Kellogg School of Management

KEL099

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MRT Micro: The CardioScope

The practice of medicine is the practice of acquiring, managing, and acting on patient information throughout the continuum of care . . .

—Chris Macmanus, CIO for Beth Israel healthcare

The snow was falling silently, making perfect conditions for cross-country skiing in the tranquil woods around Oslo. On this afternoon late in February 1996, Peter Nylund, an MBA student at Northwestern University, was preparing to present his team's findings to Jan Bakke, founder and chairman of MRT Micro A.S. Earlier in the week a journalist from *BYTE* magazine had left MRT's offices with the promise of a highly visible article about the company and its products. Bakke felt that tremendous worldwide opportunities were about to open up for his firm's products. In particular, the company had high expectations for its soon-to-be-released product CardioScope, a unique electrocardiograph (EKG) monitoring system developed for the healthcare market.

As founder and chairman of MRT since 1992, Jan Bakke had high ambitions for the company. In contrast to many other start-up companies, MRT had succeeded in bringing a number of products to the market in a period of less than four years. CardioScope had received excellent feedback from tests in markets throughout Europe, Asia, and Africa. With increased publicity and market awareness, Bakke felt that CardioScope would be ready for launch in the U.S. market, by far the largest healthcare market in the world. In order for MRT to reach its corporate goal, "to move the company into a position of global dominance in its selected market niche by the year 2000," Bakke knew it would have to be successful in the United States.

With U.S. Food and Drug Administration (FDA) approval only a couple of months away, Bakke had commissioned Nylund to form a team to thoroughly analyze the U.S. market. The team's goal was to develop a CardioScope product market entry and positioning strategy for MRT. Now, as Nylund prepared to give his team's presentation, he reviewed the work they had put together.

Company Background

MRT Micro A.S. was incorporated in August of 1992 as a private, limited company. Originally, the firm's main source of revenue was its technical consulting services. Bakke, however, perceived this business only as a means of keeping a talented staff relentlessly focused on developing their own products. His ambition was to develop unique high-technology products

and successfully bring these to the marketplace. In January 1995, after three years of successful product development, MRT decided to exit the consulting business. The time had come to devote all the company's resources to capitalizing on its exciting new technologies and building its marketing knowledge.

MRT's technological expertise was built upon its research and development (R&D) activities and the development of long-term, close relationships with local academic research resources such as the Norwegian Institute of Technology (NTH), the Technical Research Institute (SINTEF), and the University of Oslo. Financial and marketing support was ensured through close connections with the Norwegian telecommunications provider Telenor, as well as Statoil, Norway's largest corporation and one of the largest oil and gas companies in Europe. In its medical product R&D, MRT had also developed close relationships with leading Norwegian hospitals and with Norway's largest pharmaceutical company, Hafslund Nycomed. In addition, MRT had created informal relationships with Ameritech, Nokia, Cirrus Logic, NEC, and TDK in the areas of imaging and telecommunications.

The engineers at MRT came from widely varying industries. Collectively, the company had experience in areas such as instrument technology used in oil and gas exploration, imaging technology for the graphics industry, software for engineering and data mining, and miscellaneous equipment for medical use. Paired with an entrepreneurial culture, this mix of experience had resulted in rapid product innovations and a diverse product portfolio. The development of CardioScope was an example of the company's ability to integrate different technologies, including systems engineering, software development, parallel processing, image processing, database systems, electro-optics, and medical systems (**Exhibit 1** provides a description of other product lines that MRT had brought to market).

Electrocardiograph Equipment

EKGs were part of a wide category of medical equipment generically known as "patient monitors." EKGs worked by converting the analog signals created in a patient's body into digital data. They were used to monitor a patient's body and heart rate during initial patient diagnosis, testing, surgery, and post-surgery. EKGs could be used in the early detection of heart conditions that required treatment before they became critical. The patient could be treated at an early stage, increasing the chances of controlling the problem and decreasing expenses by reducing emergency hospitalization and more complex care.

Traditionally, the EKG marketplace consisted of three types of machines: electrocardiographs, long-term electrocardiographs, and cardiac telemetry systems. Electrocardiographs were stand-alone machines often used with stress testing systems such as exercise bicycles. Long-term electrocardiographs, such as Holter systems or event recorders, were often portable machines that were attached to a patient. Finally, cardiac telemetry systems were less-intensive monitoring devices that offered communications functionality, either via network or modem connections (**Exhibit 2** shows the composition and growth rates of the U.S. EKG market).

EKG products were of two types: "smart" EKG systems, which offered interpretive analysis of the EKG readings, and "dumb" systems, which performed noninterpretive monitoring only. The interpretive systems utilized software that varied in accuracy and user friendliness. EKG systems also came with a different number of "channels." The most common configurations were

single-channel, four-channel, and twelve-channel. The number of channels referred to the number of observation points or electrodes that could be mounted on an individual patient. A higher number of channels increased flexibility and reduced the chances of erroneous readings.

CardioScope

MRT's product, CardioScope, was a system that enabled physicians to measure, analyze, and log EKG data on a personal desktop or portable computer. CardioScope could be used with any Windows-based PC. Several of its features could be customized to fit customer needs. First, the product was offered with either an Industry Standard Adapter (ISA) card for desktop PCs or a Personal Computer Memory Card International Association (PCMCIA) card for portable PCs. Second, a single-machine license was available for individual users, or a multi-machine license was available for groups of users on a network (see **Figure 1**).

Figure 1: Configurations

I.	CardioScope w/ ISA card: For desktop PCs
	CardioScope w/ PCMCIA card: For portable PCs
II.	Stand-alone PC: For individual users. Can be online with remote physician via modem.
	Network installation: For groups of users (hospitals, physician groups, etc.)

In addition, each CardioScope configuration was available with different channel offerings (see **Figure 2**).

Figure 2: Channel Offerings

Single-channel: One electrode mounted on the patient. For long-term monitoring of heart rate only.
Four-channel: Four electrodes mounted around the heart region. Noncritical observation.
Twelve-channel: Twelve electrodes. Full-scale monitoring of heart and circulation.

The base product consisted of software for diagnosis and image processing, an ISA or PCMCIA card for installation in a PC, a box for receiving signals from the patient, and all necessary cables (**Exhibit 3** shows a graphic representation of the system). Purchasers of the machine would provide their own analog sensors at a minor cost. The EKG data was stored as a file on a stand-alone PC or server. MRT expected the technology used in CardioScope to have a lifetime of three to five years before new and improved technologies were developed. In the meantime, periodic updates and improvements in the software and hardware would be required. On the other hand, many buyers had indicated that they expected that their recently acquired EKG equipment would be sufficient and would not be replaced for another ten years. Prices for single-channel EKG units were typically $1,400 to $2,000. Multi-channel equipment was most often priced in the $3,500 to $6,000 range.

MRT believed that CardioScope offered several benefits over existing products in the marketplace. First, by using CardioScope, EKGs could be captured once during initial diagnosis and shared with multiple departments. Hospitals would lower costs by decreasing the usage of skilled cardiologists for every reading. Hospitals could also reduce costs with CardioScope's storage capabilities, which provided the opportunity for remote monitoring and diagnosis using a modem or other network communications device.

Second, CardioScope's software was more sophisticated than any competing product. The software provided an automatic diagnosis of a patient's heart condition and gave physicians information to make better decisions. CardioScope's expert system could analyze EKGs for abnormalities and provide a "second set of eyes" to aid physicians in interpreting EKGs. Physicians could annotate the patient's readings with text comments, which could then be shared with other physicians.

Also, the computer used to run the CardioScope software could be used as a normal PC to perform other tasks. This feature significantly reduced the incremental equipment cost to customers who already had PCs or were planning to acquire additional PCs anyway.

Competing products typically stored EKG data as a graphical image on disk, which required large amounts of storage space. CardioScope stored EKG data digitally on disk, which could then be retrieved and used to reconstruct the original graphical representation of an EKG. This efficient method of data storage, using numerical vectors rather than images, meant a file with twenty seconds of EKG registration would require only 45 KB of storage. An equivalent graphical image file would be five to ten times as large. The size efficiency resulted in tremendous speed advantages when transferring EKG data over a network or by modem.

Finally, the PC platform allowed for easier upgrading of both hardware and software, and offered flexibility in integrating the product into multiple architectures.

Even though only fifty machines had been shipped by January 1996, CardioScope had received very favorable reviews from testers and users. Jan Amlie, a professor in cardiology at Rikshospitalet University Hospital in Oslo, noted in *Medical Technology International*, "For me, it looks like this technology will be the future direction in EKG analysis."

International Expansion for the CardioScope

The company's vision was to become a market-oriented product development company with worldwide sales and recognition. By January 1996 CardioScope had been sold in the UK, Germany, Italy, Spain, Greece, Finland, Denmark, Hungary, Saudi Arabia, countries in Asia, and South Africa. In many of these markets, the product was still undergoing thorough testing. At this early stage, CardioScope had achieved its largest contracts in South Africa, where an enthusiastic distributor had managed to build a network of CardioScope users.

MRT planned to enter the U.S. market in the second quarter of 1996. This represented a significant challenge and would require consistent focus on marketing and sales. Starting in January 1996, all international activities would be organized under a separate legal entity, MRT International, with offices in Germany, the United States, and England.

Market Trends

The worldwide market for cardiac monitoring equipment was conservatively estimated to be around $370 million per year and growing at 4 percent per year.[1] Several important changes were shaping the EKG product marketplace. Increasingly, small and midsize companies were capitalizing on these changes.[2]

Aging of the Population

The aging of the U.S. population was leading to increased emphasis on cardiovascular diseases. Statistics indicated that one in every four individuals reaching the age of 50 would experience cardiac problems in their lifetime. Twelve percent of the U.S. population was over age 65, with people over age 85 comprising the fastest-growing population segment. More than four out of five people over the age of 65 had a chronic health problem, with only 5 percent in nursing homes at any one time.[3]

Government Regulations and Reform Issues

More stringent reimbursement procedures forced hospitals to manage with reduced revenues. The emphasis on cost containment increased the need for earlier, accurate patient diagnosis and the movement of healthcare provision to nonhospital providers or the home. This situation led to a greater need for Holter systems (long-term monitoring), event recorders, and cardiac rehabilitation telemetry systems.[4] Additional governmental regulation was increasing product approval time, a major obstacle for firms attempting to grow internationally.

Increasing Power of HMOs

The growth of enrollment in health maintenance organizations (HMOs) had enabled them to demand reduced prices from hospitals and specialists in an effort to rein in skyrocketing healthcare costs. Hospitals were being forced to operate with tighter margins, making cost reduction initiatives a major priority. As a result, hospitals were implementing procedures to reduce the average length of a patient's stay. This trend, in turn, was expected to increase outpatient surgery and to drive more post-operative monitoring into the hands of primary care physicians as well as directly into the patient's home.

Technological Innovations

The development of improved recording, scanning, and storage technologies was increasing the variety of tasks that EKG machines could perform. Products that used efficient data storage

[1] "World Cardiac Sales to Grow at 4% Rate, Paced by Telemetry, Emerging Markets and Aging Population," *Business Wire*, June 27, 1995.

[2] Frost & Sullivan, *World Cardiac Diagnostic Equipment and Telemetry Monitoring Markets Report* (1995).

[3] *Benefits Quarterly*, 1st quarter, 1992.

[4] "World Cardiac Sales to Grow at 4% Rate."

methods and telecommunications transmission standards were becoming more popular. Globally, there was a wide variety of both communication and data format standards in use. Common hardware platforms provided the ability to upgrade easily, decreased the risk of being restricted to a single vendor, and allowed integration of new products into existing customer product configurations. This benefit also reduced overall product cost and promoted compatibility among vendors. A big advantage of the PC platform was the ability to develop specialized software, thereby increasing product functionality.

Standard for Automated EKG Analysis

MRT's proposed market expansion into the United States was coming at a time when industry standards for EKG interpretation were beginning to be discussed. In 1994 a proposal for an international standard for electrocardiograph recording, measurement, and analysis was presented to the International Electrotechnical Commission (IEC). This proposal was the first attempt at standardization of measurement and interpretive results. Key advantages of the CardioScope were its use of a proprietary EKG interpretation and its digital storage methods. However, it was unclear whether MRT could convince the industry to accept its approach as a "standard." On one hand, MRT's relatively small size limited its power to push a "standard." On the other hand, its partnerships with several leading cardiology institutions and CardioScope's globally positive feedback increased its leverage within the cardiology community. However, a standard for interpreting results remained highly debatable, and therefore was not expected for several years.

Competition

Frost & Sullivan, a market research firm, estimated that there were approximately 95 firms selling products in the EKG marketplace in 1995. (**Exhibit 4** shows the world market shares for major competitors for each type of EKG product, and **Exhibit 5** compares various marketing dimensions for each major competitor.) Major competitor profiles are described below.

Marquette Electronics

Marquette's goal was to be the premier provider of medical electronics equipment and systems used for clinical diagnosis, monitoring, and patient information integration. Marquette's strategy was to partner with customers and establish long-term relationships and product leadership. Major products included patient monitors, clinical information systems, and cardiac catheterization equipment.[5] EKGs and other patient monitors were handled within the diagnostic division, which made up 25 percent of Marquette's total 1995 sales. Marquette had recently formed a partnership with Nihon Kohden, another EKG patient monitor manufacturer, whereby Nihon Kohden had exclusive distribution rights for Marquette's products in Japan. Marquette's 1994 sales revenues were $253.8 million, and it had more than 1,300 employees worldwide. Marquette was estimated to have about 24 percent of the interpretive EKG market and 32 percent

[5] Frost & Sullivan, *World Cardiac Diagnostic Equipment*, 8–32.

of the stress testing market. The MAC-VU and MAC 8 line of products had the capability to support remote querying via modem. The MAC PC was an EKG machine with a PC platform.

Hewlett-Packard—Medical Products Group

Hewlett-Packard's Medical Products Group was known for innovative technology, brand awareness, and outstanding customer service. The company targeted the hospital marketplace, where it could leverage its technical expertise in providing unique solutions to difficult problems. HP made products for virtually every medical product industry segment. Using a dedicated sales force in the United States, HP had overall medical electronic product sales of $1.1 billion in 1994. Globally, HP had more than 600 sales and support offices in 110 countries. Lately, however, the Medical Products Group had been the only HP division with close to zero growth compared to an overall 25 percent growth for the corporation. Its primary product in this market was the TraceMaster EKG Management System. HP's system was a PC designed to automate the editing, routing, and storage of twelve-channel diagnostic electrocardiograms. The TraceMaster had multiple features, including an easy-to-use, full-screen color editor with online help, bar code readers, multiple station editing, and annotation; used industry standard databases; and supported automatic export of data to electronic billing systems. HP had recently introduced its Models 100 and 200, designed for use in physicians' offices, cardiology offices, and clinics. HP was estimated to have about 20 percent of the noninterpretive and 17 percent of the interpretive EKG market.

Burdick Incorporated

Burdick Incorporated was the market share leader in the interpretive EKG market with approximately 40 percent of the total market. Burdick targeted both the hospital and the physician market, but had a particularly strong position in the latter. One distributor claimed that Burdick had 80 to 85 percent of the physician market, in which the company had extremely strong brand loyalty. According to one physician, "You've got to have a Burdick in order to be in primary care." Burdick prided itself on designing easy-to-use products that offered more functionality than competing products. Burdick's products ranged in price from $1,500 to $2,000 for a single-channel unit, but the company also offered multi-channel units. Burdick typically sold through distributors and had 1994 revenues of $32.8 million. Burdick did not sell PC-based EKG units. However, because it had acquired Diagnostic Medical Instruments, Burdick had access to a new recording format known as hard drive recording, which was similar to the way a PC recorded information onto its hard drive.

SpaceLabs Medical

SpaceLabs concentrated on monitoring systems, including EKG tracking, and typically targeted emerging markets. The company utilized extensive R&D, with 1993 expenditures of $30 million. SpaceLabs also provided extensive customer service, including 24-hour access to its technical support center. Senior managers were assigned to stay in touch with individual clients. SpaceLabs did not sell PC-based EKG units. Its primary systems, which were based on Unix platforms, were highly integrated.

Fukuda Denshi

In the United States Fukuda established a subsidiary to handle marketing and sales. In 1994 revenues for the U.S. subsidiary were $13 million. The company offered a wide range of EKG machines. The second biggest EKG manufacturer in Japan, Fukuda Denshi developed and priced products to target the low end of the market. This strategy had been successful, complementing the shift away from hospitals and toward lower-cost outpatient care. Fukada was estimated to have 16 percent of the noninterpretive market, 11 percent of the interpretive market, and 7 percent of the stress testing market. Fukada did not offer a PC-based EKG machine.

Nihon Kohden

The market leader in Japan, Nihon offered products in all three categories. Its stated strategy was to focus on new product designs, cost competitiveness, and emerging global markets. Nihon had R&D facilities in both the United States and Europe. The company sold its products in the United States primarily through distributors and had 1994 corporate sales totaling more than $500 million. Nihon was estimated to have 8 percent of the noninterpretive and 5 percent of the interpretive EKG market. Nihon did not offer a PC-based EKG machine.

Cardiac Diagnostic and Monitoring Equipment End Users

The current market for EKG machines was divided into hospitals, physicians' offices (including primary care physicians and cardiology specialists), home healthcare, and nursing homes (see **Exhibit 6**).

Hospitals

Hospitals constituted the largest users of both cardiac diagnostic equipment and telemetry monitoring products. However, the number of hospitals had been decreasing since the early 1980s due to federal funding cutbacks and lower-than-expected occupancy rates, and was expected to continue to decrease in the short term (**Exhibit 7** shows various hospital market statistics). Hospitals were categorized as large, medium, or small sites. Small sites were primarily located in rural areas. The larger the hospital, the bigger the purchasing budget tended to be for each individual piece of equipment. Hospitals were traditionally divided into critical care areas and sub-acute facilities. Critical care areas included the operating room, post-anesthesia care unit (also called recovery room), and intensive care units. Sub-acute facilities included step-down units, outpatient facilities (rehabilitation centers located outside the main hospital), and cardiac service centers (units offering long-term EKG monitoring for small hospitals). Critical care units and cardiology departments were the largest EKG users, with an average of one EKG machine per twenty patients. Other departments, such as obstetrics or pediatrics, also required EKG equipment.

Physicians' Offices

Office-based physicians seldom dealt with emergency care. The use of cardiac diagnostic equipment was therefore limited to geriatric care, internal medicine, and cardiology practices only. However, certain outpatient procedures in gastroenterology and radiology also required cardiac monitoring devices. In this case four-channel EKGs were used. In other disciplines (such as pulmonary diseases or neurology), physicians preferred to perform more complex procedures using hospital facilities. The number of clinics specializing in cardiology was growing, with approximately 2,200 in the United States alone.

Home Healthcare and Nursing Homes

While the nursing home segment had remained stable over the past decade, the number of patients treated at home had increased. In this segment, there had been an increasing need for both monitoring devices and cardiac diagnosis equipment. Parallel growth had been seen in the $650 million U.S. home health test products market, which was driven by many of the same factors. Because EKG results were analyzed only by physicians, the problem had been the difficulty of transmitting quality graphic data to physicians. Advances in data transmission might improve this situation.

The Buying Process

In the hospital segment, the EKG purchasing function was handled by each unit manager. When the cost of a given product exceeded $6,000 per year, the unit manager had to get approval from the hospital's central administration. Apart from the hospital, most other segments had a centralized buying function handled either by an administrator, the physicians, or the head nurse (**Exhibit 8** provides a summary of purchase influence).

Administrators were the final decision makers, and they focused primarily on budgetary concerns. They relied on the actual equipment users to make recommendations about the benefits of a given system. In general, physicians did not want to be involved in the buying process for EKGs. They were just looking for an easily readable print-out. The technicians and nurses operating the systems had greater influence over purchasing decisions. They were looking for analysis support, an easy-to-use system, and a high degree of automation. Even skilled EKG technicians at larger hospitals emphasized the importance of "fewer buttons to push." Finally, the system had to be mobile and, most importantly, reliable. Typical buying behavior reflected the following:

- Buyers who were brand loyal. Well-known names were important, and buyers tended to trust the name they saw every day because it was "proven equipment." They were usually hesitant to purchase equipment from small, unknown companies.
- Buyers who looked at manufacturers with a proven track record. These firms should be working with well-known institutions to develop their products.
- Buyers who depended primarily on medical sales representatives to learn about new technology development.

It was crucial for sales representatives to build a good reputation and have a long-term relationship with their clients. As one physician said, "If the detail man [sales representative] has a bad reputation, everyone goes into hiding when he comes." Articles in specialized magazines were also another source of information. Physicians had also started using the Internet as an information-gathering source.

Distribution

Several factors influenced the choice of channels. First, MRT needed to build up a reputation in the U.S. market. According to Linn Bakke, MRT marketing manager, "More than any other [MRT] product, CardioScope must be sold to the customers via product demonstrations, system trials, and with references to successful installations and satisfied doctors and hospitals." Second, MRT was working on an upgraded version of the CardioScope and needed to foster a long-term relationship with its customers. Finally, MRT had no experience in this market and needed to establish a feedback loop that would enable its marketing group to improve its product and strategy over time. Once the target market was defined, MRT could decide what service outputs were required by its customers. For example, in servicing smaller accounts, MRT could provide financing options. In servicing home healthcare, MRT could provide training for the nursing staff using their PC with the CardioScope applications. **Exhibit 9** shows MRT's use of marketing channels.

OEMs and VARs

In the United States, MRT could work with both the original equipment manufacturers (OEMs) and value-added resellers (VARs), as it did in Europe. In the medical industry, manufacturers often wanted the channel members who resold their hardware or software to "add value" to their products by developing specific information-processing solutions for individual clients. For example, the CardioScope could be integrated into PCs sold to care centers or into patient administration systems. MRT would provide technical support, product customization, OEM labeling, and rapid product delivery. The medical information service industry as a whole had revenues of $1.2 billion in 1995. Fueled by technological advances and a broader acceptance of information technology, industry sales were expected to reach $6.0–7.2 billion by the year 2000.[6] Physician Computer Network Inc. (PCNI) was the largest provider among more than 1,000 smaller and regional firms competing in the VAR market. PCNI estimated its market share in 1995 to be 27 percent. Other larger system providers that focused more on hospitals and larger physician groups were companies such as Oracle and Hewlett-Packard. Through advertisements in specialized magazines, MRT had already received very interesting inquiries from OEMs. Horizontal channel options included national distributors, regional distributors, manufacturers' representatives, and mail-order stores.

[6] Estimates were based on industry interviews conducted by the authors.

The Distributors

The choice of distributors implied a trade-off between the influence MRT would have over the distributor and the reputation of the distributor. The market was dominated in the hospital segment by three players that covered 80 percent of the market: Baxter, Owens & Miner, and General Medical. General Medical and Physicians Supply Services covered 30 percent of the physician market. ABBI was one of the bigger distributors in the home care segment. All other segments were characterized by a multitude of small players (**Exhibit 10** provides an overview). In the medical equipment industry, there were few exclusive contracts between manufacturers and distributors. Only large manufacturers such as Johnson & Johnson and 3M had special contracts with national distributors. Many of the smaller players tried to specialize in a certain field (such as cardiac diagnostic equipment) and offered a complete selection of competing brands.

Manufacturer Representatives

Manufacturer representatives are independent salespeople who represent various manufacturers and work on a contractually stipulated commission basis. They were already used by MRT in many countries to expand the CardioScope market. The principal limitation in using them was that they were often not able to provide after-sales follow-up and service. The nature of their reward structure pushed them to reduce their sales cycle and look at short-term gains.

Mail-Order Stores

This sales channel was handled almost exclusively by distributors.

MRT was not looking at one channel in particular, but rather at a mix of different channels in order to best reach its target market and satisfy both its short-term and long-term objectives. In addition, MRT was giving consideration to opening a sales office in the United States. An additional goal was to expand its comprehensive technical support system.

Promotion

MRT had earned a reputation for quality and insight with its product brochures, press releases, and advertising materials. Products were promoted in a number of ways, including direct marketing (MRT distributors were supplied with product flyers and encouraged to carry out targeted mailing campaigns), presentations to sales channels, sales meetings, and seminars. Completing the mix were exhibitions, equipment demonstrations to target customers, reference sales and installations, and finally, advertising. Products were promoted throughout their lifetime. MRT also printed a regular newsletter to keep both customers and sales channels aware of new products, latest releases, updates, and new applications.

MRT had found through market testing that advertising in highly specialized journals and magazines provided the highest return per dollar invested. Consequently, MRT hired a marketing communications consultant based in Chicago to generate awareness in the U.S. market. The company developed its own Web server so that it could be reached via the Internet.

Pricing

Traditionally, pricing in the healthcare market had not been a problem for suppliers of medical equipment. Costs were usually not an issue as long as the product had the necessary technology and features. It was the same situation for the field of EKG technology; prices had been determined by the cost-plus method. Restructuring of healthcare in the United States, however, had changed the focus towards cost efficiency. This change had opened up opportunities for companies that could offer standardized, low-cost solutions. MRT believed this was a positive development for CardioScope. It would be priced significantly lower than equivalent products in the market and could be viewed as an incremental purchase since many sites already had a PC and therefore needed only the CardioScope software.

Price sensitivity varied across segments. For a hospital or a physician group, acquiring EKG equipment was likely to comprise a very small part of the total equipment budget, while it could be the only expensive equipment owned by primary care physicians or nursing homes. In addition, brand loyalty and a long product lifetime (ten years) were expected to influence the price sensitivity for EKG equipment. According to one of the smaller distributors, brand loyalty was especially high among physicians, who were skeptical about small companies and new entrants into the market. For a new product to have success, it needed to be technically better than the market leader and be sold at a price that was 30 to 40 percent lower. Whether the distributor offered service was also of great importance in choosing where to buy the machine. **Exhibit 11** shows the CardioScope pricing scheme.

Targeting and Positioning

In trial markets, MRT had taken the approach of targeting "any care provider that had a need for electrocardiographs." In Europe, the company received the best response from hospitals and cardiologists. In Asia, the office-based physician market had responded more positively. In the United States, Linn Bakke felt that MRT should adopt a focused strategy because the general U.S. market was too vast for a company like MRT. The company had to find a niche market where it could develop a brand name and leverage that knowledge in the future. He felt that the hospital as end user offered several segmentation possibilities in the United States.

Mobile Intensive Care

The CardioScope could be used as a traveling device in ambulances dispatched to the scene of an accident. EKG results could be sent via modem to the hospital during transit so that interpretation could be performed before the patient arrived at the hospital. This process would allow surgeons to prepare for an appropriate surgical procedure in advance, thus reducing stress, saving precious time, and increasing patient survival.

Critical Care Area

EKG monitoring was most heavily performed in the critical care area within the hospital. The analysis feature of the CardioScope would be particularly beneficial to doctors in this situation by providing a "second opinion" and reducing the chances of a misdiagnosis that could cost lives.

Pre- and Post-Operative Care

Pre- and post-operative care would include all inpatient monitoring required before and after a surgical procedure. This segment offered a less risky environment that catered particularly to another of the CardioScope's advantages: the ability to share EKG readings across departments.

Home Care

Although hospitals were not currently making use of notebook PCs, Bakke felt that the "notebook" version of the CardioScope would allow hospitals to offer home monitoring as a service option for surgical treatment. Patients could "check out" a notebook computer and perform monitoring at home. Then the patient could send the results via modem back to the hospital for analysis.

With future development of the product (integrating the use of PCMCIA technology), MRT believed that the CardioScope could be targeted to any of the above segments and solve three of the biggest concerns in hospitals today:

1. Obtaining EKGs in different departments without cardiologists to evaluate them.

2. Providing more complete information upon which to base decisions.

3. Offering expert analysis, which would provide doctors and administrators with a valuable "second opinion."

Bakke understood that a successful launch in the United States was critical to achieving MRT's goal of "global dominance in its selected market niche by the year 2000." Whatever target market was ultimately chosen, he realized that a sound marketing strategy must consider implications of the targeting decision for the entire marketing mix in the short and the long term.

Exhibit 1: MRT Product Lines

IMAGING PRODUCTS: VIDEOPORT PROFESSIONAL, IMAGE OFFICE, IMAGE WIZARD

These products used MRT's PC card technology (PCMCIA Type I) to transform analog signals to digital data. The technology was made for notebook computers and allowed users to capture high-resolution color images from standard video signal sources such as video camcorders, video players, and television. These three products were packaged and configured to target three different markets: professional graphic designers, businesses using video and PCs in their daily operations, and the home market. The products were sold with a software package for image enhancement and manipulation. Imaging products were also supplied with connecting cables, a user manual, additional drivers, and utilities for use with standard applications such as Microsoft Office. MRT had also developed two adapters, PCMCIA to ISA and PCMCIA to PCI, allowing customers to use the system in portable and desktop PCs.

IMAGENET AND IMAGECONFERENCE

These were also video imaging products. These two products would allow MRT to enter the Internet and the video conferencing markets when they were launched in the first quarter of 1996.

ADAPTER PCMCIA TO ISA AND PCI

These adapters were sold as stand-alone products, together with the previously mentioned imaging products, or to the OEM market. Customers could use the imaging products on portable and desktop PCs.

OBSERVER PRODUCT SERIES

Observer Remote was designed for the surveillance and information market. Fitted with a modem, the camera could be connected to a telephone line for remote control and data transfer. Observer Remote was capable of continuously capturing a series of images in remote locations. Including digital input/output capability, the alarm function could be triggered by external devices such as infrared motion sensors. Upon alarm, the system could call up a predetermined telephone number and transfer the alarm data and alarm images to a central PC. Alternatively, Observer Remote could be used as a flexible time-lapse video imaging capture system that could be programmed and interrogated remotely to retrieve stored images.

Other specialized models of the Observer camera system would be released, aimed at specific markets in the same way as the Remote model. Observer General was a general-purpose compact image processing and storage system. Observer General would be an attractive product for the OEM market and integrators of machine vision system hardware and software.

CARDIOSCOPE

The CardioScope system for stationary and portable markets would open segments such as intensive care, ambulances, and home care. The new system used MRT's knowledge in PCMCIA (PC card) technology, fiber optics, and data communication. MRT had also planned to develop a repeater system for the hospital. The new CardioScope system would run on mobile communication as well as normal data networks. The CardioScope consisted of a PCMCIA or ISA bus card, EKG leads, and Windows software. When installed in a medical-use-approved PC, the product became a complete EKG workstation, with expert system analysis of measured EKG signals and the capability to maintain a complete patient database.

The essential feature of CardioScope that provided the necessary competitive edge was the expert system software for automatic EKG signal analysis. This software provided automatic diagnosis of a patient's heart conditions. Although it was not meant to replace the cardiograph's expert assessment, it provided additional information and a "second opinion" that would prove extremely valuable. It also drew attention to minor irregularities that might otherwise go unnoticed.

DATA MINING AND SMARTDISK

Data Mining was an information retrieval technology to be launched in 1997. The Smart Disk used this technology combined with MRT's PCMCIA card. The OEM market product had been the most successful.

Exhibit 2: U.S. Cardiac Diagnostic Equipment Revenue Forecasts

Year	Total Market Revenue ($ in millions)	EKG[a] (%)	LTE[b] (%)	Telemetry[c] (%)
1991	324.0	38.7	27.4	33.9
1992	334.0	38.2	26.8	35.0
1993	344.1	37.2	26.6	36.2
1994	353.4	36.6	25.8	37.6
1995	363.1	36.0	25.0	38.9
1996	371.8	35.7	24.6	39.7
1997	387.6	35.3	23.8	40.9
1998	403.5	34.8	23.2	42.0
1999	420.5	34.5	22.5	43.0
2000	438.3	34.1	22.2	43.7
2001	456.4	33.8	21.9	44.3

Source: Frost & Sullivan, *World Cardiac Diagnostic Equipment and Telemetry Monitoring Market Report* (1995).

[a] Electrocardiograph.

[b] Long-term electrocardiograph (patient-worn recording device).

[c] Cardiac telemetry system that consisted of transmitters, receivers, and central stations used together in less-intensive monitoring areas of the hospital.

Exhibit 3: Graphic Representation of CardioScope

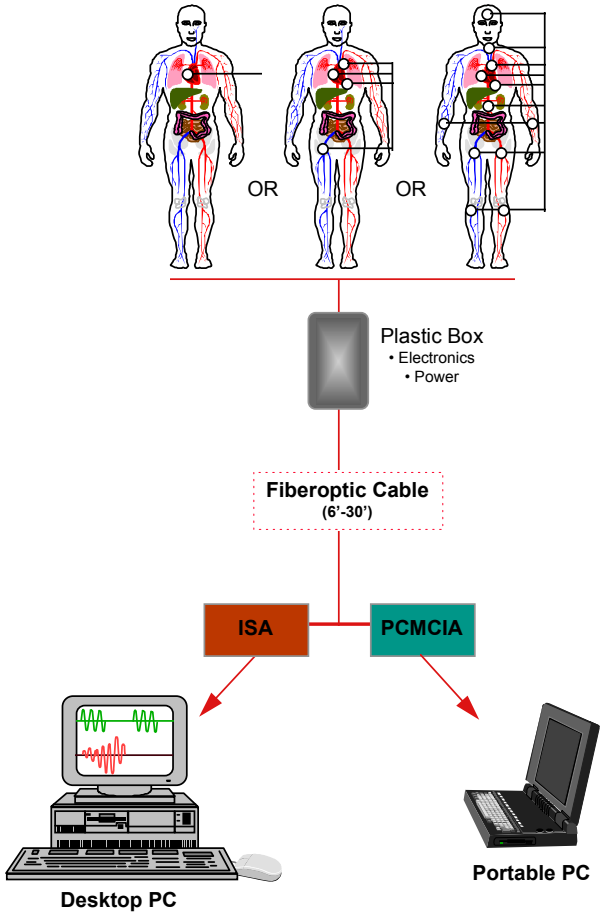


Exhibit 4: Competitive Market Share Data

	Noninterpretive EKG		Interpretive EKG		Stress Testing EKG	
Company	1991 (%)	1994 (%)	1991 (%)	1994 (%)	1991 (%)	1994 (%)
Burdick	—	28	—	16	—	10
Fukuda Denshi	16	16	12	11	—	7
Hewlett-Packard	24	20	18	17	—	—
Marquette	—	—	31	28	—	32
Nihon Kohden	8	8	7	5	—	—
Quinton	—	—	—	—	—	37
Schiller	8	15	6	13	—	—
Siemens-Burdick	39	—	17	—	—	—
Others	5	13	9	10	—	14

Company	Hospital Holter 1994 (%)	Nonhospital Holter 1994 (%)	Event Recorder 1994 (%)	Step-Down Telemetry 1994 (%)	Cardiac Rehab 1994 (%)
Accrocore	—	—	—	6	—
Advanced Med	—	8	—	—	—
Aerotel	—	—	10	—	—
Burdick	—	5	—	—	—
Datascope	—	—	—	4	—
Del Mar Avionics	23	16	—	—	—
Fukada Denshi	—	4	—	—	—
Hewlett-Packard	—	—	—	26	—
Instromedix	—	—	61	—	—
Marquette	19	12	—	—	—
Medical Data	—	—	—	3	—
Nihon Kohden	—	—	—	3	5
Oxford Medical	11	—	—	—	—
Quinton	—	—	—	—	53
Ralin Medical	—	—	6	—	—
Rozinn Electron	—	5	—	—	—
Scott Care	—	—	—	—	29
Siemens	—	—	—	4	—
SpaceLabs	—	7	—	22	—
TZ Medical	—	—	15	—	—
Zymed	14	14	—	3	—
Others	37	29	8	11	16

Source: Frost & Sullivan, *World Cardiac Equipment.*

Exhibit 5: Comparison of Major Competitive Product Offerings

	Marketing Dimension			
	Product	Price	Place (Distribution)	Promotion
Burdick Inc.	Burdick E500 Interpretative, Burdick EK-670, Burdick EK-6, also sold the Burdick Analysis program for EKG interpretation	$1,547–$3,000	Distributors	Market leader, 40 percent share, typically used by physicians
CardioPerfect	Offered Windows or DOS PC-based EKG, interpretation software, 3, 6, or 12 channels, modem transmission	N/A	Direct ordering, distributors	Trade magazines
Fukuda Denshi	FX1201—noninterpretive FCP 2101, 2201, 4104A DS330—telemetry	N/A	Established U.S. subsidiary, Fukuda Denshi America, to handle distribution in U.S.	Typically used by physicians, sells to nonhospitals
Hewlett-Packard	TraceMaster EKG System, PageWriter series, M1730A TraceMaster, Personal Holter System, HP1505, HP1517A, HP4700A, Model Xli—interpretive	$2,750–$4,750 $8,795 N/A	Direct sales force, national coverage	Trade shows, targets hospitals and other large customers
Marquette	MUSE 5000—accepted a full spectrum of data from various cardiology equipment. MAC-VU, MAC8, MAC15, MAC6, MAC PC systems, MARS Holter. All products were interpretive.	N/A	Domestic sales force 24-hour technical support staff	Long-term partnerships with customers, especially with hospitals
Mortara Instruments	ELI 50, ELI 100, ELI 200—noninterpretive Portrait EKG—interpretive H-Scribe—PC-based Holter	N/A N/A $24,000	Sold directly through medical equipment dealers to OEM and customers	Consumer, trade
MRT CardioScope	MS 250: EKG Board, 12 channels, w/software S250-1: CardioScope w/software	US $1,990 US $820	TBD for U.S. Currently sold through three channels in Europe; direct sales force, OEM, and general distributors	Consumer, trade, retail? Advertising media? Positioning?
Nihon Kohden	Nihon Kohden 3403, EKG 5503, CNS-8351-A, PC system offering multiple parameter monitoring, including EKG. EKG 8830, telemetry system	N/A	Relied on its subsidiary, Nihon Kohden America for product distributions	Targeted toward physicians
Schiller America (sub of Schiller AG)	AT-3, AT-6, AT-60, CS-100—noninterpretive (can be purchased with 3.5” floppy or hard disk). Cardiovit AT-5—portable EKG	N/A	Schiller America was a marketing & sales division; direct sales force	Cardiovit produced for physicians’ office
SpaceLabs Medical	Universal Clinical Workstation, M90104A Holter, FT200 Cardiac Workstation, PCMS cardiac step-down	N/A	Key hospital account managers, 300 service representatives in U.S., 24-hour technical support	Targeted toward hospitals and non-U.S. markets

Exhibit 6: EKG Users

Institutions	Total Number	Potential Usage (avg.)	Equipment Type
Hospitals	5,619[b]		
Critical care units	N/A	1/20 patients	4- and 12-channel
Emergency rooms	N/A	1/20 patients	4- and 12-channel
Sub-acute facilities	N/A	1/20 patients	4-channel
Cardiology/-graphy	N/A	1/20 patients	4- and 12-channel
Other units	N/A	1/unit (based on surgery)	4- and 12-channel
Physicians (office-based)	398,804[c]		
Cardiospecialists	12,095[c]	1/office	4- and 12-channel
Internal medicine	67,329[c]	1/office	4- and 12-channel
Gastroenterology	6,293[c]	1/office	4-channel
Radiology	5,748[c]	1/office	4-channel
Nursing homes	14,744[a]	1/group	4- and 12-channel
Home healthcare	20,514[d]	1/group	4- and 12-channel

Source: American Hospital Association: Hospital Statistics, 1991–1994 editions.

Frost & Sullivan, *World Cardiac Equipment*.

[a] 1991.

[b] 1992.

[c] 1993.

[d] 1995.

Exhibit 7: Hospital Market Statistics

Size of Hospital	1975	1980	1985	1986	1987	1989	1990	1991	1992
					Number				
6–99 beds	3,196	3,196	2,751	2,732	2,736	2,646	2,584	2,541	2,480
100–199 beds	1,413	1,436	1,458	1,445	1,408	1,388	1,369	1,366	1,381
200–299 beds	701	742	765	781	776	766	773	763	770
300–499 beds	651	724	736	706	686	664	661	671	651
> 500 beds	349	374	381	371	361	344	341	334	337
Total	6,310	6,472	6,091	6,035	5,967	5,808	5,728	5,675	5,619
					% of Beds Occupied				
6–99 beds	61.1	60.6	48.4	47.3	47.8	49.0	49.7	49.9	49.5
100–199 beds	71.3	71.6	60.0	58.8	59.2	60.8	61.8	60.5	60.0
200–299 beds	77.1	77.3	65.9	65.5	65.6	66.9	67.3	66.8	66.6
300–499 beds	80.0	80.0	69.4	69.0	70.1	70.9	71.5	70.4	69.9
> 500 beds	80.9	81.9	74.9	74.9	75.6	76.5	76.6	76.2	76.4
					Total Expenses ($ in billions)				
6–99 beds	4.4	8.0	12.5	14.6	16.1	17.5	18.6	20.8	22.4
100–199 beds	7.1	13.4	22.5	26.5	29.4	32.7	35.4	39.2	43.3
200–299 beds	7.0	13.8	23.9	29.4	33.0	36.5	40.7	43.9	49.4
300–499 beds	11.3	23.7	40.3	45.5	50.0	55.0	60.4	67.4	73.1
> 500 beds	12.9	24.9	42.2	48.9	53.5	56.9	62.4	68.9	76.7
Total	42.7	83.8	141.4	164.9	182.0	198.6	217.5	240.2	264.9
					Expenses per Inpatient Day ($)				
6–99 beds	102	198	382	426	456	483	506	551	599
100–199 beds	119	219	409	481	520	561	595	654	708
200–299 beds	128	235	447	523	572	614	664	719	784
300–499 beds	138	257	482	569	615	679	733	803	893
> 500 beds	155	275	503	600	654	717	783	872	950
					Expenses per Inpatient Stay ($)				
6–99 beds	665	1,234	2,276	2,700	2,971	3,173	3,348	3,742	4,032
100–199 beds	865	1,554	2,739	3,301	3,603	3,913	4,204	4,558	4,926
200–299 beds	990	1,773	3,070	3,684	4,023	4,376	4,683	5,054	5,459
300–499 beds	1,147	2,047	3,535	4,161	4,569	5,007	5,352	5,748	6,251
> 500 beds	1,637	2,627	4,387	5,216	5,756	6,310	6,873	7,567	8,167

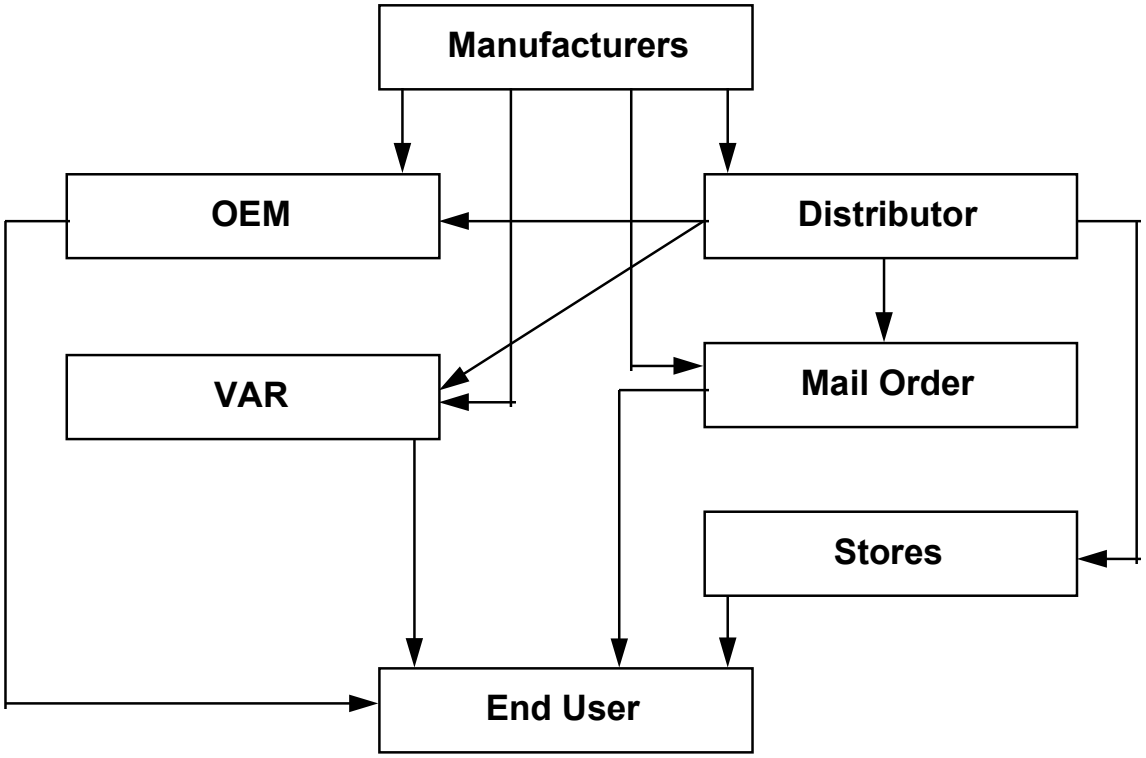
Source: American Hospital Association: Hospital Statistics, 1976, 1985–1994 editions; Frost & Sullivan, *World Cardiac Equipment*.

Exhibit 8: Purchase Influence

Decision Makers	Hospitals	Nursing Homes	Office-Based Practice	Home Care
Administrator	1	1	1	1
Unit managers	1	N/A	N/A	N/A
Technicians	2	N/A	2	N/A
Nursing staff	N/A	2	N/A	2
Head nurse/director of nursing	N/A	1	N/A	1
Physicians	3	3	2	3
Central office	3	N/A	N/A	N/A

Note: Primary Influencers = 1, Secondary Influencers = 2, Some Influence = 3

Exhibit 9: MRT's Use of Marketing Channels



OEM (original equipment manufacturer)
VAR (value-added reseller)

Exhibit 10: End-User Segment and Distributor Overview

Segment	Total Supply Market (in billions)	Growth Trend	Distributors	Annual Supply Sales (in billions)	Distributor MS%	Segment Comments
Hospitals	$12.4	Declining	Baxter	$5.400	45%	Big players
			Owens & Minor	$3.000	25%	Total system providers
			General Medical	$1.500	10%	Complex decision-making process
			Others	$2.500	20%	
Physicians (PPOs)	$3.3	Stagnant/ moderate	General Medical	$0.500	15%	A few big players, but also many small ones
			PSS	$0.325	10%	Fewer people involved in decision making
			Others	$2.475	75%	Brand loyalty/ease of use important; trend toward purchasing cooperation
Nursing homes	$2.7	Moderate/ high	Small specialists			Centralized decision power Low product/method competency Budget constrained—product not part of core service
Home care	$1.5	High	ABBI			Demand driven by trend in hospital segment
			Small specialists			Requires involvement of PPO and home nurse Requires significant training Product can generate new business for service providers

Source: Industry interviews (approximate figures).

Exhibit 11: MRT End-User Price List #05/95

Europe

Product #	Description (w/ PCMCIA & Multi-Channel)	Retail Price
MS 250	EKG board; 12 channels; w/ CardioScope software	$ 2,500
S250-1	CardioScope Windows software; single user	820
S250-5	CardioScope Windows software; 5-user kit	3,300
S250-10	CardioScope Windows software; 10-user kit	6,180
S250-15	CardioScope Windows software; 15-user kit	8,620
S250-20	CardioScope Windows software; 20-user kit	9,875

Planned U.S. Prices

	Retail	Wholesale
EKG board; 12 channels; w/ CardioScope software	$1,990	$1,200
EKG board; 4 channels; w/ CardioScope software	1,250	990