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general motors: SUPPLIER SELECTION FOR INNOVATION

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Happy Monday! It was another typical week overscheduled with meetings for Angela Hanna, a commodity buyer for the General Motors Company (GM) brake systems purchasing team. As she planned her week, Hanna realized that some of the meetings were critical for her to attend in person. Although some meetings were scheduled nearly back to back, they were in different buildings on the General Motors Technical Center campus in Warren, Michigan. Fortunately, Hanna was a member of the GM autonomous vehicle (AV) launch team, so she had access to a fleet of autonomous taxis on campus. She launched the Lyft Mobility Solutions (Lyft) application on her smartphone and booked the rides she needed to ensure a productive week.

Mary Barra, GM’s chief executive officer, made it clear that GM was going to be a disrupter in the world of personal mobility. Part of this effort was to position the company as a leader in AV development. GM planned to bring this promising new technology to market quickly and with razor-sharp precision. Public safety and defect-free quality were GM’s top priorities. As part of its quest to bring a fully autonomous vehicle to the market, GM acquired Cruise Automation (Cruise), a three-year-old company best known for having created the first aftermarket AV conversion kit. The product allowed buyers to convert their cars into AVs for highway driving with the touch of a button.

Cruise was in search of funding to enable it to further develop AV technology. Instead of investing in the company, GM decided to acquire the company and let the firm operate as a technology start-up using GM vehicles. This deal allowed for perfect collaboration between GM’s vehicle development and Cruise’s information technology (IT) capabilities. GM also collaborated with Lyft, a ride-hailing service, to create a partnership that used fleets of GM vehicles to offer its drivers safe, affordable, and reliable vehicles. Lyft would be the first organization outside of GM and Cruise to operate a fleet of GM’s fully autonomous vehicles.

State of the Industry

As the automotive industry strode towards safer vehicles, automation played a key role in the technological evolution. The next major advancement in vehicle safety—which had already begun, and promised to be the first development to significantly reduce human error, the leading cause of automobile accidents—was the implementation of autonomous technologies.

The U.S. National Highway Traffic Safety Administration described a continuum of five levels of automation as follows:

* Level 0: The human driver is in complete control of all functions of the car.
* Level 1: One function is automated.
* Level 2: More than one function is automated at the same time (e.g., steering and acceleration), but the driver must remain constantly attentive.
* Level 3: The driving functions are sufficiently automated that the driver can safely engage in other activities.
* Level 4: The car can drive itself without a human driver.

Most vehicles were equipped with level 1 automation, with an increasing number of vehicles reaching level 2. The technology was already helping to prevent accidents with features including lane departure warning signals, automated braking, and cruise control systems that maintained a safe distance and remained in the appropriate lane, even around corners. The positive response to these safety features was urging the industry to move forward to manufacture level 3 and eventually even level 4 AVs. To achieve a fully autonomous vehicle, several systems and sensors needed to be integrated using software and artificial intelligence. The technology would allow the vehicle to become a true driverless transportation experience.

It was deemed imperative that AVs be perceived by the public and lawmakers as safe and reliable. The integrated systems needed to work seamlessly and cohesively. Redundant systems were necessary to ensure that vehicles performed safely under any circumstances. In most vehicles, the driver maintained the primary control function in most applications—including steering, acceleration, and braking—most of the time. As vehicles approached level 3 automation, AV technology would become the primary controller and the driver would become the redundant controller. By 2026, AV technology was expected to assume both positions. The next generation of car buyers would find it common for cars to travel locally and between cities with no one in the driver’s seat.

General Motors Autonomous Vehicle Project Launch Team

During the previous several months, two autonomous test fleets of the Chevrolet Bolt electric vehicle (EV) had been introduced on the GM Technical Center and on the streets of San Francisco, California. These vehicles were undergoing rigorous testing, validation, and evaluation schedules, and they were performing to expectations. The next phase in the AV project was to introduce a highly controlled fleet of vehicles to be operated by Lyft. They were scheduled to begin deployment in the second quarter of 2018 and would be known as Chevrolet Bolt AVs.

The AV project team was charged by GM senior leadership to develop an autonomous driver system (ADS) that was safe for occupants, other vehicles, pedestrians, bicyclists, and could respond to the myriad of unexpected potential hazards on the road. In addition, GM wanted to maintain control of the intellectual property (IP) involved in the project. This included software, data streams, and data storage. GM’s strategy was to own the IP so that it could independently and swiftly react to changes in the technological landscape. Hanna was excited to be part of this team. Her responsibility was to source the brake control modules for both the Chevrolet Bolt AV and the Chevrolet Bolt EV.

Introducing the Chevrolet Bolt Electric and Autonomous Vehicle

The Chevrolet Bolt EV was GM’s first ground-up long-range electric vehicle. The Bolt delivered more than 200 miles (320 kilometres) of electric range. This new edition to the EV family had a 60-kilowatt-hour (kWh) lithium ion battery pack that consisted of 288 lithium ion cells, to provide 60 kWh of energy and 160 kilowatts of peak power. The new battery pack design was flat and spanned the entire floor of the vehicle. Using a 240-volt wall box, the battery could be recharged after a 50-mile (80-kilometre) commute in less than two hours. An optional fast charging system, allowing the battery to be charged up to 90 miles (145 kilometres) in 30 minutes, was also available.

A blank canvas gave GM designers the ability to design a vehicle with vivid graphics and exceptional passenger space. The flat battery pack enabled seating for five passengers and 16.9 cubic feet (480 litres in volume) of cargo space behind the rear seat. A 102.4-inch (2.6-metre) wheelbase and wide track gave the Chevrolet Bolt EV the look of a small crossover model. Its oversized windows, plunging beltline, and steeply raked windshield reflected the vehicle’s progressive profile and emphasized the bright airy feel and spaciousness of the interior. The use of lightweight materials contributed to the Chevrolet Bolt EV’s impressive acceleration rate of 0 to 60 mph (100 kilometres) in seven seconds and driving range of 200 miles (320 kilometres).

The Chevrolet Bolt EV was planned to be built at the Orion assembly plant in Michigan. For the model year 2018, regular production was expected to begin in mid-October 2017 with an estimated annual volume of 30,000 units. The price of the Chevrolet Bolt EV was approximately US$30,000[[1]](#footnote-1) after tax credits. The product lifecycle was expected to be two years.

In February 2017, GM announced that the 2020 Chevrolet Bolt would become the platform for GM’s first autonomous vehicle, the Chevrolet Bolt AV (Level 4). The car would require an entirely new braking system integrated with the vehicle’s artificial intelligence (AI)—the computerized driver. The 2020 Chevrolet Bolt EV braking system would be upgraded to level 2 automation. The EV model change and AV start of regular production would occur in October 2019. The AV was expected to have an annual volume of 10,000 units, and the 2020 Chevrolet Bolt EV/AV would have a five-year life cycle.

Brake Technology

Brake system technology went through many transformations over the years. Various established and new suppliers worked towards being first and best in the race to create fully autonomous braking systems. The key piece of the brake system, which needed to be fully integrated with the AI, was the brake booster. Hanna was confident that the supply base was capable of providing parts that would meet the needs of these programs.

Two major braking systems had been in use for many years: the anti-lock braking system and electronic stability control technology. EV propulsion systems opened the door for electronic brake booster (e-boost) technology, which eliminated the need for a vacuum booster. The braking system for an AV (levels 3 and 4) required two e-boost modules: a primary brake booster and a secondary module. The secondary module was redundant and triggered by different inputs to react in an emergency. For a semi-autonomous vehicle (level 2) such as the Chevrolet Bolt EV, beginning with the 2020 model year, the primary brake consisted of the human driver pressing the brake pedal; the secondary system was an e-boost module, similar to the AV version, that would stop the vehicle when the human driver failed to stop. IP was an important part of the e-boost module.

Chevrolet Bolt AV Sourcing Objectives

Hanna’s task was to source e-boost modules required to support the enhanced 2020 Chevrolet Bolt EV and the new 2020 Chevrolet Bolt AV. She would negotiate and award production contracts for these programs. The production supplier would need to deliver parts to the Orion assembly plant for the following scheduled production plans:

2020 Chevrolet Bolt EV

* 100 vehicles: March 2018 to December 2018
* 300 vehicles: January 2019 to March 2019
* 600 vehicles: March 2019 to October 2019 (regular production)

2020 Chevrolet Bolt AV

* 500 vehicles (non-saleable Lyft fleet): March 2018 to December 2018
* 1,000 vehicles (extended Lyft fleet): January 2019 to March 2019
* 2,000 vehicles (extended Lyft fleet): March 2019 to October 2019 (regular production)

The production of these vehicles would allow GM and Cruise, in collaboration with the ride-sharing service Lyft, to test the Chevrolet Bolt AV on the road in selected cities. The ride-sharing vehicles would be fully autonomous but would have a trained back-up operator in the driver’s seat for the continued learning and improvement of the systems as well as for any emergencies. However, to get these vehicles on the road by 2019, there was a great deal of work still to be completed . . . and fast.

A statement of requirements (SOR) needed to be distributed with a request for quote for the 2020 Chevrolet Bolt EV and AV braking system. The SOR would include a significant amount of data and detail, including GM’s IP requirements. Because the technology was advancing so rapidly, the SOR would likely require changes before the procurement process was complete. Various regulatory and statutory issues could also affect the braking system and thereby the SOR. Therefore, the language in the package was written to allow GM the flexibility to make updates. Some changes to the SOR could even be requested by suppliers, who were driving innovation in this new technology.

Because the AV industry was so new, development costs were integrated into the price of each supplier’s product. This practice was common for all new AV technology commodities, including radar systems, high-definition cameras, and *lidar* systems (a combination of light and radar detection). GM’s marketing division was still in the process of determining a feasible sale price for the Chevrolet Bolt AV.

Brake Electronic Booster Sourcing

R.U.D.I. Braking Systems (R.U.D.I.) had a contract for the manufacture of Chevrolet Bolt AV prototypes in minimal order quantities. Its contract with GM was to develop a prototype electric brake system that integrated into the ADS on the Chevrolet Bolt AV. These vehicles were built in a GM pre-production facility and used a process known as “soft” tooling, which was only appropriate for manufacturing low volumes for small projects. The prototypes were tested and worked well with the GM and Cruise version of the ADS. However, R.U.D.I. was unwilling to share its IP with GM, so it could not be tested.

As the deadline approached, all quotations for braking systems for the production of both the 2020 Chevrolet Bolt EV and the 2020 Chevrolet Bolt AV were received.

Rosie Automotive International

Rosie Automotive International (RAI) was a regular supplier to GM located in Shanghai, China. RAI was the contracted supplier for the 2018 Chevrolet Bolt EV and had the capability to quote on all of the necessary e-boost modules. However, RAI informed GM that its IP was proprietary information, so GM would not have access to, or control of, the software and data associated with the braking system. RAI’s technology experts claimed that a single point of control of IP provided greater control over its functionality. Being experts in e-boost technology, and considering IP a competitive advantage, RAI’s technology team claimed that RAI needed to retain control of the software. RAI was very confident that it would be the successful candidate for the brake system quotation. The electric brake AV hardware, which would be manufactured in-house, consisted of two unique subcomponents that comprised the complete assembly.

Shortly after GM made the last engineering change on its EV braking system to accommodate the RAI technology, RAI approached GM for a price increase. RAI claimed that the increase was necessary due to rising labour and regulatory costs in China. RAI required a larger percentage of GM business and a long-term contract guarantee to offset additional capital investment.

Elroy International

Elroy International (Elroy) was a manufacturer of electric brake systems located in Silao, Mexico. Although Elroy was not one of GM’s regular providers of brake systems, the company did supply other commodities such as bumpers and side mirrors to GM. Because Elroy had recently acquired the U.K. supplier Cogswell Braking Systems, the company had been added to GM’s bid list by the braking systems creativity team. Elroy’s capabilities as a supplier in this commodity were unknown to GM. However, the company was willing to share its IP with GM. Elroy’s electric brake system AV components consisted of three unique subcomponents that comprised the AV assembly. Elroy’s quote included a significant amount of purchased brake hardware components that were supplied by Orbitty International Manufacturing & Technology Co. (Orbitty), according to Elroy’s sales engineer Gord Butler. Elroy did manufacture some of its own AV components, however, and owned the software for its e-boost system.

R.U.D.I. Braking Systems

Headquartered in San Jose, California, R.U.D.I. had been a long-standing prototype supplier to GM, and had recently signed a high-volume production contract for the Chevrolet Equinox program. With a new state-of-the-art manufacturing site, R.U.D.I. was excited to add GM to its portfolio of production customers. The company was actively hiring new employees who exhibited enthusiasm for the business, which was reflective of the company’s excellent reputation for customer service. R.U.D.I. had not been a seasoned regular production supplier for GM. However, having signed the prototype contract for the first two fleets of the Chevrolet Bolt AV, the company became the preferred supplier by GM’s product engineering team. Therefore, R.U.D.I. was asked to help develop technical portions of the SOR for the competitive bid.

Steven Messick, the R.U.D.I. engineer who provided the quote to GM, was confident that R.U.D.I. would win the bid because the language in the SOR was very familiar to R.U.D.I.’s engineer team. The company was also capable of producing the sensors, software, cameras, and electronic modules in the autonomous arena. R.U.D.I.’s e-boost system AV components consisted of three unique subcomponents that comprised the AV assembly. R.U.D.I.’s quote included one purchased component, although the company was unwilling to share information about the source of that component. For this bid, R.U.D.I. insisted on retaining IP rights. The company was committed to working closely with GM and was open to sharing IP information in the future, once GM developed enough internal subject matter expertise.

Orbitty International Manufacturing & Technology Co.

Headquartered in Munich, Germany, Orbitty was a global powerhouse with manufacturing facilities in Europe, Asia, North America, and South America. Orbitty had partnered with GM on smaller special projects in the past. The company was recognized as an industry leader in automotive design and engineering. Orbitty had co-developed the winning vehicle of the Defense Advanced Research Projects Agency (DARPA) 2007 Autonomous Challenge, in partnership with GM and other suppliers. That collaboration had made Orbitty a preferred supplier among GM engineers. Orbitty had no ongoing contracts on GM programs, but the company’s iconic reputation for innovation excellence seemed to generate some arrogance in its dealings. Although the company clearly was lacking in terms of customer service, various automotive companies were still eager to work with Orbitty as a strategic partner.

Orbitty’s e-boost system for the Chevrolet Bolt AV was quoted as being manufactured out of its Germany facility, to take advantage of available capacity. The company was willing to share its IP information with GM, but at a premium cost. Having invested significantly in the technology, the company was eager to recuperate some of the costs of software development. Although Orbitty’s previous bid packages had been very high, GM expected few engineering changes during the development of the product, which would result in few unanticipated costs. Because the direction to move towards full automation was fast approaching, GM chose to include Orbitty in the bid, feeling that the company’s offer had merit. Orbitty’s AV e-boost system comprised three unique subcomponents that were all manufactured in-house.

Plant Information

The Orion assembly plant, located in Michigan’s Orion Charter Township, was 4.3 million square feet (400,000 square metres). Since the plant opened in 1983, more than 5.1 million vehicles had been built there for GM. The assembly plant’s products included the Chevrolet Sonic, Buick Verano, and the Chevrolet Bolt EV, which would start production in 2017. Introduced in 2011, the Chevrolet Sonic was the only subcompact car assembled in the United States. Other renowned cars built at the Orion assembly plant included the Chevrolet Malibu, Pontiac G6, Buick LeSabre, Cadillac DeVille, and Oldsmobile Aurora.

The assembly plant operated on one shift, five days per week. In 2014, a $160 million investment was made for plant tooling and equipment to manufacture the Chevrolet Bolt EV.

Supplier selection DECISION

Hanna now needed to review all proposals with her engineering teams. She needed to choose a supplier for both e-boost modules and then present her recommendations and reasoning to the sourcing table in about one week. The business would be awarded in about three weeks. With a competitive bidding process, the buyer needed to account for all tangible and intangible factors. She needed to make the best decision for GM. The target piece price was $43 for the EV e-boost module and $53 for the AV version. Hanna needed to create a complete sourcing proposal to present to the sourcing table for approval.

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1. All currency amounts are in US$ unless otherwise specified. [↑](#footnote-ref-1)