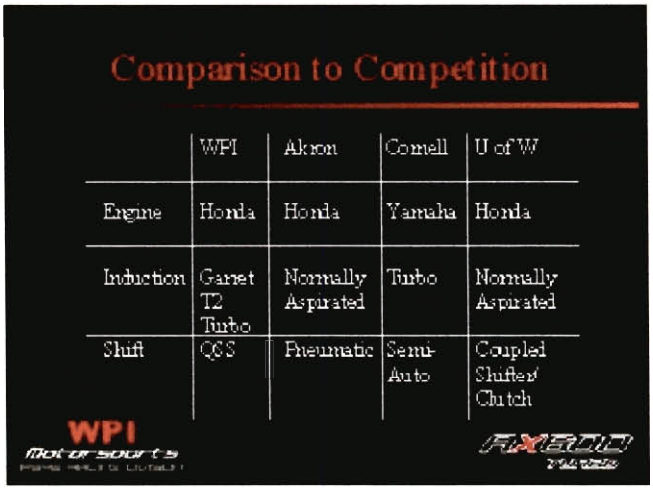


Figure 4.31

Figure 4.32

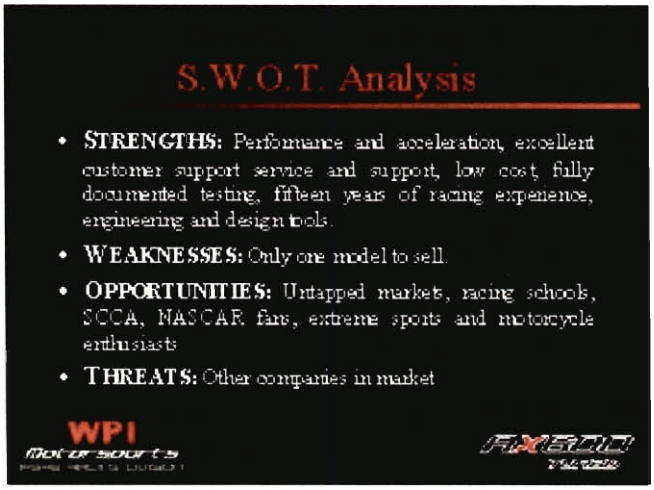


Figure 4.33. SWOT analysis.

A useful aid for identifying relevant screening criteria and for zeroing in on a feasible strategy is S.W.O.T analysis – which identifies and lists the company's strengths and weaknesses and its opportunities and threats. The name S.W.O.T is simply an abbreviation for the first letters of the words strengths, weaknesses, opportunities and threats. A good S.W.O.T. analysis helps the manager focus on a strategy that takes advantages of the firm's opportunities and strengths while avoiding its weaknesses and threats to its success [4.6].

5. Manufacturing Design

In order for our company to manufacture and distribute 1000 cars, a factory must be designed to accommodate all the requirements. This chapter was created to assist the manufacturing group for the presentation event. A layout for the factory was designed in conjunction with them would be used in the actual presentation event. Once the factory layout was created, a list of required machines was created, which includes a price list and total cost. All the components for manufacturing design will be discussed in the following chapter.

5.1 Warehouse Design

Before beginning to construct a manufacturing plant layout, the manufacturing processes and ideas need to be determined that will be used inside the plant. This means we already have some knowledge of unit quantity requirements. This knowledge should include production and shipping estimates for at least the next 4 to 5 years. It is unlikely that all of the questions will have been answered until much further alone in the layout process.

Equipment and systems planning must be integrated with manufacturing process planning and layout planning. Similar to manufacturing process planning, before the facility configuration and layout process can begin, the manufacturing process equipment used in the plant must be determined. In the plant, the material will be handled using wheeled carts and containers to simplify the transport of materials to the different workstations. The materials will be tracked throughout the plant automatically. Using

the latest technology in laser scanning and bar code readings will help control the inventory of the plant.

Once the incoming materials are unloaded from the receiving docks, they are removed from the palettes/boxes that they arrived in. All of the unpacking of the incoming materials will occur at the receiving dock [5.1]. This will help in reducing trash at each station. The materials will be delivered and stored on the racks at its proper station.

Unlike manufacturing process planning where most processes are predetermined, materials handling equipment systems are almost always designed simultaneously with the plant layout.

5.2 Overall Site Planning

One of the main concerns at this stage is automobile and truck access and egress to the site. For safety reasons, employee automobile traffic should be separated from truck traffic, if at all possible. Also, truck and auto traffic should cross no employee walkways. On the site layout, a one-way/one direction truck road width should be 13 feet minimum [5.2]. For two-way truck traffic, the minimum road width should be 26 feet [5.2]. On sites located within the U.S., when showing truck direction and turn-in radii on the drawings, show the trucks entering the area from right to left, in a counterclockwise forward flowpath, and show the trucks backing into the dock in a clockwise, reverse flowpath [5.3]. This allows the truck driver to directly view where he/she is going in a backward direction. If the flowpaths are laid out in the opposite directions, the drivers are not able to see directly where they are backing and have to rely on viewing their

reverse path on their view from the right-hand mirror. This is less safe than the first pattern.

Another major factor to consider in overall site planning is parking. For a preliminary estimate, multiply the expected total number of shift employees and estimated customer visits at the plant by 285 to get the approx. number of square feet to allow for a parking lot [5.3]. In our case, it has been determined through the cost report that there will be 62 employees including plant workers, shift supervisor, and plant managers on each shift. With the 62 employees multiplied by 285 will require 17,670 sq. ft. of parking space. If the number of employees is expected to grow by about 8% per year, use 385 as the multiplier to determine the approx. parking space needed 5 years after plant start-up.

5.3 Factory Layout

Once the exterior requirements of the plant have been determined, the focus is turned to the inside of the plant, which can be divided into the manufacturing and office space. In order to have a functioning plant layout, the manufacturing process must have positive flow, minimizing time and transporting of materials.

In our factory layout, we have a basic block-style building with a square perimeter. The building was designed to have its front fascia facing the east and the back face the west [5.3]. The sun rises in the east so the offices will get the morning sun. This will benefit in the winter months to warm the building and cut down on heating costs. With an east-west design, the entire building will be in the path of the sun at one point in the day [5.3]. This design doubles in factoring for the prevailing winds of the Northeast.

In the winter months, the winds come from the north and northeast. In the summer months, the winds come from the south and southwest. These winds have effect the temperature inside the building due to the large opening of the dock doors on the shipping/receiving end. Having the docks face the west decreases the constant loss of heat from the prevailing winds. Today, there are heating elements available that are placed at the entrance of the docks that force hot air downward. This can be considered when planning for the building's layout, although there will be an increase in electricity. These options are provided to inform about the different options available pending the location of the factory.

The overall dimension of the prototype plant layout is 310 ft. by 230 ft., giving it an area of 71,300 square feet. Although this may seem large for a startup company, it was created with expansion in mind. It is less expensive to expand with more area to begin with, but the startup costs will be higher in the beginning.

The best place to begin is the shipping and receiving area. It is here that the company will get incoming raw materials and export the final product. We would need three shipping/receiving docks, so that traffic jams wouldn't occur. If a truck drops off a shipment, it doesn't need to wait for the previous truck to unload its freight. The shipping docks have been arranged so that entering and exiting the plant are easy as possible. Once they are in the loading/unloading docks, the forklift operators will distribute the materials to the designated work area. Shelving racks have been installed at each workstation to simplify getting the materials to the station. As the work progresses in the S-type configuration of assembly, car will pass through several checkpoints for

quality control [5.1]. The finished cars are stored at the end of the line, either stored for local sales or shipped to other distribution centers.

The offices in the plant were placed in the perimeter so that expansion would be available later in the future. Another reason is so that many of the offices can have windows instead of four closed walls. The office space that is near the assembly line belongs to the manufacturing managers, maintenance, and research and development. They were placed near to each other so that communication between workers and managers would be simplified. Next to these offices are the locker room area, restrooms and the cafeteria. These were placed in the middle of the plant but along the wall so that both the assembly line workers and office personnel have an equal distance to them. To the right of the assembly area and designated the front of the building are the general offices. Here are the offices for the managers, phone operators, and network personnel. This is the side of the building that will face the street and what will be seen the most. In the other corner of the front, we will have a parts store and showroom. For our customers that are in the Worcester area, parts will be available in our store for ease of access to OEM parts. The showroom adjacent to the parts store will display several models of the AX600. Basically, we will have a dealership within the factory and a new AX600 can be purchased right of the line.

5.4 Cost Layout of Factory Machines

After determining the layout of the factory and the actual dimensions needed for the workspace, it was time to focus on the layout of each workstation. The U-shaped pattern of the workstation setup allows for smooth flow from one station to another.

Once the raw materials arrive in the receiving dock, they are unloaded with a forklift and brought to the designated parts storage area next to each station.

We turned to Oxford Machinery located in Worcester [5.4] for most of our machine selections. The founder, Kenneth Ward, was very helpful in making our machine choices. He has a 25,000 square foot building with 1.3 million dollars in inventory. We attended a machinery show at the Oxford Machinery building on April 20, 2000 that showed us the different companies and machines available and demonstrations also.

The first station is reserved for measuring and cutting. Here, the raw sheet metal and tubing will be cut to fit the desired applications. For this station, we will need two CNC plasma cutters for the sheet metal and two CNC tube cutters. The plasma cutter chosen was the Lockformer Vulcan 2900CU with Intel 586 MHz computer included. This 5' x 10' cutting table surface was chosen for its accurate cutting and versatility with variable speed cutting [5.4]. The retail price of the Vulcan 2900CU is $49,600, which includes the CAD design software package and CNC Fibre-Optic Download Software [5.4].

For the tube cutters, a Scotchman 12-1/2" cold cut-off saw (Model LT315) was chosen because of its versatility in cutting a wide range of materials and profiles. It produces an accurate, burr free cut without heat or distortion [5.4]. The machine is quickly adjustable to miter any angle from 0° to 45°. With its double mitering head, it has a maximum sawing capacity with a round tube of 3-7/8" at 90° and 3-1/2" at 45° [5.4]. With a retail price of $4,195, this cold saw includes a floor stand with coolant system, 1 blade, and 1 gallon of saw blade coolant.

The next station is for drilling and tapping. Both of these tasks will be taken cared of by two Jancy Magnetic Base Geared Head Drill Presses (Model DPSB35 Auto). Ken Ward recommended the Jancy Engineering Company for this particular job. This machine was chosen because of its rigid design, construction and quiet operation [5.5]. It has a variable 8-speed motor with 75 to 3150 RPM variability. It has a 1-1/2" drill capacity with a drill depth of 6". Its quick tool bit change allows an easy switch from drilling to tapping [5.5]. For its tapping abilities, it is capable up to ¾", which exceeds our requirements. It stands at 71" with its widest point of 16" x 20" being the worktable. The retail price of this machine is $995 with several drill and tapping bits available.

Once the tubing has been cut to the desired length, many of them require bending to its proper shape. For this job, we turned to the people at Jancy for their high-end pipe benders. We chose an Ercolina Top-Bender (Model EROK50) to do our pipe bending needs [5.5]. It has a programmable microprocessor that can store up to ten individual programs with nine bending sequences in each program. This and its tool-free former die mount will help cut down costs by decreasing the tooling time [5.5]. The Top-Bender is capable of bending multiple profiles and material shapes so it can take care of all our bending needs. Transporting this machine in the factory will not be a problem because of its hidden base wheels and lift handle. The retail price of this machine is $2,200, which comes with former and counter bending dies.

Once all the raw materials are measured, cut, bent, or drilled, they are assembled in the robotic welding area. For this station, the Panasonic line of robotic welders was chosen for their durability, ease of programming and safety [5.6]. The information for Panasonic robotic welders was from T.J. Snow Company, Inc. in Chattanooga, TN. The

PerformArc 100 from Panasonic was the model that met our requirements for computer controlled welding. It has easy-to-use programming, editing, and full welding controls. The robotic welder has easy access for forklifts to move it once in the factory. The retail cost of a robotic welder is $80,000. For our factory, the price as tested would be $110,000.

For the milling needs of the factory, we turn to the William Watts Company for their wide range of CNC turning centers and lathes. Kenneth Ward recommended this company and their helpful website. For the milling machine in our factory, we have chosen the Cinch-mill 18 bed-type milling machine from William Watts. With its cost effective PC-based CNC system, it allows simple operation. It has a large working surface for added safety and convenience [5.7]. It has a durable construction made of rigid cast iron. The retail price of the milling machine is $74,000.

The next machine needed is for lathe operations. We chose to stay with William Watts for this machines also. Since Ken Ward's company, Oxford Machinery, does not distribute lathe machines, we chose the Takang TNC-30 CNC Turning Lathe, which is sold by William Watts. This Japanese company created a machine that has a fast tool change, going from tool to tool in 0.2 seconds. With its durability and heavy cutting, it can cut minutes off of cutting time [5.7]. Its PC-based CNC system allows for single person operation. The retail price for this machine is $62,000.

After the lathe operations station, the material will proceed to the surface grinding station. Here, the material can quickly and safely grind or polish materials to the required dimensions. When we discussed this job with Ken Ward, he recommended staying with the Jancy line of belt grinders because of their tool free belt changes and low operating

noise level [5.5]. The model we chose was the Jancy Abrasive Belt Grinder (ModelBG015S) because of its 8" x 6" contact wheel. Aside from its grinding wheel, it also has a top-mounted deburring and polishing surface that has a work surface of 6" x 19". In choosing the proper grinding belt, we have selected a Ceramic Oxide belt. These belts increase performance and work well on difficult to machine materials such as stainless steel, cast iron, and aluminum alloys. The retail price of this machine is $1,100, which comes with 3 replacement belts, tool rest, and eye shields.

Table 5.1 – Cost Breakdown of Factory Machines

Work Station	Machine (Model #)	Quantity	Retail Price	Total Cost
Measuring and Cutting	Lockformer Plasma Cutter Vulcan 2900CU	2	$49,600	$99,200
Drilling and Tapping	Jancy Magnetic Base Geared Head Drill Press (Model DPSB35 Auto)	2	$995	$1,990
Bending	Ercolina Top-Bender (Model EROK50)	1	$2,200	$2,200
Welding	Panasonic PerformArc 100 Robotic Welder	1	$80,000	$110, 000 w/ Required Options
Milling	William Watts Cinch-Mill 18 Bed-Type	1	$74,000	$74,000
Lathe Operations	Takang TNC-30 CNC Turning Lathe	1	$62,000	$62,000
Surface Grinding	Jancy Abrasive Belt Grinder (ModelBG015S)	1	$1,100	$1,100

TOTAL MACHINE COST = $350, 490

5.5 Vehicle Distribution

To meet nation-wide demand, WPI Motorsports needs to be able to distribute its product consistently throughout the different regions of the country. According to the information regarding SCCA members, and other possible markets, the AX600 Turbo will be shipped to dealerships in one or more major city in each of the regions. In addition, half of the AX600s will not be shipped to dealerships, as they will be sold directly to customers through online transactions as well as over the phone.

It is our goal to be able to provide our customers with our product, without significant delay, as this could possibly decrease sales. For this reason, a potential customer should never be able to claim distance as a factor in choosing a competitor over WPI Motorsports. To facilitate demand, we will have one or more WPI Motorsports authorized dealership in each of the eight regions of the SCCA. These dealerships are located in major cities where Solo II events are held, to help attract potential customers. The selection criteria for the locations are based on the marketing survey, with population density of SCCA members and distance from other dealerships being main factors [5.8].

According to the lean production schedule compiled by the manufacturing team, production of the AX600 Turbo will begin in October. Towards the end of February, when the racing seasons begin, there will be plenty of vehicles to meet demand. No vehicles will be produced between April and September, as the peak autocross season will be drawing to a close, and the remaining stock can be sold off before the new prototypes are introduced.

As can be seen in Appendix K, the number of cars distributed per year, is proportional to the number of SCCA members serviced by that dealership. Typically, the

amount of products shipped to each dealership would mimic the demand in the previous year. As WPI Motorsports has no statistics from the previous year to support this claim, demand is assumed. In the coming years, WPI Motorsports will be able to alter the amount of cars distributed to each dealer according to the necessary data. Only half of the one thousand cars will be distributed to dealerships in the first year. As this product is relatively new, dealers may be reluctant to invest in large quantities of the AX600 Turbo, until it proves to be profitable. The remaining five hundred vehicles will be sold factory direct to customers, as WPI Motorsports realizes a much greater profit from this type of transaction. Likewise, we assume that the increasing trend of electronic commerce in industry today will result in several hundred transactions through our on-line ordering system.

Also in Appendix K, the breakdown of the number of cars per dealership every week is displayed. In several cases, the amount of cars to be distributed to a particular dealership per week is less than one. In this case, the vehicles could be delivered every other week, when ordered by the dealership, or all at once at the beginning of the racing season, providing the dealer has the room to store all the vehicles. In time, WPI Motorsports intends to develop the storage capabilities to be able to store our products, and deliver them to the dealers as needed, so that no individual dealer ever has too few or too many AX600 Turbos in stock.

In order to distribute our product effectively, WPI Motorsports must make a few assumptions in the first year. First we assume that the demand per region will be proportional to the membership in the SCCA. We also assume that demand will be very low during the off season, and that a demand exists within the racecar driving school

market as well as an untapped market for other high performance vehicle enthusiasts. In time, it is our hope that demand will grow and surpass the one thousand cars per year specified by the rules of the competition.

6. Conclusion

For this year's IQP, we focused on a different area than the previous years. Our comprehensive marketing techniques and strategies have shown to pay off in the presentation event. We created an entire business package which includes a business plan, mission statement, quality function deployment, and a S.W.O.T. analysis. Also, we have included a liability release form and a warranty should someone purchase the vehicle.

Aside from the marketing materials, we also worked together with the manufacturing group and produced a detailed factory layout, including the cost of machines. Working together in creating the presentation allowed a more consistent presentation appearance than the previous years.

With the hard work put into this project, we succeeded in our goal of producing a professional looking and complete presentation package for use at the Formula SAE competition in Michigan. The 2000 FSAE Presentation Event resulted in a tie for first place between WPI and Rochester Institute of Technology.

According the judges, the two schools had vastly different philosophies as to presenting, ours was to use technology to comfortable limits within the time allotted, R.I.T.'s was to be more formal, and speak well, about all the main points required of them. While looking at the judges scoring sheets, it is clear that the W.P.I. presentation had a more consistent score with two 49's and 48, while the R.I.T. presentation had vastly fluctuating scores between 47, 49 and 50.

When reviewing previous years' scores, it is evident that the level of the top presentations this year was far superior to previous years, as the top schools over the past two years had scores of 45 and 46 on average from each judge.

7. Future Recommendations

For the future, we have several recommendations that should help keep WPI ahead of its competition. The presentation event itself, is the most important part of the IQP project, and is only ten minutes long. Since it plays a key role in the overall score for the team, the presentation should thoroughly impress the judges, while delivering the most content possible in the time allotted.

A well-balanced presentation that includes a wide range of visual aids is recommended. This year, the judges were quite impressed with our PowerPoint presentation, the web-site displayed on laptop computers, marketing materials in customized folders, and backup slides on overhead transparencies to handle the five minute question and answer session. Visual aids make the presentation much easier to understand as well as simplify communication with the judges.

This IQP began in February 2000 and we found that by practicing the presentation as often as possible helped us be more comfortable and relaxed. It is important to be comfortable with what you are saying, as well as fit as much content into the ten minutes as possible. If the presentation goes over ten minutes, the team will be penalized. In our presentation, two judges stated that we were too fast and only used 8 minutes of the time allotted. However, this was their error in timing because we used 9 minutes and 45 seconds. Utilize the first few minutes before the presentation starts. While setting up our laptops and VCR, we had the judges view our web site and marketing materials. This way, the judges have a positive opinion before you introduce the team. Be sure that the web site is fully functional. This year's team received much praise for the detailed web

site. The judges were also impressed with the customized WPI Motorsports folder that contained all the marketing materials.

Expect the unexpected. Bring a printer as well as a copy of the presentation and web site on CD-ROM. You may need to make last second changes to some of the printed materials, and the laptops could crash at any time. Have copies of the PowerPoint presentation on backup slides for an overhead projector. Also, with the digital camera available, bring enough floppy disks and make sure the battery is charged when not in use. Technology can sometimes fail. Four teams this year had no visual aids at all because their computers kept crashing at the time of the presentation. Likewise bring backup laptops incase of emergency. If the team decides to do a commercial, use a DVD player rather than a VCR, this is to eliminate the need for queuing up of the video and the higher output resolution possible. This year the first half of the commercial had no sound because of technical difficulty. In transition from the hallway to the room, the audio cable came loose from the VCR. Outsource the commercial if possible. It will turn out more professional and save some time and effort. Ten minutes is a very short amount of time for the amount of subject matter that could be addressed in the presentation. Be general and do not spend too much time on any one subject. To include more content, make general statements that invite the judges to ask specific questions. Then have a backup slide for the overhead that provides in depth information on that subject.

Lastly, during the presentation, remember that the judges are human. They expect you to make mistakes and will attempt to ask you questions that they think you don't know. If you don't know an answer, either let the engineering group field the question, or admit that you don't know. Do not make up an answer since the judges most likely

already know what the right or wrong answer is. The proper way to answer a question you don't know is to say "I'm not sure but I will get back to you on that" or "We are currently working on that at this time". Even though this may never happen, this is what is typically done. Be relaxed and be confident and remember that no presentation is perfect. We recommend making the judges laugh, as this will ease the overall tension in the room.

Aside from the presentation, there are a few areas that have room for improvement. First of all, don't start over. Build off of what has been done in previous years. This can only help WPI Motorsports succeed in the future. One topic that was mentioned but not done was a radio commercial. This could be used as an introduction to the presentation. It would be helpful if the members of the presentation group had some general background in engineering, marketing, and overall good computer skills (Photoshop, HTML, PowerPoint, etc...). The marketing survey could be expanded upon to help refine the target market, as well as introduce other possible markets where the AX600 could be targeted towards. At the beginning of the project, set some objectives and make a timeline. The objectives will change overtime, however it is important to work continually throughout the semester rather than save all the writing to the end. It is also recommended that the IQP team work with the MQP team to find sponsors. This is an expensive IQP project in terms of printing, getting shirts and other WPI Motorsports accessories and the trip to Michigan. To save a little money, get shirts made at Guertin's Graphics (near the RMV in Worcester, MA). They already have a template for the WPI Motorsports and AX600 Turbo logos, and can be embroidered at a lesser cost, also

should the name or logo of the car change, the WPI Motorsports logo is a separate embroidery file there and can still be used.

It will cost a few hundred dollars for travel arrangements and hotel accommodations and for the competition. Bring extra money for food, transportation and entertainment. Plan before hand the transportation to and from the hotel. Chances are the hotel will be 1 to 2 miles away. A cab ride will cost $10 one way if no ride is found. You may end up spending several hours at a time at the Silverdome. Technically, the competition is in the parking lot of the Silverdome so weather plays an important factor. Some days the weather was hot and sunny, others were cold with days of rain. The team should put money together for some refreshments and food to grill up at the track to help pass the time. The food stand at the Silverdome was very expensive and not worth purchasing. Lastly, have a good time in Michigan. Detroit is only an hour's drive and the Canadian border is less than half an hour away. Good Luck.

Appendix A

The Business Plan

WPI

Motorsports

FSAE RACING DIVISION

Business Plan

- Executive Summary
- Vision/Mission Statement
- Features of the Car
- Current Status of the Business
- Market Demographics
- Marketing Techniques
- Competitive Distinctions
- Comparison to Competition
- Projected Usage
- Long-Term Development Strategy
- Market Share
- Balance Sheet
- Pricing Strategy
- Support and Service Plan

Business Plan

Executive Summary:

The WPI FSAE Racing Division designs, manufactures, markets, sells, and provides customer support for their racecars, including their most recent, the 2000 WPI FSAE AX600 Turbo. The racecars are for recreational use, and they also are qualified to race in Solo II [A.1] or autocross competitions. In these competitions, the cars race one at a time, and the drivers are timed individually as they drive over a race course. The car will be marketed to our target market, which will be discussed in our market demographics section.

Vision/Mission Statement:

Our Vision: To be the worldwide leader in the design, production, and marketing of Formula SAE Racecars.

Our Mission: To achieve our vision, we shall:

- Continually seek to improve all of the aspects of our business, including our design, production and business processes.
- Maintain open and productive communication between all members of our organization.
- Seek to fulfill customer needs as well as possible, including providing industry-leading support.
- Plan for the future, while keeping in mind the principals that have lead to our success.

Features of Car:

The latest AX600 Turbo has many improvements and outstanding aspects. The car has a stiffer frame, higher power to weight ratio, increased drivability, and a more

comfortable seat. The chassis meets all FSAE guidelines for side and front impact, as well as roll over protection. CAD modeling was used to design the stiffened chassis. In addition, the finite element program Algor was used to test the stiffness and strength of the chassis.

The race car features a Honda CBR600 F3 motorcycle engine, with maximized horsepower due to efficient intake exhaust manifolds and air restrictor designs. The performance is enhanced by a Garret T2 turbo charger. Intake charge temperature is lowered by a unique in house designed air-to-air tube bank intercooler. The Haltech F9A programmable fuel injection module supplies the engine with fuel. The driver is able to maintain maximum acceleration through the QSS quick shift system. Steering in the AX600 is basic rack and pinion with a large state ratio, giving the steering quick and taught feel. The AX600 comes with 10-inch Hoosier slicks, bolted onto aluminum hubs. The suspension system features Rock Shox Delux shock absorbers. Finally, Wilwood Dynalite calipers clamp onto aluminum rotors for a disc brake setup.

Figure A.1 The 2000 AX600 Turbo.

Current Status of the Business:

Since 1985, the WPI FSAE Racing Division has been designing FSAE racecar prototypes. To meet the objective of distributing 1,000 cars, the facilities would have to be enhanced to meet this increase in production. Currently, WPI is well-respected school with a solid reputation for engineering curriculums since 1865. Given this solid reputation, WPI attracts some of the finest students and professors in the world. WPI has established itself as a top-notch school, and the WPI FSAE racing division designs and manufacture top-notch racecars.

Market Demographics:

Our market is essentially comprised of middle-aged males, 74% between the ages of 25 and 44 [A.2]. This was determined by surveying the Sports Car Club of America, which has approximately 51,000 members [A.3]. Other potential markets are Nascar, motorcycle, and snowmobile enthusiasts. Nascar generated an estimated 2 billion dollars in revenue in 1998 in a market of over six million fans [A.4], Harley Davison, Inc. generated approximately 267 million [A.5], and Polaris Industries, Inc., generated over 76 million in net income [A.6]. These figures prove that customers are spending quite a bit of money in the automobile/entertainment market. It would be reasonable to deduce that WPI Motorsports products would appeal to these markets. Also, the market for extreme sports has been consistently growing, as demonstrated by growth in sports such as mountain biking and snowboarding. The "thrill seeking" industry generated $4,654 billion in 1995 [A.2]. In addition, WPI may explore international markets, and also the car could be sold as an educational package, for students in engineering or automotive disciplines.

Marketing Techniques:

To sell the AX600, various methods of marketing shall be used.

1. A magazine advertisement will be placed in various magazines to create customer enthusiasm for the car. In addition, the ad will be made into HTML format, and placed on web sites. Initially the ad will be placed in publications such as New England Dragway News, and SportsCar. When the marketing budget increases, the ad will be placed in publications such as Road and Track and Men's Health.

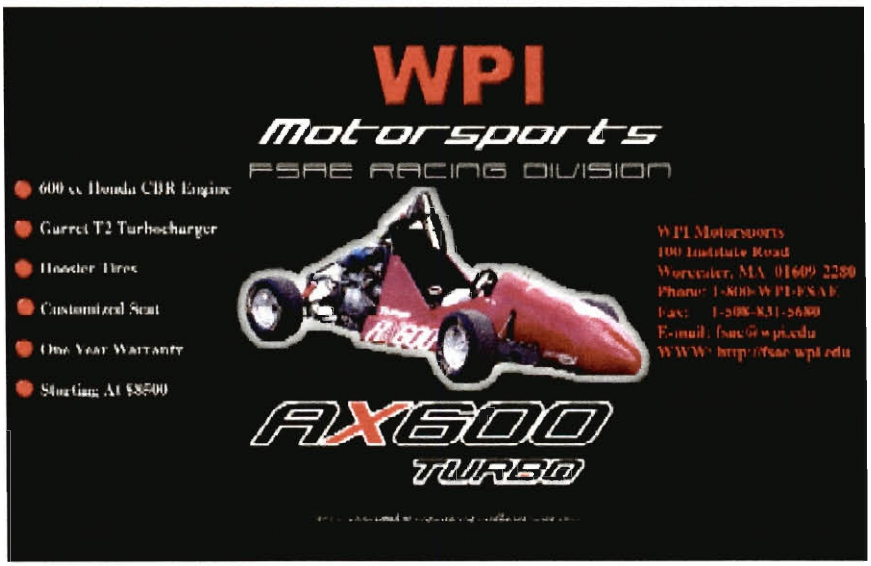


Figure A.2 The magazine advertisement.

2. A television commercial will be aired during specific broadcasts that our target audience often watches. By reviewing Nielsen ratings, the target audience can be correctly identified and the ad can be placed during programs that the demographic often watches. As the marketing budget increases, the ad will aired nationwide, but at first the ad will be shown on local cable airtime.
3. Radio commercial will be run on select stations that our market generally listens to. A short radio segment will be played on stations such as WAAF, WZLX, and WEEI.
4. Promotional events will enhance brand recognition. The WPI FSAE Racing Division will be on site with product information and other promotions.

5. A comprehensive brochure will provide the potential customer with all relevant information. The full-color brochure will include: detailed product descriptions, specifications, warranty information, and support information.
6. A Website will serve as a way for customers to get extensive information about the car, have access to support resources, and order parts online.
7. A 1-800 number will provide the customer with constant support and information.

Competitive Distinctions:

- 15 years experience in design and manufacture of FSAE Racecars.
- Extensive service and support after the purchase, including a 2-year warranty and 3-year power-train warranty.
- State-of-the-art engineering design tools such as CAD, Algor, Pro/ENGINEER, Pro/MECHANICA, TKSolver, etc.
- Garrett T2 TurboCharger
- Air to Air Tube Bank Intercooler
- QSS – Quick Shift System
- Team Consisting of Mechanical, Manufacturing, and Electrical Engineers and Marketing

Comparison to Competition:

The 2000 AX600 is a very favorable option in comparison to the competition. Our overall goal is to provide a car that excels in all areas. This goal is tested through a series of performance events where the AX600 is tested versus its competitors. This section contains strengths/weaknesses analysis and a number of tables demonstrating how WPI compared to our competitors based on dynamic events that took place at the 1999 Formula SAE Competition. Only a limited amount of information about our competitors was available, however by looking the performance of the competitors in the FSAE

events, we are able to see which aspects of their vehicles proved to be outstanding. This information was obtained through a comprehensive report of the results of the 1999 FSAE competition [A.7]. The competitors we choose to look at were the University of Akron, Cornell University, the University of Missouri at Columbia, and the University of Washington. These teams placed first, third, fourth and fifth overall, but they had consistent high performance throughout the competition. The second place team, the Rochester Institute of Technology, scored low in some of the events examined, specifically 21st in the skid pad event and 32nd in the acceleration event, so for that reason they were not considered as a major competitor. A common way to compare a business or product to its competitor's is to analyze strengths and weaknesses. The following sections show the strengths and weaknesses of WPI Motorsports and it competitors.

WPI Motorsports

Strengths: Acceleration, 6th, plus additional new for 2000 features: Garret T2 Turbocharger, Custom Intercooler, Quick Shift System. Solid business performance, placed well in both cost report and presentation event, typically, other manufacturers have priced their car at around $9,000, where we will be selling ours for $8,200. This pricing is based on the parameters set by the FSAE Competition. [A.1].

Weaknesses: Endurance event, 24th, Skid Pad event, 50th, Autocross event, 32nd.

Competitor: Akron University

Strengths: All around excellent car, outstanding performance in all dynamic events, 1999 FSAE Competition winner.

Weaknesses: Poorly run business, low performance in Cost Report, 22nd, and presentation event 22nd.

Competitor: Cornell University

Strengths: Endurance, Acceleration, Solid business performance, tie for 5th in presentation event, 5-time FSAE competition winner.

Weaknesses: Skid pad event, 27th, and Autocross event 22nd. Questionable handling, braking.

Competitor: University of Washington

Strengths: Endurance, Skid Pad, Autocross, Solid business performance, tie for 5th in presentation event and 11th in cost report.

Weaknesses: Acceleration, 16th.

Competitor: University of Missouri, Columbia

Strengths: Endurance, Autocross, Good business performance in Cost and Presentation events.

Weaknesses: Skid pad event, 18th, and Acceleration, 23th

Table A.1: Endurance/Economy Event.

University of:	1999 Place	Fuel System	Suspension	Seat
Akron	1	Electronic Fuel Injection	Double A-arms, Thermoplastic Springs & Viscous dampers	N/A
Cornell	2	Student Designed Harlan Injection	Double A-arms, Non-parallel, unequal length, Inboard pull-link packaging	N/A
Washington	3	Electromotive TEC II	Double A-arms, Cane Creek air springs & dampers	N/A
Missouri at Columbia	5	EPIC	Double A-arms, non-parallel, swaybar, RockShox springs and clampers	N/A
WPI	24	Haltech F9A, Programmable Fuel Injection Module	Non-Parallel Double Wishbones, Rock Shox Deluxe	Customized Seat, made of hardening foam, ergonomically pressured mapped to eliminate high points of stress

The first event we choose to examine was the Endurance Event. This event is a competition of time, measure in seconds. Other criteria are cones on the course, which are knocked down, and also the maximum and the minimum volume of the fuel tanks are recorded. Fuel Economy is very important to this event. The 2000 AX600 has a Haltech F9A Programmable Fuel Injection Module. This system can be programmed to supply the engine with various fuel map configurations to adjust for things such as altitude, environmental and mechanical conditions. To be successful in this event, measures must

be taken to avoid driver fatigue. WPI Motorsports does this two ways, with a high performance suspension, and with a customized seat. The AX600 has a four-wheel independent suspension, utilizing non-parallel double wishbones at each wheel corner to absorb shock independent of the other wheels. The shocks that were selected for this car are Rock Shox Deluxe, which feature 300 lb/inch spring with adjustable compression and rebound clamping. Finally, the vehicle comes with a customized seat, which is made by having the customer sit in molding foam while it hardens, so the result is a seat with the exact shape of the customer. The seat is then covered by a soft cloth covering to cushion the driver.

Table A.2: Skid Pad Event.

University of:	**1999 Place**	**Tires**	**Brakes**
Akron	3	Goodyear	Front: 2 discs Rear: 1 disc
Cornell	27	N/A	Wilwood
University of Washington	5	Hoosier	Wilwood
Missouri at Columbia	18	Goodyear	Wilwood
WPI	50	Hoosier	Wilwood

Another important event is the skidpad event. Tires and brakes are critical for success in this event. For tires the AX600 features Hoosier 10-inch diameter slicks, which improve traction and reduce unsprung weight. For brakes, the AX600, uses Wilwood calipers, which are used by 2 out 3 of our competitors. Our specific make is the

Wilwood Dynalite Caliper, which clamp onto aluminum rotors in a disc brake set-up. Center of gravity of the vehicle is another important characteristic; the AX600 is 8 inches above the frame rail, which reduces chance of rollover, improving handling during braking.

Table A.3: Autocross Event.

University of:	1999 Place	Differential	Wheelbase	Frame	Engine
Akron	5	Limited Slip	1778 mm	4130 Spaceframe	Honda 600 cc
Cornell	20	Student designed Koller differential w/ Zexel Torsion gears	1829 mm	4130 Chromoly Steel	Yamaha 600 cc
Washington	10	Zexel Torsion	1778 mm	4130 Spaceframe	Honda 600 cc
Missouri, Columbia	3	Zexel Torsion	1828.8 mm	4130 Steel	Honda 600 cc
WPI	32	Torben: Torque Sensing Traction	1790.7 mm	4130 Chromoly Steel	Honda 600 cc

To score well in the autocross event, vehicles must have good acceleration, handling, and braking, a shorter wheelbase, and lightweight frame. While the braking of the AX600 was already discussed, the differential provides excellent traction and the engine, a Honda 600 cc CBR engine allows for quick acceleration. The differential aids the handling of the vehicle by allowing power transfer between the drive wheels during cornering, as well as permitting both drive wheels to turn at the proper speed to maximize traction. The differential allows for smoother cornering as the wheels spin independently of each other, and the ability of the differential to transfer power to a gripping wheel from

a slipping wheel. The Honda CBR engine is a highly rated engine, as it is used by two out of three of our competitors. One unique aspect of our vehicle is our traction control system. This feature greatly enhances our traction, as does the shorter wheelbase, which reduces the radius it takes to turn the vehicle. Our wheelbase is very close to or shorter than our competitors. The 4130 Chromoly frame is lightweight but stiff, it is the choice of most of the competition.

Table A.4: Acceleration Event.

University of:	1999 Place	Induction Type	Shifter
Akron	2	Naturally Aspirated	Pnuematic
Cornell	1	Turbocharged	Semi-Automatic
Washington	16	Naturally Aspirated	Integrated shifter & clutch system
Missouri, Columbia	23	Naturally Aspirated	Cable Operated
WPI	7	Turbocharged	Quick Shift System

The finally event that is worth examining is the acceleration event. High acceleration is achieved through a number of things, including induction type and shifter. The AX600 features a Garrett T2 Turbocharger. A turbocharger is an exhaust gas driven supercharger. Exhaust gas from an engine is used to drive a turbine connected by a common shaft to a compressor. This compressor in turn is used to supply air under pressure to the engine which combined with the correct amount of fuel has the effect of increasing the output of the engine over that of an engine of equal size without a

turbocharger [A.8]. Having the turbocharger gives us an advantage over the competition. The Quick Shift System is a unique feature of the AX600 that allows for no loss in acceleration due to shifting. The QSS works by way of a very fast relay wired to the shift lever and to the fuel injector ground wire. When pulled out of gear, the switch connected to the ground lever opens, leaving the injector with no ground reference and unable to inject fuel to the cylinder as normal. Combustion is temporarily removed from the reference from the engine by lack of fuel, relieving the loads from gears and allowing smooth and quick shifting, until the shifter is moved to the next gear and fuel is again injected into the cylinders and resuming operation [A.9].

By examining the results of the FSAE Competition, WPI Motorsports gains insight into areas that we have excelled and also areas were we need improvement. By continually seeking design improvements, we will be more competitive each year.

Projected Usage:

The WPI FSAE AX600 typical has a useful life of about 5 years, after which time the introduction of newer models make the car obsolete. The car will be covered under warranty for a period of two years with basic coverage and three years with powertrain coverage, beyond which the customer must maintain the car. After the warranty has expired WPI will continue to provide the customer with technical support. In addition, WPI will provide customers with manufacturers contact information for outscored items.

Long Term Development Strategy:

Our long-term strategy is to be able to produce greater than 1,000 cars per year, and expand our market share, while we continue to provide our customers with the best possible car. Currently, the product is between the market introduction and the market growth phase of the Product Life Cycle. At this point, the concept of owning a racecar or participating in a race event with a streetcar is familiar to large audience, however to

market could continue to grow with increased visibility and marketing. With a larger market, greater sales can be achieved.

Market Share:

The current market for FSAE racecars is still emerging. While over 100 universities produce the prototype cars, the actual number of commercial producers is small. To gain a large market share, WPI would need to prove itself providing an outstanding car. Another potential setback in the attempt at a large market would be the fact that many vehicles in the SOLO II race class are modified streetcars. WPI would have to demonstrate that using their car offers an advantage over all streetcars to compete for this share of the market.

Balance Sheet:

Here is the balance sheet for the WPI FSAE Racing Division. The balance sheet is a current listing of the company's assets and liabilities.

Table A.5:WPI Motorsports Balance Sheet.

Assets	
Current Assets	
Cash	$15,000
Petty Cash	$600
Accounts Receivable	$15,000
Inventory	$4,000
Short-term Investment	$6,000
Prepaid Expenses	$1,500
Long-Term Investments	$3,000
Fixed Assets	
Land	$150,000
Buildings	$380,000
Improvements	$50,000
Equipment	$18,000
Furniture	$850
Automobile/Vehicles	$0
Total Assets	$643,950

Liabilities	
Current Liabilities	
Accounts Payable	$10,000
Notes Payable	$3,950
Interest Payable	$18,000
Taxes Payable	
Federal Income Tax	$134,000
State Income Tax	$42,000
Self-employment tax	$50,000
Sales Tax	$48,000
Property Tax	$128,000
Payroll Accrual	$165,000
Long-term Liabilities	
Notes Payable	$54,000
Total Liabilities	$643,950

Pricing Strategy:

To determine a price for our product, WPI Motorsports must consider many different factors. The overall value of the AX-600, competitor pricing, manufacturing, labor and overhead costs, distribution considerations, warranty issues, demand, and perceived notions of the consumer must all be carefully analyzed to render a suggested retail price that will be both enticing to the consumer, and profitable to WPI Motorsports.

Generally, consumers have only a small percentage of their yearly income allocated for items such as high performance vehicles. Hence, the price of the AX-600 Turbo must be attractive to potential customers. In contrast, if the price is too low, customers will perceive that the car has little value [A.10]. The AX-600 Turbo should fit into the price range of its competitors, unless it has some outstanding feature that would make it cost significantly more or less.

However, there really are no actual competitors that exist in this market as of now. Aside from drastically different high performance vehicles, the closest comparison would be vehicles in the A Modified class, which are more than double the price guideline set by the rules of the competition [A.2]. So, in order to determine the best price for the AX-600 Turbo, we must rely more on manufacturing aspects, the overall value of the car, as well as customer's needs.

From the cost report, it has been established that it costs $6,800 to manufacture the AX-600 Turbo per unit in mass quantity. Also, the vehicle is quite valuable as is noted by the new and improved features of the 2000 model, and the satisfaction and freedom the customer receives as a result of owning the racecar. The price of the car must also cover the transportation costs of delivering it to the dealerships across the nation, and the costs of labor, as well as storage fees and equipment costs.

Having a Warranty for our product also introduces another type of cost. Assuming that occasionally, parts will fail as a result of factory imperfections, WPI Motorsports must be prepared to cover those mishaps at no extra cost to the customer, to maintain a good relationship with our buyers. Although many incidents are not covered by our warranty, issues may arise where we will have to take parts out of stock, which will decrease inventory. The price of the AX-600 must compensate for these potential occurrences.

Demand and perceived notions of the consumer also affect the suggested retail price of the AX-600 Turbo. If demand for our product goes up, so should the price. That is, if Solo II racing becomes more popular, which is our goal, customers will be willing to

pay more for the car. However, if the cars are not selling well, the price must be lowered to make sure WPI Motorsports at least breaks even. Lastly, perceived notions of the customer play a role in pricing the AX-600 Turbo. Customers feel that when they pay several thousand dollars for a product, it is well worth the value [A.10]. Likewise, when the price of a product ends in "99" rather than "00" consumers instinctively feel that they are getting a better deal. However, in our case, the price will end in "00" because higher priced products are sometimes perceived as inferior when priced ending in "99" [A.10]. All things considered, The 2000 AX-600 Turbo will be priced at $8200. With this markup, WPI Motorsports will realize a profit of .5 to 1.2 million dollars. This profit will be more than enough to compensate fore the aforementioned costs of doing business.

Support and Service Plan:

The WPI FSAE Racing Division will provide support through means such as: a customer service hotline, 1.800.WPI.FSAE, contact through e-mail, fsae@wpi.edu, and distributor support, where available. In addition, WPI will provide customers with manufacturer contact information for parts that have been outsourced.

Appendix B

The Marketing Materials

You'll find copies of our printed marketing materials in the following order.

1. Color Brochure
1. Poster Design #1
2. Poster Design #2
3. Magazine/ Newspaper Advertisement

Also included, is a copy of our commercial, and web page on CD-Rom

WPI

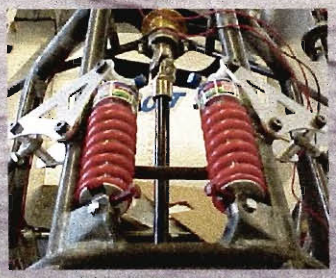
Motorsports

FSAE RACING DIVISION

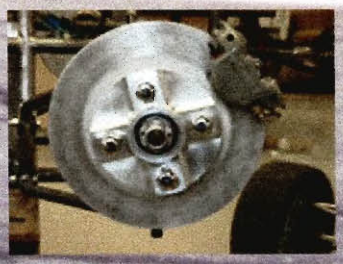
AX600 TURBO

WPI ... Committed to Engineering Excellence Since 1865

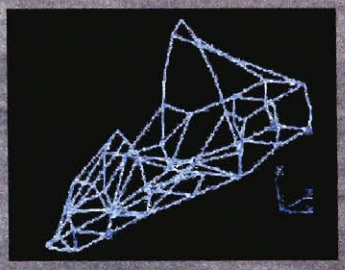
WPI FSAE Race Techn



Performance Tuned Suspension
Lightweight heavy-duty shocks provide all the necessary responsiveness and control needed for racing on the autocross circuit.



Front and Rear Disc Brakes
Our brakes incorporate lightweight calipers and rotors designed to take on any braking need under any condition.



CRO-MOLY Frame
Designed to provide many years of service under the harshest racing conditions. This frame has been designed to give the driver maximum protection in case of collision.

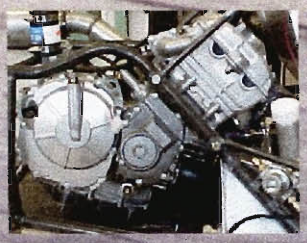
Turbo and Intercooler
This year's model contains a turbo and a special WPI designed intercooler to yield more than enough power for any racer. In testing our intercooler is has a much better performance to cost ratio than any commercially available model.

Other Features:

- Multiple Seat Options
- Differential
- Traction Control
- Quick Shift System

NOLOGY AND INNOVATIONS

IMPROVED ELECTRONIC FUEL INJECTION
IS ONLY ONE OF THE MANY HIGH QUALITY ELECTRONIC SYSTEMS INCORPORATED TO MAKE SURE YOU REACH THE FINISH LINE FIRST.



600CC HONDA ENGINE
OFF OF THE HONDA CBR MOTORCYCLE, REQUIRED ADDITION OF TRACTION CONTROL TO REDUCE WHEEL SPIN

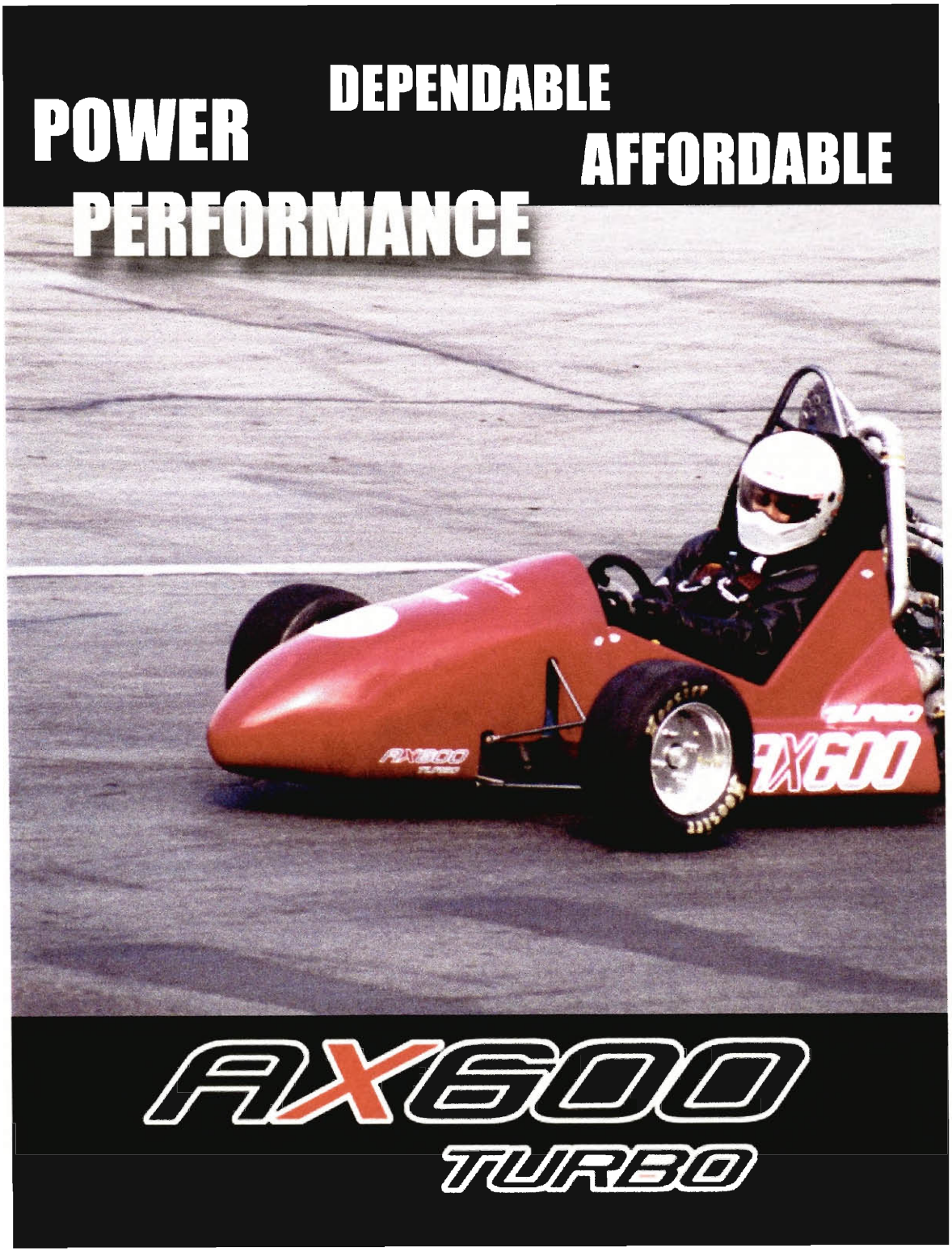
ERGONOMIC DESIGN
THE WPI AX600 IS DESIGNED AROUND THE DRIVER, NOT JUST TO SATISFY THEIR NEED FOR SPEED BUT TO LET THEM DO IT IN A MANNER THAT IS COMFORTABLE AND SAFE. SUCH DESIGN FEATURES INCLUDE OUR SPECIAL FORM FITTING SEAT, MOVABLE PEDALS, AND A WELL LAID OUT DASHBOARD.

EASY TO MAINTAIN
DESIGNED TO BE EASY TO MAINTAIN, THE WPI AX600 AUTOCROSS RACER REQUIRES A MINIMAL TOOL KIT TO MAINTAIN AND REPAIR. THIS IS DONE BY STANDARDIZING FASTENER TYPES WHENEVER POSSIBLE.

WPI

Motorsports

FSAE RACING DIVISION


POWER
DEPENDABLE
AFFORDABLE
PERFORMANCE
AX600
TURBO

Options and Accessories

2000 WPI Formula Autocross Racer

Specifications:

Horsepower	120 hp	Intercooler	Custom (27% efficient)
Torque	47 ft-lbs	Weight (w/ fluids)	510 lbs.
0-60 mph	3.35 sec.	Wheelbase	70.5 in.
300 ft. Drag Time	4.60 sec.	Ground Clearance	3.25 in.
Braking 60-0 mph	82 ft.	Track Width	52/52 in. (F/R)
Lateral G's	1.33 G	Weight Distribution	40:60 (F/R)
Top Speed	80 mph	Tires	Hoosier 10" Slicks
Engine	Honda CBR 600 F3	Brakes	Wilwood Dynalite
Displacement	599 cc	Differential	Zexel Torsen Limited Slip
Compression Ratio	12:1	Suspension	Rock Shox Deluxe
Transmission	6-speed QSS	Frame Type	Tubular Space Frame
Ignition	Dyna 2000 Electronic	Fuel Capacity	2 gal.
Turbocharger	Garret T2 (7 psi boost)	Steering Rack	Bailley Chassis Mini Baja

One Year Basic/ 18 Month Powertrain Warranty

The WPI Formula Autocross Racer comes with a one year basic coverage and 18 month/unlimited hours powertrain warranty. The warranty covers transmission and drivetrain.

Race With Zero Down

We offer 100% instant financing on the WPI Formula Autocross Racer with the WPI Credit Plan. Qualified buyers can race a WPI AX600 with no money down. In most cases computerized credit approval takes only minutes. Contact the WPI Mototrsports Financing Department for more details.

Race With Safety

The WPI Autocross Racer is not a toy. This vehicle is designed to pull extreme G-forces and rapid acceleration. Reckless driving can cause injury or even death. Always fasten the seatbelt harness, wear a certified helmet, and eye protection.

WARNING: This vehicle is NOT intended for street use. It is ILLEGAL to operate this vehicle off of the race track.

WPI
Motorsports
FSAE RACING DIVISION

100 Institute Road
Worcester, MA 01609-2280
Phone: 1-800-WPI-FSAE
Fax: 1-508-831-5860
E-mail: fsae@wpi.edu
WWW: http://fsae.wpi.edu

POWER DEPENDABLE AFFORDABLE PERFORMANCE

AX600 TURBO

WPI
Motorsports
FSAE RACING DIVISION

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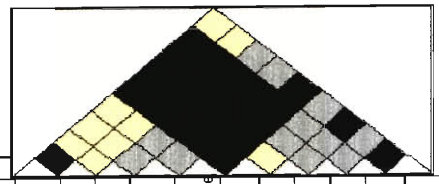
E-mail: fsae@wpi.edu
WWW: http://fsae.wpi.edu

Appendix C

The Design for Manufacturing

1. The Quality House

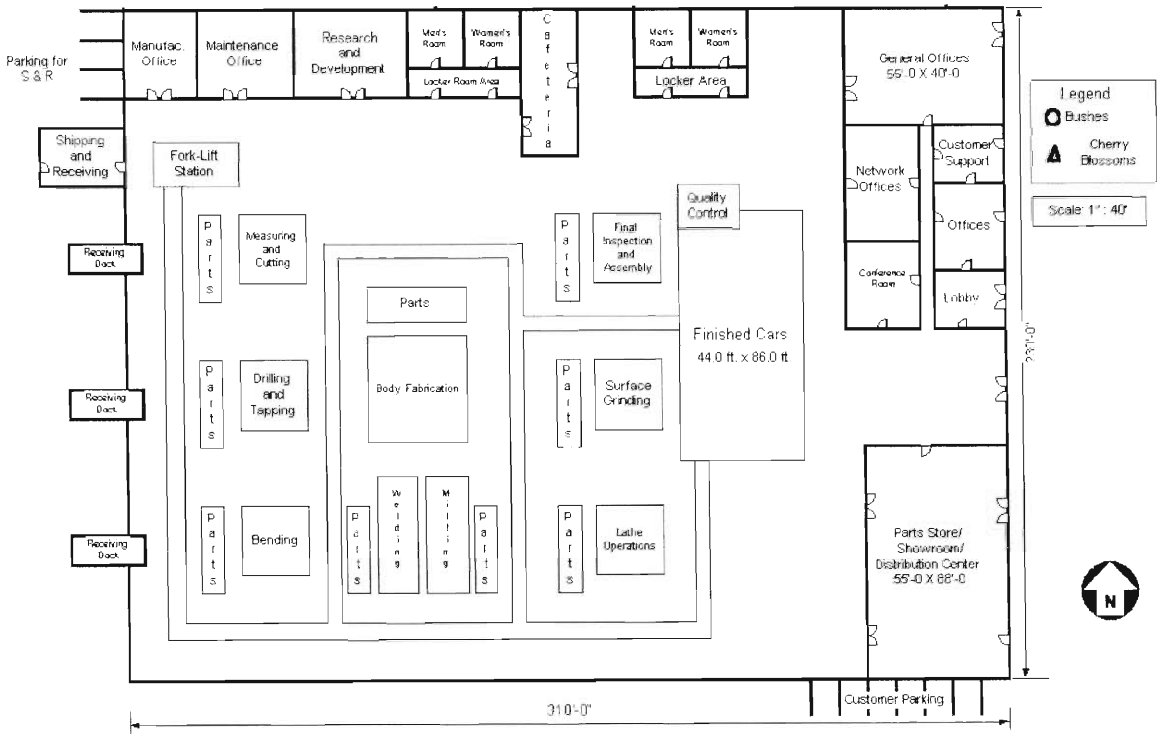
2. The Plant Layout



Strong Correlation
Moderate Correlation
Weak Correlation

Technicla Requirements		Weight	Braking	Acceleration	Slalom Performance	Skidpad Performance	Assembly Quality	Engine Access	Wrench Clearance	Adjustability	Crashworthiness		Rate of Importance	2000 Entry	Competitor X	Competitor Y	Plan	Ratio of Improvement	Sales Point	Absolute Weight	Demanded Weight	
Customer Requirements	Handling	9	3	3	9	9	1	0	0	0	3		5	4	4	5	5	1.25	1.50	9.38	27%	
		261	87	87	261	261	29	0	0	0	87											
	Braking	3	9	1	3	9	0	0	0	0	1		4	4	4	4	5	1.25	1.50	7.50	22%	
		72	216	24	72	216	0	0	0	0	24											
	Acceleration	9	1	9	9	9	0	0	0	0	0		4	5	4	3	4	0.80	1.50	4.80	14%	
		135	15	135	135	135	0	0	0	0	0											
	Ease of Maintenance	3	0	0	0	0	3	9	9	9	3		4	4	4	4	4	1.00	1.20	4.80	14%	
		45	0	0	0	0	45	135	135	135	45											
	Power to Weight Ratio	9	0	3	3	3	0	0	0	0	1		3	4	4	3	3	0.75	1.20	2.70	8%	
		72	0	24	24	24	0	0	0	0	8											
	Competitiveness	3	3	3	9	9	3	3	3	3	3		3	4	4	4	3	0.75	1.20	2.70	8%	
		24	24	24	72	72	24	24	24	24	24											
	Reliability	0	0	0	1	1	9	0	0	0	9		3	4	4	4	3	0.75	1.20	2.70	8%	
		0	0	0	13	13	117	0	0	0	117									34.58	100%	Total
	Total	36	16	19	34	40	16	12	12	12	20	217										
	%	17%	7%	9%	16%	18%	7%	6%	6%	6%	9%	100%										

2000 FSAE House of Quality Table


Parking for S & R
Manufac. Office
Maintenance Office
Research and Development
Men's Room
Women's Room
Locker Room Area
Cafeteria
Men's Room
Women's Room
Locker Area
General Offices 55'-0 X 40'-0
Legend
Bushes
Cherry Blossoms
Scale: 1" : 40'
Shipping and Receiving
Fork-Lift Station
Network Offices
Customer Support
Offices
Conference Room
Lobby
Quality Control
Receiving Dock
Parts
Measuring and Cutting
Parts
Drilling and Tapping
Parts
Bending
Parts
Body Fabrication
Parts
Welding
Parts
Milling
Parts
Final Inspection and Assembly
Parts
Surface Grinding
Parts
Lathe Operations
Finished Cars
44.0 ft. x 86.0 ft.
Parts Store/ Showroom/ Distribution Center 55'-0 X 66'-0
297'-0"
310'-0"
Customer Parking
N

Appendix D

The AX600 Turbo Warranty

2000 WPI FSAE AX600 Warranty

Basic Coverage: The basic coverage period is 12 months. This warranty covers any repairs needed to Correct defects in materials or workmanship of all parts and components of each AX600 except for those specifically stated under the caption: WHAT IS NOT COVERED."

Powertrain Coverage: The powertrain coverage is 18 months. This warranty covers all of the repairs included in the basic coverage, plus the additional engine, transmissions and drivetrain. This coverage does not include the components listed under the caption, "WHAT IS NOT COVERED."

WHAT IS NOT COVERED:

- Damage, Failures or Corrosion due to Accidents, Misuse or Alterations.
- Any vehicle where the Odometer has been altered.
- Damage, Failures, or Corrosion from Environmental conditions.
- Damage, Failures, or Corrosion due to lack of or improper maintenance.

ORIGINAL EQUIPMENT WARRANTIES

The warrantor of many of the components of the WPI FSAE AX600 is not WPI FSAE, however, the warrantor for each of the components is listed below.

- Hoosier Tires
- Garrett TurboChargers
- Honda
- Haltech
- Dyna-2000 Digital Ignition module
- Rock Shox
- Geo
- Wildwood Dynalite calipers
- Complete list is available from WPI Motorsports

Appendix E

The Presentation Event Outline, Guidelines, and Checklist for Setup and Presenting

Outline

I. Setup and Pre-presentation

a. David and Jake setup the LCD, T.V., VCR, laptops and overhead projector.

b. George will set up the video camera.

c. Jon and George familiarize the Judges with our marketing materials within the presentation folder and let them browse our web-page. The folder is divided into two sides, one for marketing materials, and the other for manufacturing. One left hand side, the marketing side; there will be a copy of the brochure, magazine ad, several designs, warranty, and liability release. The right hand side will contain the following manufacturing materials: a quality house, a plant layout, takt time information sheet, lean manufacturing design chart, design methodology, manufacturing schedule, and a sheet explaining the advantages of SEER/DFM.

II. Introductions

a. Group members: Jon Suchecki, George Enriquez, David Henry, Jacob Coolberth, Vinod Tilak, Chris Lashua, and Mike Baran

b. Outline of presentation

III. Identifying The Target Market

a. Location

b. Demographics

IV. Customer Satisfaction Criteria

a. Customer needs, point to each bullet

b. New and improved features to meet those needs, point to each bullet

V. Specifications of the AX-600 – Point to each spec.

VI. The Marketing Campaign

a. Refer the judges to our marketing materials

b. Show commercial

VII. Cost analyisis

a. Define profit made

VIII. Warranty and Support Services

a. Web page

b. Dealerships graphic, point to map

IX. Financing Options

X. Conclusion

a. Why WPI Motorsports

b. Why the AX-600

c. Introduce Vinod

Checklist for Presentation

Qty.	Description
3	Laptops
	2 for presenting

	1 for showing web page
1	LCD Projector
1	Overhead Projector
1	VCR
1	Set of printed backup slides
2	Extension cords
2	Surge suppressors
4/5	Presentation folders with
	Magazine Advertisement
	(2) Posters
	Brochure
1	Copy of MQP
7	Polo shirts
1	Printer (left in hotel room)

Guidelines for Setup

Before entering conference room

1. start up laptops #1, #2, and #3 (George and David)
2. untangle cords (Jake)
3. unpack folders and confirm all contents in place (Jon)

Once in conference room

1 plug in extension cord (Jake)

2 place laptop #3 in front of judges, explaining about web page (Jon)

3 hand folders to judges or place at their locations (Jon)

4 place overhead on table and place backup slides next to it (Jake)

5 set up laptop #1, #2 and LCD projector (David)

6 Set up video camera and tripod (George)

7 Place set of materials at podium/front of room (Jon)

8 Set up VCR (cue tape, sound check) (David)

9 Ready on lights (if needed) (Jake or George)

10 Start Presentation

Appendix F

Meetings with Dick Parkinson

The meeting with Dick Parkinson was a great learning tool in helping us improve our presentation for the FSAE competition. Mr. Parkinson let us use his conference room to get the actual feeling of presenting in a large room with many people. After showing him our presentation, he commented on all the aspects that can be improved.

His first comment was for us to interact with the slides that we made. Instead of standing in front of the slides, we should use the slides to our advantage, possibly using a laser pointer with them. One problem missing in a few of our slides was the sources we obtained the information from. We should either mention them in the slide or say where this information was gathered. He noticed that there was a slight pause in between the slides and these few seconds add up in such a short presentation.

Another problem we had was our use of graphics on the slide. They were either too small or missing from the slide. We need a picture of a map that would display our dealership locations and demographics. For improving the layout of our customer wants, he suggested placing a pie chart instead of percentages so it would be more appealing to the eye.

The final problem we had was the order of our slides. He suggested that after showing the new product and TV commercial, we should then talk about financing options, which would lead into the warranty, and end with the cost of the car. This ties in well with the manufacturing group that goes after the marketing group.

Mr. Parkinson provided us help in each of the seven times we visited him in his office. Once our presentation was finally running smoothly, we began practicing the entire presentation, which includes the manufacturing segment. Each of our visits helped polish our presentation and to prepare for the competition in Detroit.

We thank Mr. Parkinson for his time and comments that have shown to greatly improve the presentation and our project entirely.

Appendix G

AX600 Series Owner's Manual

Pit and Repair/Maintenance Bay Reference

Fuel Selection
Turbocharged Engine:
Normally Aspirated:

Engine Oil –
SAE Preferred for racing between 40-60 degrees F
SAE Preferred for racing between 60-100 degrees F

Fluid Capacities
Fuel: 1.9 gal
Cooling System: 2 qt.
Engine Oil w/o filter change: 2 qt.
Engine Oil w/ filter change: 2.5 qt.

Engine Info
Oil Filter:
Spark Plug Gap:
Spark Plug:
Firing Order:
Ignition Timing:

Tires
Hoosier or Equivalent Racing Slicks
Size Front:
Size Rear:

Brakes:
Pad type:
Pad Size:

WPI
Motorsports
FSAE RACING DIVISION

00-734-1432 4-5 Printed in USA

WPI

Motorsports

FSAE RACING DIVISION

AX600 TURBO

OWNER'S MANUAL

2000

Introduction

This manual has been prepared with the assistance of our service and engineering teams to instruct you with the proper maintenance and operation of you new WPI Motorsports vehicle. Your vehicle comes with a limited warranty, the information about this warranty is supplied in a separate booklet as well in other various locations. Following the instructions in this manual will make sure your vehicle is in ideal racing condition and will make your driving more enjoyable.

After reading through this manual, please store in a location convenient to your storage or repair area for the vehicle. This manual must be included with the vehicle should it be sold.

Should you be unable to make a repair or adjustment, feel free to contact WPI Motorsports or a WPI Motorsports authorized repair location. They can supply parts, advice, or do the repair or adjustment for you.

How To Use This Manual

Consult the table of contents to determine which section contains the information you need.

Throughout this manual the words **WARNING** and **CAUTION** and **ADVISORY** appear. These serve as reminders to be especially careful and attentive to what you are doing. Failure to follow instructions could cause you or the vehicle harm.

A complete index of topics is in the back of this manual.

WPI Motorsports, 2000

TABLE OF CONTENTS

DRIVING AND ALCOHOL

Drunken driving is a frequent cause of motor-vehicle accidents.

Your driving ability can be seriously impaired by drinking any amount of alcohol, as such it is unsafe to drive you vehicle in a race or in general after consuming alcohol.

WARNING Driving after drinking can
Lead to an accident. Your perceptions
Are less sharp, your reflexes are
Slower, and your judgement is impaired
When you have been drinking.
Never drink and then drive.

DRIVE ON APPROVED RACE TRACKS

It is illegal to operate this vehicle on city, town, and state roads, highways, and trails. You may only use this vehicle on approved race tracks, use in any other location may lead to fines, jail time, and or seizure of vehicle.

SECTION 1

BEFORE STARTING YOUR VEHICLE

CONTENTS

Steering Wheel Quick Release

Your WPI Motorsports vehicle comes equipped with a steering wheel quick release mechanism to aid in the entry and exit of the vehicle. You should familiarize yourself with the mechanism as its proper use can greatly speed up exit time from the vehicle in case of emergency.

Steering Wheel Quick Release Operation:
To use the quick release device is relatively simple, as shown in the pictures below

1: reach behind steering wheel
2: pull release lever towards you
3: continue holding the lever and pull the steering wheel towards you
4: release lever and pull the steering wheel off

To reinstall the steering wheel, merely match the mark on the wheel up with that on the post and push the steering wheel into position.

Safety Harness

Always use your harness. The chance of serious injury is greatly reduced when your safety harness is used. Properly used, the safety harness will provide protection from being thrown from the vehicle and from striking the interior of the vehicle.

Your vehicle is equipped with a 5 point safety harness with quick release buckle. This should be adjusted to restrict all unnecessary movement while driving, e.g. you should be able to reach the controls comfortable, but not be able to bend forward more than a few inches. The harness is directly connected to the frame of the vehicle without any inertial reel locks to provide maximum rigidity in the retention system.

Before driving the vehicle in races, you should practice getting out of the harness as quickly as possible. Should an emergency situation arise during racing, this practice can mean the difference between life and death.

4

PRE-RACE CHECKLIST

1) All Fasteners In Place ____ 2) All Fasteners Tightened _____

3) Check Hoses for leaks ____ 4) Check Fluid Levels _____

5) Check Harness ____ 6) Check Tire Pressure _____

7)

Appendix H

Contract and Waiver for Purchasing WPI Motorsports Products

While doing our research at extreme sports vehicle dealerships, we have found out that people buying extreme sports vehicles make the buyer sign a waiver releasing the dealership and vehicle manufacturer from liability of injury or death with the exception of in most cases some kind of manufacturing defect, usually gross defect. As such, we at WPI Motorsports have decided to make a similar waiver and combine it with a secondary purchase contract that each buyer must sign before the car is turned over to them. In the case of online purchases, the buyer must check an agreement box on the order form otherwise the order will not be processed. A copy of our contract is below:

Contract and Waiver for Purchaser of WPI Motorsports Products

THIS IS A RELEASE OF LIABILITY AND PAYMENT CONTRACT - READ BEFORE SIGNING NOTE: THIS FORM MUST BE READ AND SIGNED BEFORE THE PARTICIPANT IS ALLOWED TO TAKE OWNERSHIP OF A WPI MOTORSPORTS VEHICLE.

This document is a contract between the undersigned purchaser(s) and WPI Motorsports. By agreeing to this contract, the undersigned do hereby acknowledge the following:

1) Sports Car racing is a dangerous activity that can lead to injury or death. It requires the proper use of safety equipment and driving techniques. By signing this document, I do hereby acknowledge this fact and do hereby release WPI Motorsports from any liability for death or injury as a result of racing or other work pertaining to the vehicle purchased from WPI Motorsports. As the purchaser I reaffirm the fact that I have read this statement by affixing my initials here: _____ and by placing the date here: _____
2) I KNOWINGLY AND FREELY ASSUME ALL SUCH RISKS, both known and unknown, EVEN IF ARISING FROM THE NEGLIGENCE of those persons released From liability below, and assume full responsibility for the use and actions of me and the aforementioned WPI Motorsports product.
3) Sports Car racing is a demanding sport of both the driver and equipment, as such I acknowledge that the warranty included with my purchase of a vehicle from WPI Motorsports is limited under, but not limited to, the condition that the vehicle is properly maintained and certain systems as stipulated in the warranty remain stock/un-tampered with.
4) I acknowledge that it is illegal to operate this vehicle off of a legally recognized racetrack and as such acknowledge that use in other locations can result in arrest with fines or internment as possible consequence(s).

5) I, for myself and on behalf of my heirs, assigns, personal representatives and next of kin, HEREBY RELEASE AND HOLD HARMLESS WPI Motorsports, WPI Motorsports FSAE Racing Division , the Designers and Builders of the product I am purchasing, their officers, officials, agents and/or employees ("Releasees"), WITH RESPECT TO ANY AND ALL INJURY, DISABILITY, DEATH, or loss or damage to person or property, WHETHER CAUSED BY THE NEGLIGENCE OF THE RELEASEES OR OTHERWISE, except that which is the result of gross negligence and/or wanton misconduct.
6) I/we acknowledge the fact that a car is an expensive purchase and as such agree to follow the payment plan if any which is laid out below:

(circle one) Purchase/Payment Plan Term: _____ Down Payment: _____

APR: _____ Security Deposit: _____ Monthly Payment: _____

Vehicle Serial Number: _____

I HAVE READ THIS RELEASE OF LIABILITY AND ASSUMPTION OF RISK AND PAYMENT AGREEMENT, FULLY UNDERSTAND ITS TERMS, UNDERSTAND THAT I HAVE GIVEN UP SUBSTANTIAL RIGHTS BY SIGNING IT, AND SIGN IT FREELY AND VOUNTARILY WITHOUT ANY INDUCEMENT.

Signature: _____ Date: _____

Name (print clearly): _____

Address : _____

Sales Representative/Witness:

Signature: _____ Date: _____

Name (print clearly): _____

Appendix I

Rules and Updates for the Presentation Event

4.5 Presentation Event (numbering as per FSAE rule book)

4.5.1 Presentation Event Objective

The concept of the presentation event is to evaluate the team's ability to make a presentation to the customer. The presentation should address the "Concept of the Competition" as described in section 1, and should convince the customer of the superiority of the team's design. The presentation judges will evaluate the organization, content, and delivery of the presentation. The team that makes the best presentation (regardless of the quality of the car) will win the event.

4.5.2 Presentation Schedule

Presentation will be made on the first day of the event. The presentation time will be randomly selected and will be posted in conjunction with the organizational meeting held in the morning. A team will receive zero (0) presentation points if they fail to make their presentation during the allotted period.

4.5.3 Presentation Format

One (or more) team member(s) will give the presentation to the judging team. The organizer will provide details regarding the presentation in the newsletter. The presentation cannot last more than 10 minutes and should not be interrupted by questions. After the presentation, there will be approximately 5 minutes of questions. Only judges

are permitted to ask questions. The audience may not ask questions or make any comments or distractions. During the question period, team members are encouraged to answer questions.

4.5.4 Evaluation Criteria

The presentation judges will consider the content, organization, and delivery of the presentation and will only evaluate the team's ability to give a presentation. The judges will use the judging form given in Appendix A-6.

4.5.5 Scoring Formula

The scoring of the event is based on the average of the two or three presentation judging forms. There is a maximum of 50 points from the Presentation Judging Form.

PRESENTATION SCORE = 75 * P your /P max

It is intended that the scores will range from near zero (0) to seventy-five (75) to provide good separation.

Updates from SAE

From: KatKlauz@aol.com

Date: Mon, 1 May 2000 16:35:32 EDT

Subject: [FSAE:670] FORMULA SAE PRESENTATION EVENT DESCRIPTION

To: fsae@smash.gatech.edu

X-Mailer: AOL 4.0 for Windows 95 sub 102

Sender: owner-fsae@smash.gatech.edu

All:

The following is the information for the 2000 FSAE Presentation Event.

Best Regards,

Kathleen McDonald

FSAE Coordinator

Date: Thursday, May 18, 2000

Location: DaimlerChrysler FREC Bldg. - Auburn Hills

Overview:

After a year of planning, fabricating, and testing a new, prototype vehicle, the team aspires to sell their vehicle design to a make-believe racing manufacturer. The competitors in this event will be judged on their ability to create and deliver a presentation that clearly explains the merits of their design. The winner of the event will score 75 points.

The Presentation:

Competitors are to make a presentation to upper level executives of an imaginary manufacturer. The presentation should tie together all factors that would influence the marketability and manufacturability of their design. The technical aspects of the vehicle

design should be presented to reinforce or support performance claims. The competitors should show an understanding of the marketplace and the targeted customer, and show how their design fits into its expected market. Competitors must convince the judges that their prototype represents a profitable enterprise for the manufacturer.

The Vehicle:

The racecar is designed for the nonprofessional weekend autocrosser. It should have high performance characteristics in handling, accelerating, and braking. Knowledge of the customer should dictate a design that is a compromise between cost and performance while also being safe, reliable and easy to maintain. The car's marketability is enhanced by other factors such as aesthetics, comfort, use of common parts, and high tech features. All of the vehicles are required to conform to safety regulations as defined in the FSAE rulebook. The goal is to produce 4 cars per day for a limited production run and the prototype vehicle should actually cost below $30,000.

Presentation Tips from Previous Experience:

1) Spell check all overheads, handouts, slides, etc.

2) There is no dress code; however, bad first impressions are difficult to remedy.

3) Remember that equipment has been known to fail, copies can be ruined in transit, etc. Consider other alternatives in case something should go wrong.

4) Have someone from your team video your presentation and the judges' comments afterward for your team's future FSAE efforts.

5) The most technically knowledgeable person on the team may not be the best person to lead the presentation team. Choose someone who is charismatic and good at public speaking.

Equipment Provided:

The organizers will provide the following equipment in each conference room:

1) TV/VRC

2) Slide Projector

3) Overhead Projector

4) Screen

No other AV equipment will be provided. It is the responsibility of any team who wishes to use more sophisticated equipment to provide said equipment themselves.

Shuttle Service:

Due to limited parking at the DaimlerChrysler FREC Building, shuttle service will be provided to and from the presentation site. The particulars will be covered at the Captains' Meeting Wednesday evening at the Silverdome. The shuttle stop will likely be located near the event site entrance (outside of the snow fencing), near the practice tracks. In the event that this location changes, teams will be notified Wednesday evening. DO NOT GO TO THE LARGE BLUE SHUTTLE SIGN ON THE BACK FENCE OF THE PARKING LOT. IT HAS NOTHING TO DO WITH THE FSAE EVENT.

The Event:

The event takes place on the first day of the competition. Each competitor will be assigned a time and a location. The competing school will choose one or more members to make a presentation that will last no longer than ten minutes. A five-minute question and answer period will follow the presentation. Only judges may ask questions during this time. The audience (usually team members) may not ask questions, make comments, or create distractions. During the questioning period, only presenters are allowed to answer questions.

A team of two or three judges will grade the competitors. The judges will use the form in Appendix A-6 of the FSAE rules for event scoring. This form breaks the scoring down into five equally weighted categories: Content, Organization, Visual Aids, Delivery, and Q&A period. A perfect score on the judges' form will be 50 points. The scores for a team of judges will be averaged together. There will be seven judging teams, so each team will only judge 15% of the total competitors. The judges' combined score may be adjusted because some judging teams may grade, on an average, higher or lower than other judging teams. The competitor's final score will be calculated using the following equation:

PRESENTATION SCORE = 75 * Pteam /Pmax

It is intended that the scores will range from near zero (0) to seventy-five (75) in order to provide good separation. If a team misses their allocated period, the team will receive

zero (0) Presentation points. The team that makes the best Engineering Presentation (regardless of the quality of the car) will win the event.

Judging Guidelines:

1. Judge only the presentation aspects of this event. Don't get caught up in the details of the design or cost. Judge only how well the team presented their design.

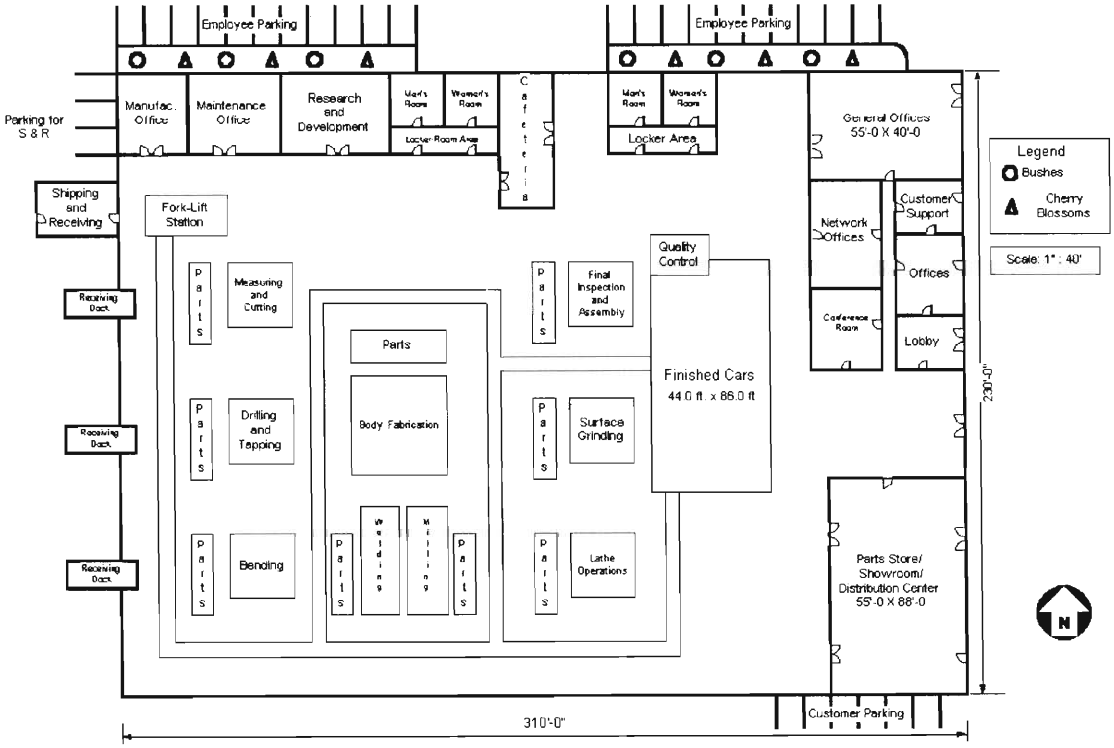
2. Don't interrupt the students' presentation. Wait until they are finished to ask questions.

3. The question period is strictly 5 minutes or less.

4. Make sure that the presentation is graded immediately after the team leaves the room

Appendix J

Manufacturing



Factory Layout

Appendix K

Vehicle Distribution

Table K.1 Vehicle Distribution

Dealership Location	# of SCCA Members	# of Cars Per Year	Racing Season	Weeks	Cars Per Week
Worcester, MA	6252	58	Jun. 10 to Oct. 8	17	3.4
Washington, DC	5253	50	Jun. 10 to Oct. 8	17	0.3
Atlanta, GA	4,109	35	Feb. 26 to Nov. 19	39	0.9
Orlando, FL	5177	42	Feb. 26 to Nov. 19	39	1
Columbus, OH	3,793	35	Mar. 4 to Oct. 29	34	1
Detroit, MI	3693	35	Mar. 4 to Oct. 29	34	1.1
Chicago, IL	3840	35	Mar. 4 to Oct. 29	34	1
Rogers, MN	1292	15	Mar. 4 to Oct. 29	34	0.5
Tulsa, OK	1406	15	Feb. 5 to Nov. 19	42	0.35
Saint Louis, MO	1842	18	Feb. 5 to Nov. 19	42	0.5
Houston, TX	2746	25	Jun.3 to Oct. 29	21	1.2
Denver, CO	1991	20	Mar. 4 to Oct. 29	34	0.6
Portland, OR	2675	25	Mar. 4 to Oct. 29	34	0.7
San Francisco, CA	4850	45	Mar. 4 to Oct. 29	34	1.3
Buttonwillow, CA	3565	35	Feb. 27 to Nov. 5	37	0.1
Avondale, AZ	1043	12	Feb. 27 to Nov. 5	37	0.3
		500			

Appendix L

Presentation Event Results

Marketing Presentation

Enclosed in this appendix are the judge's scores from the 2000 FSAE Presentation Event. This year resulted in a tie for first place with Rochester Institute of Technology. There were three judges for the Presentation Event, two being male and one female. Two of the judges gave high scores of 49. The third judge was overwhelmed with our website that he spent most of the presentation looking through it. He coincidentally gave the lowest score, giving a 9 for visual aid and delivery. It was interesting to find that the times for our presentation varied between 8 minutes and 12 minutes. One comment that stood out was that some speakers spoke too fast. In practicing for our presentation, it has been timed to utilize the full 10 minutes including the commercial. After reviewing the presentation on tape, the presentation took exactly 9 minutes and 45 seconds including the commercial. This means that each judge started to time it at different times. The 2001 Presentation Event group should take these comments from the judges along with the future recommendations into consideration.

Included in this appendix are the overall results for the 2000 FSAE Presentation Event. Worcester Polytechnic Institute and Rochester Institute of Technology were tied for first place out of 104 schools that participated. The presentation event was maximum of 75 points towards each teams overall score.

JUDGE TEAM NUMBER 5 JUDGE INITIALS NLS TIME 8 minutes

SCHOOL Worchester Polytechnic CAR NUMBER 600

PRESENTATION JUDGING

Score the following categories on the basis of 0-10 points each according to the following scale (any number or fraction along this scale may be used).

0.0	=	inadequate or no attempt
2.5	=	attempted but below expectation
5	=	average or expected
7.5	=	above average but still lacking
10	=	excellent, perfectly meets intent

10 **CONTENT:** Were the concepts presented appropriate and adequate to explain how the car meets the intent of the customer? Were enough technical details presented without being boring?

10 **ORGANIZATION:** Were the concepts presented in a logical order progressing from basic concept and showing how the engineering accomplished the concept? Was it clear to the audience what was to be presented and what was coming next? Were distinct introduction and overviews as well as summary and conclusions given?

9.5 **VISUAL AIDS:** Were visual aids used or clear visual references made to the car? Were the illustrations visible for all of the audience?

9.5 **DELIVERY:** Did the presenter speak in a clear voice? Did the presenter show enthusiasm and promote confidence in the technical aspects? Did he maintain eye contact?

10 **QUESTIONS:** Did the answer illustrate that the team fully understood the question? Is there doubt that the team understood the answer? Did the team promote complete confidence in their response to the questions?

49 **TOTAL = PRESENTATION POINTS (50 points maximum)**

COMMENTS: Some speakers spoke too fast. Given that you didn't use up the entire 10 minutes, they could have spoken slower

JUDGE TEAM NUMBER 5 JUDGE INITIALS AR TIME 1:58 - 2:10

SCHOOL WORCHESTER POLY CAR NUMBER 600

PRESENTATION JUDGING

Score the following categories on the basis of 0-10 points each according to the following scale (any number or fraction along this scale may be used).

0.0	=	inadequate or no attempt
2.5	=	attempted but below expectation
5	=	average or expected
7.5	=	above average but still lacking
10	=	excellent, perfectly meets intent

10 **CONTENT:** Were the concepts presented appropriate and adequate to explain how the car meets the intent of the customer? Were enough technical details presented without being boring?

10 **ORGANIZATION:** Were the concepts presented in a logical order progressing from basic concept and showing how the engineering accomplished the concept? Was it clear to the audience what was to be presented and what was coming next? Were distinct introduction and overviews as well as summary and conclusions given?

9.5 **VISUAL AIDS:** Were visual aids used or clear visual references made to the car? Were the illustrations visible for all of the audience?

9.5 **DELIVERY:** Did the presenter speak in a clear voice? Did the presenter show enthusiasm and promote confidence in the technical aspects? Did he maintain eye contact?

10 **QUESTIONS:** Did the answer illustrate that the team fully understood the question? Is there doubt that the team understood the answer? Did the team promote complete confidence in their response to the questions?

49 **TOTAL = PRESENTATION POINTS (50 points maximum)**

COMMENTS: THE BEST - THEY HIT EVERY OBJECTIVE
DELIVERY JUST A LITTLE FAST, ONE VERY
MINOR AUDIO/VISUAL GLITCH.

JUDGE TEAM NUMBER 5 JUDGE INITIALS _____ TIME 2:02 - 2:10
8 min

SCHOOL WPI CAR NUMBER 600

PRESENTATION JUDGING

Score the following categories on the basis of 0-10 points each according to the following scale (any number or fraction along this scale may be used).

Intro ✓
agenda ✓

0.0	=	inadequate or no attempt
2.5	=	attempted but below expectation
5	=	average or expected
7.5	=	above average but still lacking
10	=	excellent, perfectly meets intent

10 **CONTENT:** Were the concepts presented appropriate and adequate to explain how the car meets the intent of the customer? Were enough technical details presented without being boring?

10 **ORGANIZATION:** Were the concepts presented in a logical order progressing from basic concept and showing how the engineering accomplished the concept? Was it clear to the audience what was to be presented and what was coming next? Were distinct introduction and overviews as well as summary and conclusions given?

9 **VISUAL AIDS:** Were visual aids used or clear visual references made to the car? Were the illustrations visible for all of the audience?

9 **DELIVERY:** Did the presenter speak in a clear voice? Did the presenter show enthusiasm and promote confidence in the technical aspects? Did he maintain eye contact? Too Fast

10 **QUESTIONS:** Did the answer illustrate that the team fully understood the question? Is there doubt that the team understood the answer? Did the team promote complete confidence in their response to the questions?

48 **TOTAL = PRESENTATION POINTS (50 points maximum)**

COMMENTS: website

Overpowering

Did too much too fast

2000 Results

Place	Car No.	Team	Cost Score	Presentation Score	Design Score	Acceleration Score	Skid Pad Score	Autocross Score	Endurance-Economy Score	Total Score
1	12	Texas A&M University	76.52	66.64	125	68.12	0	150	355.96	842.232
2	46	University of Wisconsin, Madison	84.39	56.49	135	67.59	0	108.07	338.3	789.83
3	77	Cal Poly Pomona	67.49	51.4	90	62.92	0	103.94	319.75	695.511
4	9	University of Florida	73.83	51.39	95	68.5	0	124.23	266.52	679.469
5	73	University of Leeds	71.87	68.48	145	62.97	0	108.02	199.69	656.027
6	61	Brown University	73.36	39.12	125	68.87	0	96.59	245.39	648.333
7	76	University of Waterloo	70.52	59.43	140	56.75	0	52.33	234.4	613.439
8	96	University of Toronto	62.6	53.54	135	69.58	0	83.11	206.13	609.954
9	32	University of Pittsburgh	70.84	44.39	60	33.71	0	93.62	286.06	588.62
10	116	Cal Poly San Luis Obispo	52.86	66.39	85	63.49	0	49.11	251.93	568.774
11	86	North Carolina A&T State University	62.07	62.61	80	58.97	0	60.64	239.21	563.499
12	151	Dartmouth College	82.64	60.04	100	30.85	0	44.75	240.86	559.149
13	27	Cornell University	73.16	73.98	143	75	0	126.26	0	491.397
14	2	Rochester Institute of Technology	71.04	75	150	70.28	0	120.78	0	487.102
15	80	University of Texas, Arlington	66.68	66.09	144	63.23	0	140.79	0	480.792
16	1	University of Akron	62.59	56.73	141	65.99	0	114.11	0	440.427
17	4	University of Missouri, Columbia	72.81	60.84	135	49.21	0	120.3	0	438.162
18	47	North Carolina State University	55.91	36.37	90	56.51	0	30.7	166.26	435.751
19	67	Rutgers University	62.68	39.33	0	59.37	0	23.56	239.05	423.989
20	13	California State University, Northridge	61.24	53.13	115	48.61	0	116.07	0	394.055
21	232	Michigan Technological University	71.69	66.09	125	54.57	0	76.06	0	393.408
22	94	Lawrence Technological University	69.64	59.84	80	51.67	0	127.12	0	388.274
23	5	University of Washington	67.97	63.71	85	50.55	0	119.96	0	387.19
24	33	Georgia Institute of Technology	69.43	44.89	143	69.79	0	9.73	45.09	381.921
25	44	Syracuse University	53.69	28.53	50	20.54	0	52.78	163.91	369.448
26	55	University of Central Florida	75.54	44.81	80	0	0	0	165.28	365.629

27	14	Pennsylvania State University	53.14	40.69	125	73.26	0	49.48	4.58	346.153
28	45	Kokushikan University	52	31.47	60	0	0	6.61	191.56	341.65
29	63	University of Cincinnati	64.33	71.39	125	46.62	0	33.86	0	341.202
30	60	Universite du Quebec a Trois Rivieres	60.71	41.72	125	54.14	0	57.23	0	338.789
31	29	Bradley University	59.29	66.09	75	56.07	0	0	79.5	335.944
32	40	Queens University	70.06	68	115	49.16	0	32.48	0	334.702
33	26	University of Michigan, Dearborn	71.21	36.24	110	28.38	0	82.05	0	327.872
34	600	Worcester Polytechnic Institute	78.36	75	70	56.65	0	46.36	0	326.375
35	99	University of British Columbia	68.45	67.67	75	61.08	0	52.92	0	325.127
36	119	University of Birmingham	68.28	55.37	135	32.51	0	29.81	0	320.972
37	30	Universite de Sherbrooke	54.64	35.97	95	72.31	0	59.17	0	317.098
38	54	University of California, Davis	54.97	24.67	75	44.88	0	0	116.59	316.111
39	11	Auburn University	-35.84	34	75	23.96	0	82.16	136.22	315.513
40	25	Ohio State University	73.9	51.39	135	33.75	0	14.01	0	308.039
41	157	South Dakota School of Mines & Technology	61.07	63.08	60	49.72	0	69.36	0	303.226
42	43	University of Hartford	71.38	37.48	70	31.01	0	0	89	298.875
43	0	Virginia Institute of Technology	44.23	56.98	80	51.53	0	62.25	0	294.997
44	575	University of Toledo	80.5	51.12	95	31.8	0	28.68	0	287.102
45	35	North Dakota State University	63.65	40.45	55	0	0	0	124.43	283.53
46	20	Purdue University	65.81	71.52	90	48.16	0	0	0	275.489
47	70	University of Michigan, Ann Arbor	76.86	67.39	125	0	0	3.23	0	272.474
48	103	Michigan State University	82.09	55.68	85	45.19	0	1.27	0	269.234
49	53	Rensselaer Polytechnic Institute	61.43	43.16	60	17.94	0	85.89	0	268.416
50	19	University of Missouri, Rolla	72.14	61.49	65	62.2	0	0	0	260.829
51	10	Clarkson University	56.58	54.87	80	67.8	0	0	0	259.252
52	71	University of Western Ontario	66.38	69.04	90	15.58	0	18.18	0	259.187
53	38	Drexel University	72.66	35.99	90	60.22	0	0	0	258.872
54	89	University of Oklahoma	70.34	52.15	80	24.44	0	0	0	226.933
55	72	Iowa State University	63.39	44.81	55	48.75	0	10.78	0	222.733
56	111	Kettering University	68.16	48.2	100	0	0	0	0	216.357
57	74	University of Kansas	68.07	41.5	90	0	0	16.75	0	216.319

58	792	Carleton University	66.55	60.08	85	0	0	0	0	211.629
59	24	University of Saskathcewan	62.21	43.88	45	24.63	0	34.51	0	210.23
60	62	Kansas State University	64.59	41.29	55	0	0	49.03	0	209.903
61	81	Saginaw Valley State University	67.96	47.77	90	2.96	0	0	0	208.684
62	31	Monroe County Community College	61.15	43.99	55	44.57	0	0	0	204.71
63	51	University of Delaware	70.99	28.42	105	0	0	0	0	204.406
64	78	Marquette University	48.74	56.23	60	38.92	0	0	0	203.898
65	28	University of Louisville	63.53	64.19	70	0	0	0	0	197.717
66	79	University of Texas, Austin	58.14	67.81	65	0	0	0	0	190.95
67	23	University of Utah	64.94	33.05	90	0	0	0	0	187.988
68	22	University of New Mexico	65.23	52.66	65	3.43	0	1.49	0	187.821
69	87	McMaster University	47.26	13.4	10	43.21	0	0	72.41	186.277
70	52	Instituto Technologico de Chihuahua	72.58	44.67	65	0	0	0	0	182.246
71	85	University of Buffalo	54.1	27.73	0	25.29	0	69.56	0	176.679
72	21	University of Minnesota, Twin Cities	65.58	32.13	75	0	0	0	0	172.71
73	69	Ecole Polytechnique de Montreal	54.38	37.03	80	0	0	0	0	171.414
74	49	University of North Carolina, Charlotte	43.47	23.81	80	19.23	0	0	0	166.512
75	400	West Virginia University	49.86	43.45	55	0	0	0	0	148.305
76	39	Duke University	56.83	41	50	0	0	0	0	147.827
77	15	University of Colorado, Boulder	54.66	41.96	50	0	0	0	0	146.618
78	50	Southern Illinois University	62.79	0	45	38.13	0	0	0	145.918
79	100	University of Regina	58.01	34.25	50	0	0	0	0	142.258
80	418	Universite du Quebec, Chicoutimi	55.79	23.56	40	19.27	0	0	0	138.62
81	148	University of Calgary	65.72	37.57	35	0	0	0	0	138.286
82	93	United States Naval Academy	29	51.07	55	0	0	0	0	135.068
83	999	Colorado School of Mines	58.63	31.76	40	0	0	0	0	130.393
84	37	Vanderbilt University	28.84	0	60	28.15	0	0	0	116.992
85	42	University of Windsor	51.35	14.38	50	0	0	0	0	115.732
86	48	University of Iowa	35.33	30.39	20	0	0	0	0	85.717
87	56	Concordia University	52.98	14.53	0	0	0	0	0	67.509
88	68	FAMU/FSU College of Engineering	-100	26.3	75	42.82	0	23.3	0	67.41

89	121	New Jersey Institute of Technology	21.53	0	0	30.23	0	0	0	51.761
90	41	Colorado State University	49.69	0	0	0	0	0	0	49.69
91	18	McGill University	45.25	0	0	0	0	0	0	45.25
92	101	University of Alberta	36.04	0	0	0	0	0	0	36.04
93	16	University of California, Irvine	33.94	0	0	0	0	0	0	33.94
94	200	United States Air Force Academy	27.66	0	0	0	0	0	0	27.66
95	17	Florida International University	0	0	0	0	0	0	0	0
95	36	University of Illinois, Urbana-Champaign	0	0	0	0	0	0	0	0
95	57	Oklahoma State University	0	0	0	0	0	0	0	0
95	64	University of California, San Diego	0	0	0	0	0	0	0	0
95	66	Laval University	0	0	0	0	0	0	0	0
95	75	Florida Institute of Technology	0	0	0	0	0	0	0	0
95	505	University of Arizona	0	0	0	0	0	0	0	0
95	709	Memorial University of Newfoundland	0	0	0	0	0	0	0	0
95	812	Oakland University	0	0	0	0	0	0	0	0
104	360	Temple University	-100	0	0	0	0	0	0	-100

Appendix M
Presentation Slides

The primary and backup slides of the presentation

WPI

Motorsports

FSAE RACING DIVISION

AX600 TURBO

Introductions

- Marketing Group
  - Jonathan Suchecki: Manager
  - George Enriquez
  - David Henry
  - Jacob Coolberth
- Manufacturing Group
  - Vinod Filak: Manager
- Engineering Group
  - Mike Baran: Manager
  - Chris Lashua
  - Brendan Collins

WPI Motorsports FSAE RACING DIVISION

AX600 TURBO

Overview

- Does a market exist for a Formula SAE racecar?
- Where is the market?
- Who is our market?
- What does the market want?
- What is our solution?
  - Why is it unique?
  - What does it cost?
- Conclusion

WPI Motorsports FSAE RACING DIVISION

AX600 TURBO

Market Size

- Potential Markets:
  - 54,363 members, 110 Clubs of SCCA, 8 Regions *
  - Race Car Driving Schools
  - NASCAR (over 6 million fans)
  - High Performance Machine Enthusiasts

* Sports car Club of America, Inc., 9033 East Easter Place, Englewood, CO 80112, http://www.sccaro.

WPI Motorsports

AX500 TURBO

Dealerships

- Nationwide
- Minimum of 1 per SCCA region, 15 total

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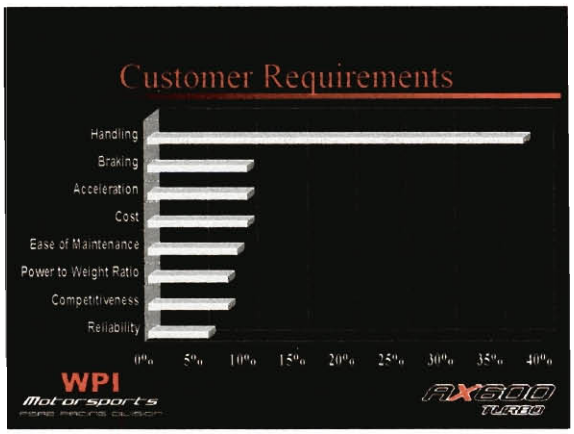
AX500 TURBO

Marketing Demographics

- 92% Male
- Average Age: 36 years old
- Average Income: $77,087
- Occupations:
  - 53% Technology Related
  - 22% Self-Employed Management Related

WPI Motorsports

AX500 TURBO


Customer Requirements
Handling
Braking
Acceleration
Cost
Ease of Maintenance
Power to Weight Ratio
Competitiveness
Reliability
0%
5%
10%
15%
20%
25%
30%
35%
40%
WPI
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TURBO


NEW FEATURES
Handling
• Differential
• Traction Control
• Shorter Wheelbase
TORQUE SENSING TRACTION
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TURBO


NEW FEATURES
Acceleration
• Custom Intercooler
• Garret T2 Turbocharger
• Quick Shift System
WPI
Motorsports
AX500
TURBO

Improved Features

The 2000 AX600 Turbo

- Ergonomic Cockpit
- Customized Seats
- Safety Features
- Serviceability

WPI Motorsports FSAE Racing Division

AX600 Turbo

Performance Specifications

0 - 60 mph: 3.35 sec

Max. Speed: 80 mph

Lateral G's: 1.33 G's

60 - 0 mph: 82 ft.

Horsepower: 120 hp

Torque: 47 ft-lbs

Power/Weight: 1:4.4

WPI Motorsports FSAE Racing Division

AX600 Turbo

Marketing Campaign

- Brochure
- Magazine Ad
- Posters
- www.ax600.com
- Promotions
- 1-800-WPI-FSAE
- TV Commercial

WPI Motorsports FSAE Racing Division

AX600 Turbo

Warranty & Support Services

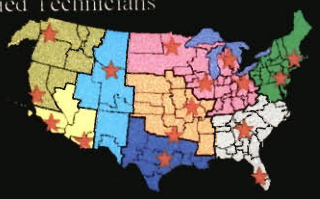
- 12 Month Basic/18 Month Powertrain Warranty With Extension Options
- Owner's Manual
- 1-800-WPI-FSAE Support Line, Operator, and E-mail Support
- Web Page Help Documents
- Dealerships/Parts Services

WPI Motorsports FSAE RACING DIVISION

AX600 TURBO

Dealerships

- Full Parts and Repair Services
- Certified Technicians



WPI Motorsports FSAE RACING DIVISION

AX600 TURBO

Production Cost Analysis

	Cost	Profit
• Manufacturing	$6,500	
• Direct Sales.....	$7,700	$1,200
• Sales To Dealers.....	$7,000	$ 500
• Suggested Retail Price...	$8,200	

Annualized Profit Range - 1000 cars

$0.5M - $1.2 M

WPI Motorsports FSAE RACING DIVISION

AX600 TURBO

Financing Options

- 12, 24, or 36 month options
- No Money Down
- Low APR
- Same Day Credit Approval
- Starts at $235 a month for 36 months

WPI Motorsports

AX600 TURBO

Conclusion

- Why WPI Motorsports?
  - 15 years of racing experience
  - Excellent customer support
  - Fully documented analysis and testing
  - Marketing strategies and S.W.O.T. analysis
- Why the AX600 Turbo?
  - Price
  - Performance
  - Satisfies the most demanding drivers

WPI Motorsports

AX600 TURBO

Manufacturing the

AX600 TURBO

Manufacturing Overview

- Component Design
- Manufacturing Design
- System Design
- Manufacturing Cost Breakdown
- Conclusion

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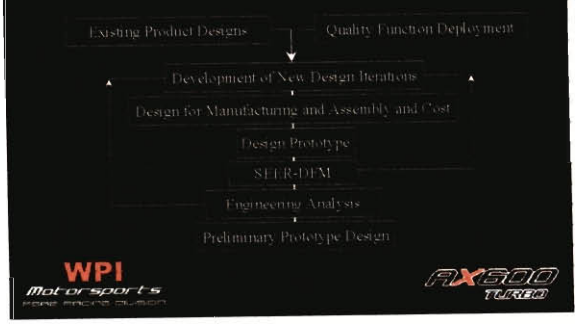
AX600 TURBO

Prototype Design Methodology



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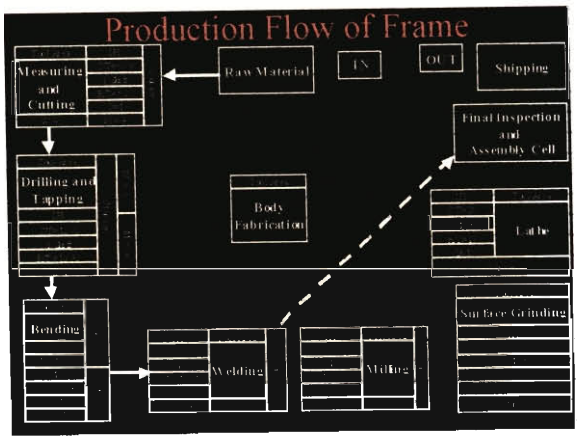
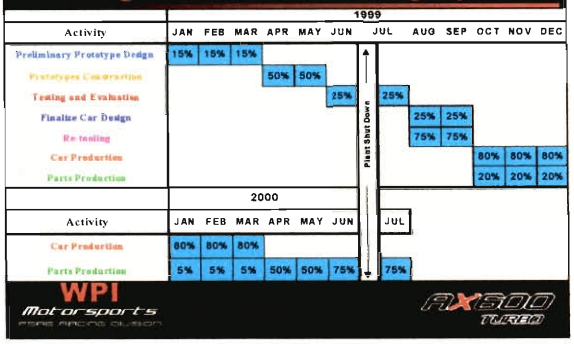
AX600 TURBO

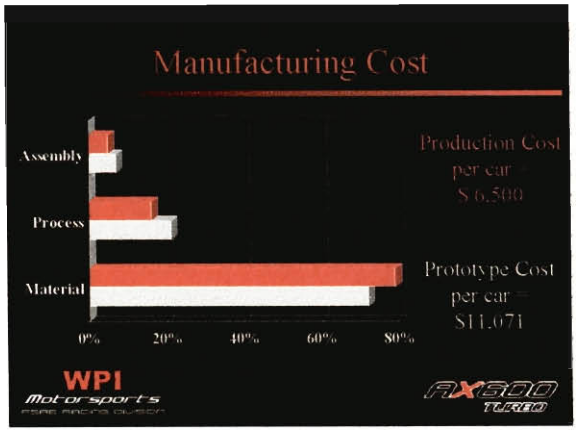
Production Flow of Frame



Design and Manufacturing Cycle



Manufacturing Cost



Conclusion

Goals for Manufacturing:

- —Confirm feasibility for 1000 cars/year.
- —Ensure design is feasible.
- —Define procedures for manufacturing.
- —Specify tooling and machinery.
- —Design a factory layout.


We thank you for your time, WPI Motorsports now invites your questions about our car.
AX600
TURBO

Market Size/Location/ Dealerships/Factories

- Dealership locations done by locating largest clusters of SCCA members and placing dealerships strategically to those groups.
- Factory located near large clusters and near major distribution nodes (railway, airport, UPS Hub, etc…)

WPI Motorsports

AX600 TURBO

Marketing Demographics Customer Wants

- Data was ascertained by the SCCA and surveys done by WPI Motorsports.
- Customer wants survey done last year by WPI Motorsports through an e-mail form letter sent to SCCA club mailing lists of approximately 900 members.
- New and improved features directly related to the survey results.

WPI Motorsports

AX600 TURBO

NEW FEATURES

The 2000 AX600 Turbo

- Garret T2 Turbocharger
  - Exhaust gas from the engine drives a turbine which is connected to a compressor which supplies air to the engine.
  - Gives roughly 20 horsepower boost over normally aspirated engine.
  - Faster acceleration is the bottom line.

WPI Motorsports

AX600 TURBO

NEW FEATURES

The 2000 AX600 Turbo

- Intercooler
  - Specially designed by WPI Motorsports Engineers.
  - Functions as a radiator that cools air before entering engine.
  - Reduces thermal load on engine.
  - High efficieney air to air design.
  - Continues to work as a heat sink if intake tubes get clogged.

WPI Motorsports PERE RACING DIVISION

AX600 TURBO

NEW FEATURES

The 2000 AX600 Turbo

- Quick Shift System
  - Works by temporarily deactivating fuel injection, which stops combustion, thereby reducing load on gears, allowing faster and smoother shifting.

WPI Motorsports PERE RACING DIVISION

AX600 TURBO

FEATURES

The 2000 AX600 Turbo

- Honda 600cc CBR Engine
  - "Best all around" - *Bike* Magazine
  - high horsepower
  - very reliable
  - low cost

WPI Motorsports PERE RACING DIVISION

AX600 TURBO

NEW FEATURES

The 2000 AX600 Turbo

- Traction Control
  - Adds better traction by applying variable braking to the wheels.
  - Necessary to reduce wheel spin caused by the additional horsepower of the turbocharger.

WPI Motorsports

AX600 TURBO

FEATURES

The 2000 AX600 Turbo

- Differential
  - Works by allowing the two rear wheels spin at different rates to maximize traction in turns.

WPI Motorsports

AX600 TURBO

Improved Features

The 2000 AX600 Turbo

- Ergonomic Cockpit
  - Designed using Pro-ENGINEER CAD human factors data.
  - Pressure mapping used to eliminate high points of stress in seat.
  - Shaped using ergonomic models and fitted to WPI Motorsports' drivers specifications.
  - Controls have been placed for maximum efficiency.
  - Adjustable pedals allow a range of driver sizes.

WPI Motorsports

AX600 TURBO

Improved Features

The 2000 AX600 Turbo

- Customized Seats
  - Two types of seat available
    - Custom molded to the individual customer.
    - Pre-molded to our pressure-map design.

WPI Motorsports

AX600 TURBO

Improved Features

The 2000 AX600 Turbo

- Safety Features
  - Our car incorporates a front crumple zone and impact absorbing foam in the nose and can withstand an 11.2 mph impact in an elastic manner from the front.
  - The side of vehicle can withstand a 6- mph collision in an elastic manner.
  - The sides of the vehicle have 2 safety members, which exceeds FSAE racecar rules.
  - Crashworthiness proven through dynamic testing.

WPI Motorsports

AX600 TURBO

Improved Features

The 2000 AX600 Turbo

- Minimal Tools Necessary for Most Repairs
  - 2 torque wrenches
  - 2 screwdrivers
  - 7 sizes of wrenches and socket wrenches
  - English allen wrench set

WPI Motorsports

AX600 TURBO

Performance Specifications

Performance Specifications found during dynamic testing, virtual design testing, and through analytical means.

WPI Motorsports FSAE Racing Division

AX600 TURBO

Marketing Campaign

- Newspaper Ad
  - placed in sports sections and technology sections
- Magazine Ad
  - placed in sports, technology, and men's magazines
  - includes business mail reply cards
- Brochure
  - placed in dealerships, conventions, and promotional events
  - also available by phone, mail, and internet request
  - available online

WPI Motorsports FSAE Racing Division

AX600 TURBO

Marketing Campaign

- www.ax600.com
  - Our web site with information about the car, company, events, and race results.
  - Allows for online ordering of parts, accessories, and vehicles.
- Promotions
  - at races… give out information, t-shirts, bumper stickers, etc…
- Radio Commercial
  - airs during rush hour on major region radio stations

WPI Motorsports FSAE Racing Division

AX600 TURBO

Marketing Campaign

- 1-800-WPI-FSAE
  - our 800 number with access to everything about WPI Motorsports, help, and ordering
  - live operators available 7am-9pm est 7 days a week automated assistance 24/7
- TV Commercial
  - to be shown on locally syndicated channels

WPI Motorsports FSAE RACING CLASS

AX500 TURBO

Financing Options

- 12, 24, or 36 month options
  - Found by looking at other extreme sports vehicle markets, such as ATVs, Snowmobile, and motorcycle.
- No Money Down
  - Found by inquiring at extreme sports vehicle dealerships.
  - Certain credit rating(s) required to get preferred financing.
- Low APR
  - Variable, based on bank financing, extreme sports vehicle market (ATV, snowmobile, etc…).

WPI Motorsports FSAE RACING CLASS

AX500 TURBO

Financing Options

- Same Day Credit Approval
  - With good credit
  - Available on weekdays only, during normal bank operation hours.
- Starts at $235 a month for 36 months
  - Based on: base model of car, no money down, good credit (no security deposit), 10% APR.

WPI Motorsports FSAE RACING CLASS

AX500 TURBO

Warranty & Support Services

- 12 Month Basic 18 Month Powertrain Warranty With Extension Options
  - please see warranty enclosed in folder
  - Based on warranties from: motorcycle, ATV, snowmobile, and small watercraft markets.
- 1-800-WPI-FSAE Support Line, Operator, and E-mail Support
  - These are common support means.

WPI Motorsports FSAE RACE DESIGN

AX500 TURBO

Warranty & Support Services

- Web Page Help Documents
  - Guidelines for troubleshooting common minor problems with the vehicle.
- Dealerships Parts Services
  - Needed for ordering parts and getting your car fixed professionally.
  - Customers can call 800 # for closest authorized repair location.

WPI Motorsports FSAE RACE DESIGN

AX500 TURBO

Cost Analysis

- Manufacturing Cost
  - Based on cost report which includes prototype costs and estimated cost to manufacture 1000 units
- Direct Sales
  - Sales direct from factory, most profitable for us as there is no middle-man
- Sales To Dealers
  - Sales to dealer price, before dealer mark-up
- Suggested Retail Price
  - A reasonable cost for the car based on competitions price and our features, dealer has right to stray from this

WPI Motorsports FSAE RACE DESIGN

AX500 TURBO

S.W.O.T. Analysis

- **STRENGTHS:** Performance and acceleration, excellent customer support service and support, low cost, fully documented testing, fifteen years of racing experience, , engineering and design tools.
- **WEAKNESSES:** Only one model to sell.
- **OPPORTUNITIES:** Untapped markets, racing schools, SCCA, NASCAR fans, extreme sports and motorcycle enthusiasts
- **THREATS:** Other companies in market

WPI Motorsports FSAE RACE CLASS

AX500 TURBO

Comparison to Competition

	WPI	Akron	Cornell	U of W
Engine	Honda	Honda	Yamaha	Honda
Induction	Garret T2 Turbo	Normally Aspirated	Turbo	Normally Aspirated
Shift	QSS	Pneumatic	Semi-Auto	Coupled Shifter Clutch

WPI Motorsports FSAE RACE CLASS

AX500 TURBO

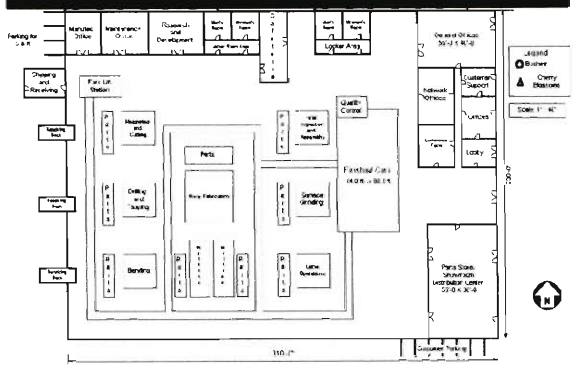
Comparison to Competition

	WPI	Akron	Cornell	U of W
Endurance Fuel Injection	Multi-port fuel injection system Haltech F9A	EFI	Student Designed Harlan	Electromotive Tec II
Braking	Wilwood Dynalite Calipers	F/R Disc	Wilwood Calipers	Wilwood Calipers

WPI Motorsports FSAE RACE CLASS

AX500 TURBO

Factory Layout



Quality Function Deployment

- Customer Requirements
- Technical Requirements
- Competitive Comparison
- Goal

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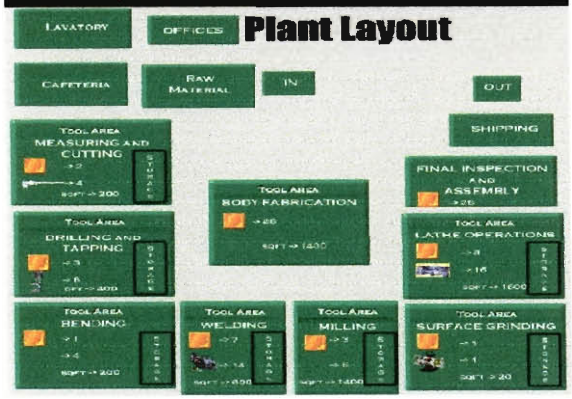
Floor Layout



Objectives of Manufacturability

- Design for Manufacturability and Assembly.
- Design to Cost.
- Calculate Time to Produce.
- Analyze Cost to Manufacture and Quantify Design Trade-off.
- Identify Assembly and MFG Cost Drivers.
- To Fulfill Customer Requirements.
- Cut Cost Early in the Design & MFG Cycle

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What is S.E.E.R ?

System Evaluation & Estimation of Resources.

(Family of tools)

What is SEER-DFM?

SEER Tool to analyze Manufacturing Design.

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Key Applications of SEER.

- Powerful, Flexible Analysis of Cost.
- Calculates Time to Produce.
- Output on:
  - Process Time Cost.
  - Setup Time Cost.
  - Run Time Cost.
  - Inspection.
  - Material Cost.
- Quantify Design Trade-off.

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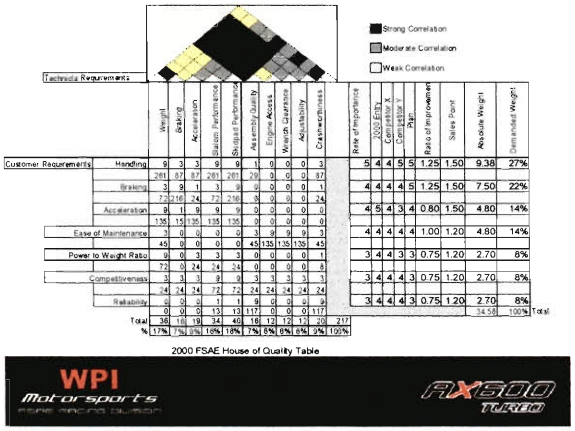
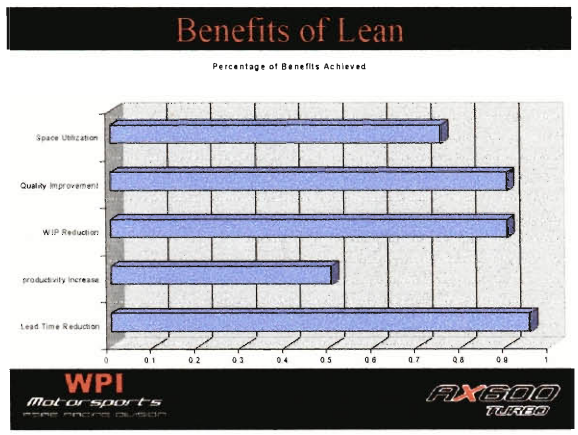
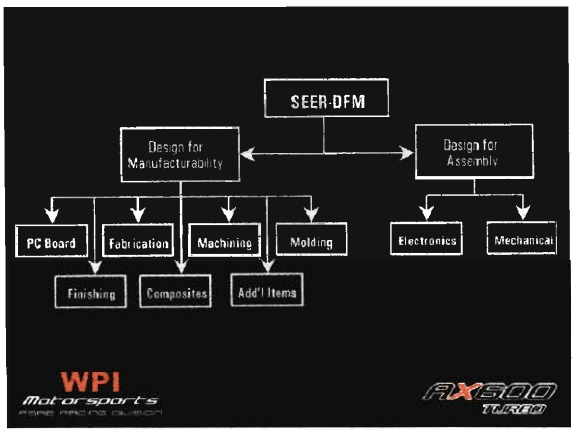


2000 FSAE House of Quality Table





Advantages of SEER:

- Cut's Cost Early in Design &MFG Cycle.
- Optimize MFG & Assembly Methods.
- Reduce Product Development..
- Estimate any MFG Processes.
- Incorporate Custom Processes.
- Design to Cost.
- Trade off Analysis.
- Manage Risk.
- Identify MFG Assembly Cost Drivers.
- Evaluate Assembly Methodology.
- Concurrent Product Development.
- Understand Impact of Change.
- Increased Product Quality and Reliability.

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Lean Building Blocks

Lean Factory

One Piece Flow	Cellular		Takt Time
Pull Kanban	POUs		Quick Changeover
Quality @ Source	Batch Reduction		Teams
Standardized Work	Workplace Organization	Visual	Plant Layout

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Establish Takt Time

Takt Time = Demand Rate

$$\text{Takt Time} = \frac{\text{Work Time Available}}{\text{Number Units Sold}}$$

$$\text{Takt Time} = \frac{49980 \text{ min.}}{1000 \text{ cars}} = 49.98 \text{ min car}$$

Goal: Produce to Demand

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