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The Orthopedic Motor Market: Minnesota Micromotors, Inc. and Brushless Motor Technology

Minnesota Micromotors, Inc. (MM), based in Minneapolis, was a manufacturer of brushless, direct current (BLDC)¹ motors used in orthopedic medical devices. Devices utilizing MM's motors were typically used by orthopedic surgeons in large bone surgery, reconstructive surgery, trauma surgery, and sports medicine procedures. MM sold approximately 97,000 motors a year and had a 9% share of the \$137 million U. S. medical motor market for orthopedic and neurosurgery devices. (See Exhibit 1A.)

MM was a division of privately held Fractional Motors Limited, which had revenues of \$350 million (just over \$12 million, or 3%, generated by MM) and 1,300 employees (45 employed by MM). MM's revenues had been growing in line with the industry average rate of 5.5% over the prior three-year period; however, the most recent quarterly financial data showed a decline in revenue. Although senior management was pleased that MM had just turned a modest profit after several years of losses, there was concern about recent potential market share loss. The BLDC motors in which MM specialized offered several advantages over brushed DC motors, including greater efficiency and reliability, less noise, longer lifetime (no brush erosion), and relatively lower electromagnetic interference. Given that a BLDC motor required no airflow for cooling, its internal components could be entirely enclosed and protected from dirt. BLDC motors were better suited to applications needing a wide speed range — for example drill systems, used

in orthopedic bone surgery that must perform at 10, 000 to 95, 000 revolutions per minute.

Fractional Motors viewed MM as a strategic division in its corporate portfolio because of the long-term growth potential in high-end medical and orthopedic devices markets. The segment of the motor industry in which MM operated was highly competitive, with over 100 participants. Manufacturers were divided into three tiers: vertically integrated, multinational tier 1 companies that produced many types of motors; tier 2 companies that specialized in either brushed DC, BLDC, or universal motors technology; and small, privately held tier 3 companies that were niche providers like MM and that produced only BLDC motors for orthopedic uses. Smaller motor manufacturers like MM sought to distinguish themselves from their competitors by offering original equipment manufacturer (OEM) customers domain knowledge, customer service, product functionality, and compatibility with other automation products. In 2009, one of MM's major tier 3 competitors introduced a high torque, BLDC motor line. These multilayer coil BLDC motors were precision-engineered to reach higher temperatures without compromising motor function. The industry average net price of the competitors' motors was \$118.

Orthopedic OEM Market and Purchasing Criteria

1 MM produced fractional horsepower motors, which had a power (machine strength) rating between 1/200 and one horsepower (1 HP). The fractional horsepower DC motor market was divided into brushed and brushless DC motors. Brushed DC motors used a mechanical system of stationary metallic

contacts (“brushes”) to transfer electrical energy. By contrast, brushless DC motors used an electronically controlled commutation system.

Professor Das Narayandas of Harvard Business School and Heide Abelli (MBA 1993) prepared this reading for use with the Marketing Simulation: Managing Segments and Customers (HBP No. 7018).

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Simulation Foreground Reading—The Business-to-Business Orthopedic Motor Market

Orthopedic devices, used to treat musculoskeletal disorders of the human body, constituted the third largest global medical equipment market and were forecast to grow to over \$20 billion by 2012. Among the 1,300 U.S. orthopedic OEMs, Zelting, Di Preto, and Stemper Corporation were the leaders in joint reconstruction, with a combined market share of 64%; Syphone and Stemper Corporation were the leading OEMs in trauma fixation, with a combined market share of 57%. The selection of motors for use as components in medical devices such as orthopedic products was an involved

process, usually requiring electrical engineers at the OEM to consult with application engineers from the motor manufacturer in order to get a customized design specified to their parameters, including physical-size constraints.

Given the complex nature of designing and building small-but-sophisticated orthopedic power tools, these “value-add” customer service features were just as important in the OEM decision-making process as the technical features of a motor. The most critical OEM purchasing criteria included the following: Thermal (heat) resistance. A common cause of motor failure was when the expected load (the turning torque) exceeded the motor’s rating, causing the motor to heat up quickly and break down. Usually it was desirable to select a motor that would not reach its maximum operating temperature (measured in degrees Celsius) in the specific orthopedic device use setting. A high level of thermal resistance was especially important for motors that were frequently sanitized at high heat (autoclaving).

Power-to-size. In BLDC motors, the ratio of torque (measured in watts) delivered to the size of the motor (measured in cubic inches) was higher than in brushed DC motors, making BLDC motors useful in applications where space and weight were critical factors. In demanding orthopedic procedures such as hip resurfacing, small and light handheld power tools facilitated precise maneuvering by surgeons. Furthermore, powerful surgical tools that did the job quickly limited both the surgeon’s hand fatigue and the potential for repetitive stress injuries. Cost. Because BLDC motors contained permanent magnets and a complex electronic controller, they cost more up

front than brushed motors. However, BLDC motors with a smaller power supply could often be a less expensive long-term solution, because they could last up to three times longer than a brushed motor.

MM's Product Line and Customer Base

MM's main product line was the Orthopower Micromotor™, which was over 75% shorter and 90% lighter than conventional flat motors. MM had invested significantly in the product line's power-to-size and efficiency — the two features cited most often by OEMs as sources of differentiation for MM's medical motors. MM's Orthopower Micromotor™ BLDC motors delivered the highest efficiency among all miniature DC motors. Moreover, the Orthopower Micromotor™ reduced power-supply requirements by drawing less current, which minimized generated heat, and its high-speed, slotless design significantly reduced vibration. The Orthopower Micromotor™ was priced at \$142 list, and discounts off of list ranged from 4% to 16% for large-volume purchases. Approximately 70% of Minnesota Micromotors, Inc.' revenues were generated from customers that placed large-volume orders. The balance was generated from customers that ordered in smaller volumes from distributors. Customers placing large-volume orders were roughly divided into four subsegments (A-D), distinguishable by their purchasing behavior and the relative importance they assigned to specific product features. Segment A placed a premium on the motor's power-to-size ratio and generally required a high level of sales support due to the requirement for customization. MM generated approximately 33% of its dollar revenue from this segment (see Exhibits 1A and 1B). 2

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Segment B placed a premium on the motor's thermal resistance performance and also highly valued the market and technical knowledge of a manufacturer's sales representatives. MM's market share in this segment was just under 8%. A high thermal resistance was the leading feature touted by device manufacturers in this segment.

Segment C, the least price-sensitive of large-volume customers, required superior motor performance on both thermal resistance and power-to-size ratio. MM's dollar revenue market share of this segment was just over 7%. These OEMs manufactured sophisticated, high-end neurosurgery tools used at leading research hospitals, and therefore their technical standards were very stringent. The fourth segment, Segment D, was very price-sensitive. These OEMs sold orthopedic tools in bulk to group purchasing organizations (GPOs), which sought to get the most economical rates for their individual members. A relatively high share (22.8%) of MM's dollar volume came from this segment. Finally, customers who purchased through distributors were also quite price-sensitive. Since small-volume purchasers generally had to buy off-the-shelf motors from a distributor's catalog, they were concerned that the motors would be easy to integrate into their surgical tools and that the vendor's product literature would be comprehensive. MM's market share of dollar volume in that segment was approximately 28.6%. In terms of total

dollar volume, all of the customer segments were growing at rates from 5% to 6%.

MM's Current Go-to-Market Strategy

MM's sales organization had two channels for reaching customers. MM used either its own sales force to sell directly to OEMs or it sold to various distributors, who in turn sold to OEMs. MM used its 11-person sales force to call on customers purchasing larger volumes of motors, although large-volume customers occasionally also purchased motors through distributors. No contractual obligations locked customers into a long-term relationship with MM. In addition to changing a motor's list price, MM's sales representatives had discretion regarding both the discount for large-volume customers and the discount for distributors. The discount structure influenced the motor's net price to customers. Large-volume purchasers of motors received a 12% discount. MM currently offered its distributors the same discount that it offered to large-volume purchasers it served directly. As a result, the net price to large-volume customers was typically lower than the net price paid by smaller-volume customers who were served by MM's distributor base.

Each year, MM spent over \$2.5 million on sales, general, and administrative expenses. Over 75% of the total SG&A expenditures went directly to compensate the sales force (the balance was spent on marketing communications and training). However, the company also invested in training and professional development for the sales reps. Sales reps typically earned a base salary of \$100,000, plus a bonus directly related to the

growth of revenue in their “book of business.” The typical rep was responsible for \$1 million in revenues and received an average annual bonus of \$100,000. To ensure that its sales reps were performing, MM frequently hired and fired reps based on the company’s evolving requirements. The sales reps spent most of their time retaining their large-volume customers, although they did spend some time on new customer acquisition, occasionally creating conflict with distributors.

The relationship between MM and its customers was a close one, and it involved a constant dialogue between many participants on both sides, including engineers, sales representatives, procurement staff, and product managers. They worked together to resolve problems that arose with product specifications, product performance, delivery schedules, shipping arrangements,

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manufacturing process planning, product service, product liability issues, and so on. The quality of these relationships and the benefits gained by both sides were critically important to MM. MM commissioned \$200,000 in market research annually in order to gain information about customer preferences and about its performance on key purchasing criteria relative to the competition. In addition, MM required its sales reps to submit formal reports to product development staff. The market research gave MM’s sales representatives a better understanding of the marketplace and

improved their effectiveness in daily interactions with OEM customers.

Furthermore, the senior management at MM used the strategic insights from the market research and sales reports to plan and allocate R&D spending on feature-performance improvements to its BLDC motors.

The Challenge for MM's CEO2

As the newly appointed Chief Executive Officer of Minnesota Micromotors, Inc., you are now responsible for designing the company's marketing strategy. This includes determining all aspects of the company's go-to-market approach (including sales-force deployment and distribution-channel strategy) and associated elements of product policy, including pricing and market positioning of the company's orthopedic motor line. You will need to make critical decisions regarding how marketing resources such as sales-force time and market-research funds should be allocated. You will also need to determine how MM will meet the needs of the market and its intended customer base. In doing so, you should understand how market segments value MM's product offering, and you will need to decide whether and how MM's positioning relative to segment needs and behaviors should change.