SMART MICROSENSOR: A CASE ANALYSIS

Feraidoon (Fred) Raafat, College of Business Administration, San Diego State University, San Diego, CA 92182, (619) 594-5685, fred.raafat@sdsu.edu
Don Sciglimpaglia, College of Business Administration, San Diego State University, San Diego, CA 92182, (619) 594-4435, Don Sciglimpaglia@sdsu.edu
Dylan Bach, Nam Nguyen, Ian Pawloski & John Wozniak, San Diego State University, San Diego, CA

ABSTRACT

This paper describes a marketing plan by a San Diego based high technology company for its new chemical sensor product line.

INTRODUCTION

Graduating San Diego State University MBA students, as a part of their academic program, complete a "real life" consulting project, in which faculty members participate and provide guidance. One such project was conducted for a high technology company, which we will call FD, which required assistance in determining and strategizing marketing plan for its new chemical sensors.

Company History

FD is a San Diego high technology company founded in the mid 1950's as a division of a large defense firm. It is currently privately held, employs approximately 5000 people and has facilities in various cities in the United States and across the world. One FD program of interest is the development of smart micro-sensors (E-SMART), devices used in automated sensor monitoring systems in government and commercial applications. Uses include assisting Homeland Security with threat assessments for potential nuclear, biological, and chemical (NBC) attacks as well as commercial environmental monitoring applications.

Background

Through funding from the Department of the Navy, FD developed a prototype Chemical Vapor Sensor (CVS) system capable of detecting gases produced from flaming and smoldering fires. The purpose of that project was to develop a fire detection sensor superior to those currently available used in both the surface and subsurface naval vessels. FD successfully developed and tested this technology, but was unable to sell the product to the Navy as a fire detection sensor.

FD determined that the uses for this product potentially extended far beyond fire detection applications. During a subsequent study, the CVS technology was proven to detect and quantify 13-15 gases in near real-time. The only gases that the sensor was not able detect are the so-called noble gases (odorless, colorless, gases, with very low chemical reactivity -- helium, neon, argon, krypton, xenon, and radon). Additional gases can be added to the product's capability through further testing and development. Based on this study, FD formed a partnership with an equipment sales company to develop and sell hand-held CVS devices using its smart micro-sensing technology through a licensing agreement. These

devices are marketed to hazardous materials (HAZMAT) response teams as a tool during chemical responses; however, FD would like to identify and explore other potential markets for this technology.

The toxic industrial chemical (TIC) detection market is largely dependent on Environment Protection Agency (EPA) and Occupational Safety and Health (OSHA) regulations and legislation governing emissions and processes that industries adopt to minimize emissions of hazardous gases and gas leaks which may result in an explosion or safety hazard. Demand for gas sensor equipment is largely driven by the need to monitor the presence of toxic gases, combustible gases or lower explosive limit gases, and the level of oxygen in the workplace or in a confined space.

Moreover, although the use of chemical warfare agents (CWA) against enemy forces during war has existed since the beginning of the 1900s, it was not until the 1990-1991 Gulf War that the threat and lethality of CWAs became more worrisome. Coalition forces feared that Iraq would use CWAs against them and troops were provided chemical detection equipment. However, they were bulky and cumbersome to operate and were sometimes faulty. In 1995, the threat from chemical attacks moved to the civilian arena when the Tokyo subway was filled with sarin gas. In this incident, 9% of emergency medical service providers suffered the effects of acute exposure. As a result, the rescue efforts were delayed. This threat was exacerbated by the events of 9-11 and the anthrax attacks that followed. These events highlighted the vulnerability to various threats on US soil and the potential for future CWA attacks.

Several different technologies are used today to detect chemical agents. A large variety of equipment is available that is capable of identifying liquid droplets of chemical agents on surfaces and in vapors. The main challenges with these technologies are selection of an appropriate sample for analysis and filtering out non-hazardous environmental chemicals that may be present.

PROJECT OBJECTIVES AND METHODOLOGY

The objective of this project was to provide U.S. market data to FD that would enable them to determine if they should pursue entry into the home fire/gas monitoring, industrial plant monitoring, commercial airline atmosphere monitoring, on-soldier monitoring, military vehicle mounted monitoring, and fence line monitoring markets. This analysis was designed to enable FD to determine the market attractiveness of the selected markets and entailed the following:

1. Entry strategy
2. SWOT analysis for the FD technology compared to the existing competition
3. Expert opinions of each market.
4. Market requirements (required certifications, product features and life requirements, potential liability issues and pricing)

The viability of each market segment was investigated to determine if there is a need for a product with the unique features of the FD's CVSs. This task was accomplished by using Internet searches, industry websites, company websites, annual reports, periodicals, library searches including LexisNexis, and professional journals for each market (as available). For established products, the key features that provide a competitive advantage and their respective price points were investigated. Additionally, the total market size of the products and market growth rate of each market segment were calculated or estimated. If a similar product did not exist in a particular market segment, an industry expert was asked

to provide an estimate of the market size for that product. Next, top targeted markets were further investigated based on the following criteria:

1. Key features: If the FD's CVSs could not include (or unable to include with reasonable modification) a key feature for the market segment, it was eliminated from the study.
2. Market size and growth potential: Larger markets with greater growth potential were given higher priority than the smaller ones.
3. Price point: Markets using higher priced CVS devices were given higher priority than markets with lower priced ones.

RESULTS OF STAGE 1 FINDINGS

The results of the investigation for each market are summarized below:

Home Fire and Gas Monitoring Market

The home fire and gas detection market includes fire/smoke alarms, carbon monoxide (CO) sensors, combination fire/CO sensors and radon sensors. The primary brands that were found in this market are First Alert, Firex, and Kidde. There are approximately 231 million smoke alarms in the U.S. of which 77 million are out of date. The smoke/fire alarm market has been growing due to the home construction market and government mandated smoke detector installation laws in 38 states and other municipalities. The price point ranges from $5 for low-end detectors to $70 for wireless units. Market data on the CO and combination fire/CO sensors is limited. However, the market size will increase if states mandate the installation of CO sensors in new homes. The price point for CO detectors ranges from $25 to $60 and the combination CO/fire detectors ranges from $40 to $60. The radon gas detector market is even more difficult to quantify. There are few competitors that offer a fixed unit electronic radon gas detector. The competing products to the electronic detectors are one-time use units, which are placed in a home for a period of time and then sent to a lab for analysis. The price point for the electronic detector is approximately $100, and the price point for the one-time use sensor ranges from $10 to $35. The price points for the home gas and fire/smoke market are too low to be profitable for the FD technology and hence this market was not pursued any further.

Industrial Plant Monitoring Market

The industrial plant monitoring market is a mature market and is well served with the existing product lines. The industrial plant monitoring equipment can be described as a fixed device used to monitor a specific location. The key feature of the products is the ability to detect particular gas or gases that maybe in use at the particular site. The technology used varies by specific chemical detection requirements and includes electrochemical, ionization, photoelectric, and catalytic bead. The major participants in the industrial plant monitoring market include Smiths Detection, Industrial Scientific Corporation, Gas Imaging Technology, Delphian, and Gas Measurement Instruments LTD. The current technologies available are reasonably priced (vary by application). The annual growth rate is estimated to be 3.8%.

Commercial Airline Atmosphere Monitoring Market

The key issues for the commercial airline monitoring market include the sensitivity of fire detection equipment, the ability to integrate with a fire suppression system, and the frequency of false alarms. The Federal Aviation Administration (FAA) is currently updating regulations regarding the detection of flaming and smoldering fires. Current FAA regulations stipulate that a fire detection system must be able to detect the fire within one minute of the start of the fire. The price of smoke detection/fire suppression systems currently ranges from $2,200 to $12,000. The total commercial airline market includes 14,315 existing aircraft with an additional 4,175 current orders.

On-Soldier Monitoring and Military Vehicle Mounted Monitoring Markets

The U.S. Department of Defense Joint Chemical Agent Detector (JCAD) is responsible for acquisition and distribution of devices to detect, identify, quantify, and warn personnel of nerve, blister, and blood chemical warfare agents (CWAs). It is expected that JACD to need about 280,000 units, which if FD would be awarded the contract, it become the leader of the chemical detection market. In order to win this contract, suppliers must demonstrate that the device can meet the required sensitivity levels and provide accurate warning. A major concern with the current technologies is that increasing sensitivity reduces reliability and vice versa. Smiths Detection currently supplies the U.K. Ministry of Defense with LCAD units - the unit price for an LCAD is approximately $7,000.

Fence Line Monitoring Market

The fence line monitoring market is divided into two segments based on the proximity of the sensor to the source of gas. The first segment uses technology that can detect the gas at a distance from the sensor, while the second segment uses technology that detects the gas when the gas and the sensor come in contact. The FD technology does not apply to the first segment and the market for in-gas sensing is primarily military. Competitors in this segment include Smiths Detection, Bruker, BAE, and General Dynamics. The fence line monitoring systems use the same basic chemical sensing units as the military vehicle mounted monitoring systems. The price point for the current equipment ranges from $5,000 to $20,000. For the purpose of this study, the three markets were combined into one as the military market.

RESULTS OF STAGE 2 FINDINGS

The markets selected from Stage 1 are the commercial airline atmosphere monitoring and military monitoring markets. The fence line monitoring, on-soldier monitoring, and vehicle mounted monitoring were combined into the military market due to the similarities in the technologies and applications.

Commercial Airline Market

The SWOT analysis for the FD's CVS in the commercial airline atmosphere monitoring market is as follows:

Strengths

- New technology that is able to detect and quantify multiple gases
- Superior sensitivity

- Compact and lightweight
- No moving parts

Weaknesses

- Major airplane manufacturers are hesitant to use unproven systems when current models are already working.
- Must pass certification process through FAA
- New in market and no reputation
- Not currently combined with suppression technology
- Product does not have required accreditations

Opportunities

- Reduce false positive/negative readings
- Improve sensitivity of current equipment
- Improved ability to detect smoldering and plastic fires
- Single sensor that can detect smoke/fire and chemical gases

Threats

- New technologies that are more sensitive and have lower false positive/negative rates
- Technologies that can detect biological or nuclear weapons
- Faster detection techniques

Market Requirements

The commercial airline atmosphere monitoring market is driven by FAA and Transportation Security Administration (TSA) requirements regarding certification of smoke detection, fire suppression, and false alarm rates. The FAA and other regulatory agencies throughout the world require that cargo compartments and lavatories on passenger-carrying aircraft be equipped with fire detection and suppression systems. Current regulations require that the detection system alarm within one minute of the start of a fire. Flight tests are also required to certify detection systems and demonstrate compliance with these regulations. False fire alarms in aircraft cargo compartments are estimated to occur 100 times more frequently than an alarm due to an actual fire source. This often results in emergency diversion landings that are costly (up to $40,000) and may needlessly compromise the safety of the flight.

The price of fire detector and suppression models ranged from $2,200 to $12,000. Pricing information is difficult to obtain as manufacturers consider pricing to be proprietary. Fines may be issued for false alarms and additional costs would be incurred for landing cost as a result of false positive responses, which is up to $40,000 per occurrence.

Military Market

The SWOT analysis for the FD's CVS in the military market is as follows:

Strengths

- Capable of detecting and quantify any gas, except noble, through software changes
- Highly sensitive
- Compact and lightweight
- No moving parts

Weaknesses

- New technology with unknown long-term reliability
- Has not passed military validation testing
- Has not been used to detect chemical agents in a military environment
- Must be in contact with the gas to detect it

Opportunities

- Reduce false positive/negative readings
- Improve sensitivity relative to competitors
- Could be combined with an existing sensor technology to improve performance
- Create a sensor that has almost unlimited chemical gas detection capability

Threats

- New, more sensitive technologies with lower false positive/negative capabilities
- New technologies that can detect biological and chemical weapons in a single sensor
- IR or similar technologies that can detect and quantify gases from a distance
- Reduced military CDE spending due to reduced threat perception

Manufacturers of the chemical detection systems for the military are protected from certain liabilities by their contracts. Military contracts indemnify manufacturers from product liability lawsuits that are common in consumer products. The military does its own testing and proves the design on new equipment. As long as the equipment performs as designed, there are no liability issues. It is estimated that the market would grow to $418.3 million by 2010. Figure 2 shows the total size of both the military and civilian markets and Table 3 benchmarks the existing technologies within the military market. Price ranges from $5,000 to $20,000 for portable military chemical detectors. Adding or improving features such as ruggedness, battery life, and number of detectable gases will increase the price. The primary drivers for the chemical detection market are threat perception, government spending, and technological innovation.

CONCLUSIONS AND RECOMMENDATIONS

This section includes recommendations to FD regarding entry into the commercial airline atmosphere monitoring market and the military market.

Airline Monitoring Market

It is recommended that FD should not enter the airline atmosphere monitoring market at this time because the current suppliers sufficiently serve the market. If the CVS can be proven to be a significant improvement over existing technology or if the regulatory environment changes, FD could enter the airline monitoring market by licensing the technology. The section below describes recommendations only if the CVS tests show significant improvements over existing technology or the regulatory environment changes and FD decides to test the market again. Since airline fire detection and suppression equipment is not a FD core competency, licensing the technology to a market leader would

allow GA to gain access to the contacts and marketing and distribution capabilities while minimizing the risk to enter a new market on its own. FD should license its CVS technology to a major participant already entrenched in the market that is looking to upgrade its existing technology. The FD CVS may be able to both improve sensitivity and decrease false positives. The two leading companies to partner with are Smiths Detection and Goodrich.

Military Market

It is recommended that FD to enter the military market by licensing the technology to a market leader. FD could enter the market by itself, form a joint venture, or license its technology. Entering the market by itself or creating a joint venture would require significant capital investment by FD and may expose FD to significant risks. Since military chemical detection equipment is not a FD core competency, licensing the technology would allow it to gain access to the contacts and marketing and distribution capabilities while minimizing the risk of entering a new market.

It is recommended that FD pursue an agreement with Smiths Detection for the military market. General Dynamics is also a good potential licensing partner, but would not benefit from synergies realized from the hand-held agreement with Smiths Detection. Smiths Detection requires low false negatives on its devices and demands the ability to detect a gas below the concentration of observed chronic or acute health effects. Smiths Detection also is looking to increase the number of gases that can be detected. The FD CVS technology can meet the current requirements, and also can detect the wide range of gases that Smiths Detection sees as a very important need in the future.

REFERENCES

Available upon request