2016 FSAE® BUSINESS LOGIC CASE

Institution/Team Identification: Yale University, Bulldogs Racing

Analysis of Market Data

The market for track day cars is very diverse: the products range from $20k to $2m, 80HP to +500HP, open-wheel to road-legal. The consumer base often overlaps with the comfortably-off Gen Y and younger Gen X adults. We identify our market as the amateur open-wheel track-focused cars, with no road legality restriction; Ariel Atom, BAC Mono, Radical RXC and Caterham 420R are representative examples. The mean power-to-weight in this bracket is 400HP/ton, torque is 300Nm, 0-100kph is 3s, weight is 700kg and price is $75k. In this bracket, the correlation between price and power-to-weight is not statistically significant. Correlation between price and sales roughly follows the FSAE model, except the sales are about 3x as high, with few outliers (eg KTM X-Bow, thanks to its presence in FIA races). Prices can easily double with the options.

Company Strategy

Based on the analysis, we defined our vehicle, BR16, as a car that delivers more fun per dollar spent: striking appearance, simple design, easier operation, less maintenance and more torque. This recipe asked for a single-speed no-frills gearbox, plug-and-play drivability, a simple steel spaceframe and very few moving parts, while still allowing tunability for ambitious drivers. Thus BR16 could only exist as an all-electric car in an IC-saturated market. The design of BR16 follows the vintage F1 school to reflect the attractive contrast between classic and fast, which stands out among the high-tech track cars, as proven by Morgan's success with the Three Wheeler. Our consumers are those who want to start track days but are intimidated by the complexity and hassles of the vehicles; BR16 is priced such that it is an easily accessible entry into the track. An optional "DAQ Pack" equips the car with various sensors for those who would like a more serious tracking experience.

Target Selling Price	$44,995 (+$15,000 for DAQ Pack)
Target Vehicle Production Cost	$34,389 ($41,239 for DAQ Pack)
Target Production Volume (from Table 1)	30 (+0 to 5 for DAQ Pack)
Target Annual Profit	$308,331 (+$8,000 for every DAQ Pack sold)

Vehicle Strategy & Performance

BR16 leads the competition in terms of figures that directly contribute to "fun": the twin e-motors and 4:1 ratio single-speed gearbox give way to 1120Nm of torque, 95HP continuous and 220HP 10-second burst power, no gears to worry about and almost no need of maintenance. A 5.7kWh battery box is good for about 15-20 autocross laps, which is enough for even the seasoned drivers. With a 75kg driver, BR16 weighs 300kg (733HP/ton peak), giving rise to a 0-100kph time of 2.5s, depending on track conditions. These figures and the vintage design make BR16 a plug-and-play race car with a timeless look and a great investment for our customers, who are looking for new hobbies that are the most fun with the least hassles. The accessible base price of $44,995 yields the highest absolute profit with the FSAE pricing and sales model.

Plans for Efficient Design (and Manufacture)

4WD and in-hub motors were considered in the brainstorming phase, but were dropped due to concerns of reliability, manufacturability and cost. A steel spaceframe was chosen over a CFRP chassis for simplicity, ease of repair and low cost. CFRP and Dacron body panels enable easy access and are conducive to production thanks to suitability to repeated use of molds. The most complex piece of the car is the battery box, which is suitable to low-volume manufacturing thanks to the modularity of cell stacks. The powertrain makes the most use of the traction circle of the Hoosier slicks and all the drivetrain components are off-the-shelf for easy replacements. The battery box, motors and motor controllers are both air and liquid cooled and protected against dangerous HV situations with redundant circuits for increased safety and reliability.

Key Design Features		**Key PerformanceTargets**	
Chassis/Body Type	steel spaceframe chassis, CFRP and Dacron body panels	Accn. 0-75 Metres	3.6s
Power train type	Electric	Lateral Accn, (g)	1.7g
Power / engine	2 x Enstroj Emrax 207 MW, 80kW peak, 32kW continuous	Fuel Economy	7.72 km/Wh
Target weight, kg	225kg (no driver)	0-100kph/0-100-0kph	2.5s/4s
Design Language	Vintage F1	Range	44km