



BRIEF CASES

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Applied Research Technologies, Inc.: Global Innovation's Challenges

On June 5, 2006, Peter Vyas paced his office as he grappled with a request for \$2 million to re-launch a mini water-oxidation product. Despite two failures to bring this product to market over the past three years, his team was confident this latest iteration was a winner.

For Vyas, general manager of the Filtration Unit of Applied Research Technologies (ART), the request presented a major challenge. He recognized that his team had worked tirelessly to make this project a reality and strongly believed they were now headed in the right direction. But he also understood that the Filtration Unit's track record of failure during this product's development had hurt its credibility. If he supported the proposal, he knew he would be putting on the line not only his own personal credibility but also that of the entire unit.

Due to the project's size, final approval would be made by Vyas's boss, Cynthia Jackson—the newly appointed vice president of ART's Water Management Division. Jackson was acutely aware of the mounting losses in the Filtration Unit, and she had already devoted a significant amount of time trying to get them back on track. She had confided to one of her colleagues:

When I took on this assignment, I was told my first task was to “fix” the Filtration Unit. The unit only had one revenue-generating product line and had failed to bring a profitable new product to market in five years. It was clear that I was expected to either turn it around or shut it down.

I'm trying to protect them and ensure they get support, but my initial feeling is if they are to survive, they must become much more disciplined. They seem to be making progress on that front, but in all honesty, I sometimes wonder if it is time to cut our losses and initiate a harvest strategy for the unit.

HBS Professor Christopher A. Bartlett and Heather Beckham prepared this case solely as a basis for class discussion and not as an endorsement, a source of primary data, or an illustration of effective or ineffective management. This case, though based on real events, is fictionalized, and any resemblance to actual persons or entities is coincidental. There are occasional references to actual companies in the narration.

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Applied Research Technologies, Inc.

ART was one of the technology world's emerging giants. The company had grown through the merger and acquisition of numerous technology-based industrial companies, acquired in the LBO buyout waves of the 1980s and 1990s.

By 2006, ART consisted of a portfolio of about 60 business units, each of which operated as a profit center. Total corporate revenue was \$11 billion in 2006.¹ Major divisions in the corporation included Healthcare (medical diagnostic equipment), Industrial Automation (robotics), Energy (extraction, conversion, and transportation solutions for the oil and gas industry—including the Water Management Division), and HVAC (Heating Ventilation and Air Conditioning, including climate control solutions for residential, commercial, and industrial markets). **Exhibit 1** shows the organization structure of the company.

The company's success had been built on its innovative and entrepreneurial culture, coupled with a decentralized management philosophy. ART's vision statement, proudly displayed in almost every office and cubicle, stated: "We aim to change the world through innovation, and to grow our place in it through entrepreneurship."

Culture and Practices

ART was dedicated to supporting innovation not only with funding (the company's R&D spending was double the rate for U.S. industrial companies), but also in its practices, several of which were deeply embedded in the company's culture. ART encouraged employees to spend a half day each week "experimenting, brainstorming, and thinking outside the box." It was a practice that the company's visionary founder and current CEO, David Hall, referred to as "tinker time." He explained the concept:

Innovation and entrepreneurship are the twin engines driving this company. It's the reason we've ingrained "tinker time" in our culture...I expect all our managers, and particularly those on the front line, to create, promote, and back promising ideas. But we understand that when you go for the big leap, you won't always clear the bar. So there is no shame in failure when you are stretching for big objectives. Around here we routinely celebrate what we call "worthy attempts"—even when they are unsuccessful.

Knowledge sharing and dissemination was another key part of ART's business philosophy, and despite the high level of decentralization and profit accountability, technology and human capital were both widely shared among divisions. For example, experts in one division routinely served as advisors on project committees for other divisions, and it was not uncommon for employees to go "on loan" to help another unit with a promising product idea or technology.

The company also moved quickly to bring products to market. If an idea showed promise, funding was usually available for small "beta batch" productions, which often allowed market testing to achieve what was called "proof of concept" within ART. Once an innovation was proven, significant investment was quickly put behind it.

Objectives and Priorities

To infuse discipline into its decentralized organization, ART's top management set highly aggressive performance objectives and tied executive compensation tightly to them. In 2006, as in

¹ Of that total, Water Management Division sales were \$560 million and Filtration Unit sales were \$38 million

any other year, each division was expected to deliver sales growth of 10%, pretax margins of 15%, and return on invested capital of 20%, referred to as the "10/15/20 Target." The belief that innovative products were the source of the company's ongoing competitive advantage was reflected in a companywide metric requiring 30% of each division's total sales come from products developed in the last four years.²

Hall also continually emphasized that to be competitive, ART had to shorten the life cycle between a new technology's conception and its commercialization. In response, the company had introduced the "Fast Track Pipeline," a program that focused on the highest priority projects by providing them with additional resources and management attention. ART currently had 67 such projects in the pipeline, six in the Water Division, but none in the Filtration Unit. (The mini oxidation unit had not been identified as a "Fast Track" project).

In the late 1990s, Hall began pushing to grow ART's global presence. "It's important not just to expand our market access, but also to broaden our talent access," he insisted. "Innovation and entrepreneurship know no national boundaries." In the quest to meet this challenge "to attract the best and the brightest wherever they live," in 2000, the corporate R&D group opened the India Technical Center (ITC)—a substantial operation that Hall hoped would become a model for other R&D centers he planned to open up around the globe.

The Filtration Business Unit

The Filtration Unit was part of a business ART acquired from an oil and gas services company in 1996. Its core product line was in mobile water treatment that allowed oil and gas exploration companies to meet government water recycling requirements at well heads and drilling sites. These products were still the unit's core line, but in the late 1990s, new competition from Chinese manufacturers had led to a commoditization of the business and an erosion of margins. ART's newly acquired filtration business had tried to develop the next generation of products and technologies, but after two high-profile new product failures, the unit had lost confidence. By 2006, it was losing about \$6 million annually.

New Management, New Energy

In a promotion from his role as a lab manager in the HVAC Division, the 32-year-old Vyas had assumed the role of business manager for the Filtration Unit in June 2001. He immediately confronted the unit's twin organizational problems of low morale and growing turnover, and in his first year, rebuilt the team by carefully selecting entrepreneurial-minded individuals to fill the vacancies left by turnover in the unit. One of his key recruits was Janice Wagner, whom he knew from her five years as a marketing manager in the HVAC Division. She was excited to join a unit that had an opportunity to develop a new business from scratch.

Convinced that survival depended on innovative growth, Vyas appointed a technology evaluation team early in his tenure, charging them with the responsibility to focus on technologies with the potential to turn the unit around. In one of his first reviews with that team, Vyas learned that for almost a year, the filtration unit had been working with ITC technicians on an exciting new technology the young Indian team had developed based on a license obtained from a Delhi-based start-up company. Developed as a potential solution to the widespread Third World problem of obtaining clean water in remote regions, this small-scale oxidation system was thought to have

² Hall had recently increased this target from 25% of each unit's sales from products developed in the last five years.

application in many less-developed markets. But in an effort to cut costs, the filtration unit's previous management had decided to abandon the collaboration a year earlier.

After reviewing the technology, Vyas became convinced that this had been a mistake and encouraged his evaluation team to pursue the project. Working closely with the ITC technologists, the team concluded that the oxidation technology was the most promising opportunity in their portfolio, and recommended developing a small-scale oxidation system that enabled waste-water disinfection in small batches. "We were so excited by that decision," said Div Verma, the ITC technologist in charge of the project. "We believe this project can make a huge difference to the lives of millions."

Motivated by the support they received, the ITC technicians developed a promising initial design. Without bulky equipment (the equipment was a 26-inch cube) or an electrical power source (it utilized battery power), this small system could transform waste water into potable water without chemicals in minutes. A single unit had the capacity to process approximately 2,000 liters of contaminated water per day. With pride, they took their design to Vyas.

But Vyas wanted to understand the business opportunity and asked Wagner to prepare a brief overview. Wagner learned that only about 2.5% of the world's water was fresh, and most of that was frozen. Population growth, industrial development, and agricultural expansion were all putting pressure on fresh-water supplies in both developed and developing countries. Indeed, the World Resources Institute found that demand for water was growing at twice the rate of the population. As a result, the World Health Organization estimated that over 1.1 billion people lacked access to clean water, and that 2.4 billion lacked access to basic sanitation. The research also revealed that water-borne diseases accounted for 80% of infections in the developing world, and in 2002, 3.1 million deaths occurred (90% children) as a result of diarrheal diseases and malaria. As countries such as India and China industrialized, they used more fresh water and added more pollution to existing water sources.

Wagner concluded that the scarcity of clean water was reaching crisis levels in developing nations, and that the mini-oxidation system could help avert some of the catastrophic effects. But she also reported comparable R&D efforts also underway in the government and private sectors in China and Europe, and that several companies in the United States and Canada were researching the technology. Nevertheless, her analysis suggested the ITC team's product was further along and probably superior to anything else in the space.

New Opportunities, New Initiatives

Vyas decided to pursue the project and convinced the VP of Corporate R&D who had ITC oversight to allow the three ITC technologists working on it to become members of his technical team—a move that would allow them to focus on developing commercial designs for the oxidation technology. Simultaneously, he asked Wagner to do a first-cut market assessment to identify potential opportunities for the technology. Over the next few weeks, through focus groups and interviews with potential customers, she uncovered several promising applications. (See **Exhibit 2**).

But while the market research was exciting, progress in bringing a product to market proved to be slow and difficult. From January 2003 to February 2006, the technology team coordinated with separate manufacturing and marketing teams located in the United States to work through two complete cycles of product development, beta batch productions, and test marketing of two different versions of the mini-oxidation system. Both failed due to what were subsequently revealed to be defects in the design and lack of interest in the marketplace.

The first-generation product was aimed at the application for which the technology was originally developed—to provide developing nations with safe drinking water. Largely supported by foreign aid, the mini-oxidation system was field-tested by representatives from funding agencies. Unfortunately, the output water had a detectable odor which the funders found unacceptable. Despite assurances that ITC technicians could fix the problem, the trials failed to convert into orders.

The team decided to refocus a second-generation product on specialized applications in Western countries where funding was more available. The plan was to develop a slightly modified version of the product and aim it at a potential market for military use and NGO disaster relief activities that Wagner had identified in her initial analysis. This decision was enormously disappointing to the Indian technologists who had developed the initial prototypes, and Vyas had to work hard to keep them on board. The second-generation product fixed the odor problem, but field trials showed that the solution caused the unit to consume too much power, requiring frequent battery replacement. Once again, no orders were forthcoming.

While these trials were occurring, the filtration unit's small R&D team in the United States persuaded Vyas to allow them to work with corporate R&D on an entirely new version of the product that would utilize ultrasound waves for water disinfection. High frequency vibrations were shown to control the growth of algae, organic waste, and bacteria such as *E. coli*. Market applications for this technology included treatment for clean water storage receptacles, public/private ponds, fish tanks, and ballast water. However, in 2006 this technology was still in the earliest stages of research and testing.

New Oversight, New Discipline

In January 2006, just as Vyas and the rest of the mini-oxidation team were launching their second-generation system, Cynthia Jackson was appointed vice president of the Water Management Division. Jackson's attention was soon drawn to the troubled Filtration Unit which she felt needed to put much more rigor into the planning and analysis that supported their product development activities. According to Jackson:

Peter Vyas seems to be an excellent talent manager. He was able to recruit and retain good people to his unit, and then build them into highly motivated teams on two different continents. He's also shown himself to be an outstanding advocate for the group's ideas—skilled at managing upward, gaining support, and running interference so his team can concentrate on the task at hand. And I'm aware that the company has high hopes for the Filtration Unit, but the results just are not there.

In my view, the unit lacks discipline. They had a promising technology that was in search of a market, but had not done the work to nail down either. In the first meeting I had with them I explained that they would be developing any future proposals using a rigorous three-phase process linking market analysis and technological development to business planning.

In her first meeting with Vyas, Jackson also made it clear that the unit's continued existence was in jeopardy if they did not turn things around.

Mini-Oxidation's Third Launch Attempt

To coordinate the third launch of the mini-oxidation system, Vyas assembled a single six-person development team with representatives from various functions located in the United States and India. Because Janice Wagner had demonstrated strong project management skills, Vyas named her

as the team leader. (**Exhibit 3** details committee membership.) From the outset, the team was highly committed to the product and worked tirelessly to complete Jackson's three-phase process.

Phase 1: General Product Concept and Market Analysis

Wagner took the lead in preparing the Phase 1 requirement "to develop a general product concept supported by market research." Having learned that the unit lacked the expertise to sell to developing markets, governments, and NGOs, she decided to focus additional research on U.S. data that seemed to indicate strong potential for a residential water purification system. She also decided to see if opportunities might exist in domestic agricultural applications.

According to the Palmer Drought Index from April of 2006, 26% of the United States was considered in moderate to extreme drought conditions, and Wagner's research showed that low rainfall, high wind, and rapid population growth in the Western and Southeastern regions of the country caused a major water scarcity problem for these areas. The resulting government-imposed water restrictions often led to severe limitations or outright bans of water used in residential landscape irrigation. Because re-use of waste water would serve conservation efforts while preserving residential landscaping, Wagner felt that the mini-oxidation system offered a perfect solution for the needs of homeowners in these drought-stricken areas. In addition, since the product would be used for irrigation and not for drinking water, the disinfection quality could be lowered and energy consumption would therefore be reduced compared to past product iterations.

Wagner's research on the U.S. water industry indicated that the domestic water-treatment equipment market generated sales of over \$9 billion. (**Exhibit 4** provides selected data from the research.) Residential water treatment products ranged from water filters that reduced sediment, rust, and chlorine odor (average retail price \$50) to systems that provided more comprehensive household water purification (retail price \$1,500 to \$3,000). The research also showed that in-ground sprinkler systems cost between \$1,800 and \$4,000, and after conducting some industry interviews and focus groups, Wagner felt this was a good barometer of what a homeowner was willing to pay for a lush, green lawn.

After discussing the product concept with the development committee members, the team decided to recommend a retail price of \$2,000 (\$1,000 wholesale price) for a residential irrigation mini-oxidation system (RIMOS) capable of supporting a 10,000 square-foot lawn. Pricing for an agricultural irrigation large oxidation system (AILOS) would be significantly less on a per-acre basis, with details to be developed only after further research had been done. Wagner and Vyas compiled the data and product concept information in a formal proposal for Jackson to approve.

Jackson responded to the team's Phase 1 proposal with a flurry of questions and challenges. She highlighted the sparseness of concrete market numbers and their lack of data on target markets. And when the team floated the idea of designing a larger-scale agricultural version of the system, she asked them to think about whether that would stretch resources too thin. With the whole company under pressure to trim budgets, Jackson asked the team to consider reducing the project's costs by eliminating either the RIMOS or AILOS product. After some discussion, Vyas and his team agreed to focus future product development and marketing efforts on the RIMOS product for the U.S. market.

Phase 2: Technical Specifications and Prototype

Having won the approval of Phase 1, the team was now ready to begin the second phase of Jackson's product development process. This involved designing actual product specifications and determining how to do this within the \$1,000 wholesale price point that the group had determined was appropriate. A working prototype was also to be created as part of this phase.

The team relied heavily on ITC expertise to adapt the existing product originally designed to provide potable water in remote locations, to one capable of processing wastewater for lawn irrigation. During this phase, several misunderstandings surfaced between team members in the United States and India. For example, Wagner became concerned when the Indian team repeatedly missed design deadlines she had requested. When she confronted Div Verma, the lab leader responsible for the project, he responded tersely:

Peter told us he wanted the new design to be flawless. I take that as my number one priority. We can't meet this deliverable without proper testing. Why is everything so rushed with you? If we don't have a perfect design, then we run the risk of failing a third time and that is not acceptable. My team will not provide designs for a prototype until we are sure that all the bugs have been worked out. We don't want to be involved in another failure.

Emphasizing the mandate to move quickly while ensuring product quality, Vyas mediated the disagreement by crafting a compromise that gave the Indian technical team a formal schedule allowing them two weeks of extra testing time. "I felt there was a mix of disappointment and pride that had to be dealt with," said Vyas. "I also told Div that this third generation product would give us the credibility to return to the developing world project." Once the prototype was finished, the final designs and specs were again submitted for review.

Jackson was impressed by the attention to detail in this latest iteration, but wanted to ensure that the team was fully utilizing the internal expertise available at ART. With Jackson's help, Vyas tapped engineers and manufacturing managers from the HVAC and Healthcare Divisions who had expertise his team was lacking. He invited them to join his development team, and they quickly became deeply engaged in the project. They identified several design changes and production specifications that increased efficiency and lowered manufacturing costs.

Phase 3: Business Plan

The development of the business plan was the most difficult phase for Vyas and his team. They were unaccustomed to creating complex sales forecast models and cost estimates. But eventually they developed a detailed product concept, marketing approach, and manufacturing strategy for RIMOS, as well as sales forecasts, cost projections, and expense estimates. They also acknowledged that they still believed there was a significant market in water treatment for the developing world and in emergency relief work, but these future options had not been included in the current forecasts or business plan. They hoped to explore these with the help of the Oil and Gas Division which had excellent international contacts.

Jackson challenged the team's pro forma financials which she felt lacked the data to support their assumptions. She asked the team to perform additional due diligence and to justify their assumptions. She also pushed back on the projected sales assumptions and suggested that the pro forma financials needed to be stress-tested. But after testing the analysis, Wagner felt her research was sound and was adamant about the size of the opportunity and their ability to capture the market. Vyas stood by Wagner and also defended the financial data which he felt had been carefully developed by the manufacturing and technology experts. **Exhibit 5** summarizes the team's sales and operating margin forecasts.

The team acknowledged that its assumptions relied on the ability to gain access to the HVAC Group's Residential Market Division. As Wagner pointed out, ART's norms encouraged them to take advantage of these types of synergies, and they had good contacts in the division. However, the HVAC Residential Market Division's senior executives had full discretion regarding the products distributed through its channels, and they had not yet made a formal decision about RIMOS.

Jackson also expressed her concerns with the \$2,000 retail price point and pushed Vyas to clearly identify the risks associated with the plan. After further consideration, the team developed a risk assessment and response matrix, which they included in the business plan (**Exhibit 6**). The business plan revealed the need for \$2 million in funding for beta batch production of RIMOS and the marketing budget to support its distribution and promotion.

Toward a Decision: Go or No Go?

An hour after receiving the investment proposal from his team, Vyas was still pacing back and forth trying to decide whether to support or reject their request for the \$2 million in funding for RIMOS. He knew his development team was absolutely convinced it could succeed, but he also realized that the unit's existence and even his own career were being openly questioned.

Two floors above Vyas's office, Jackson was also contemplating the RIMOS project. Having heard through the company grapevine that a funding request had been submitted to Vyas, she began to think about how she would handle the request if it was sent up to her. She had heard rumblings from other managers in her division that the Filtration Unit was a drain on division resources and that it was time to pull the plug on any additional funding.

As a newly promoted division VP, Jackson understood that her actions would be closely watched. She wanted to make sure she did not drop the ball.

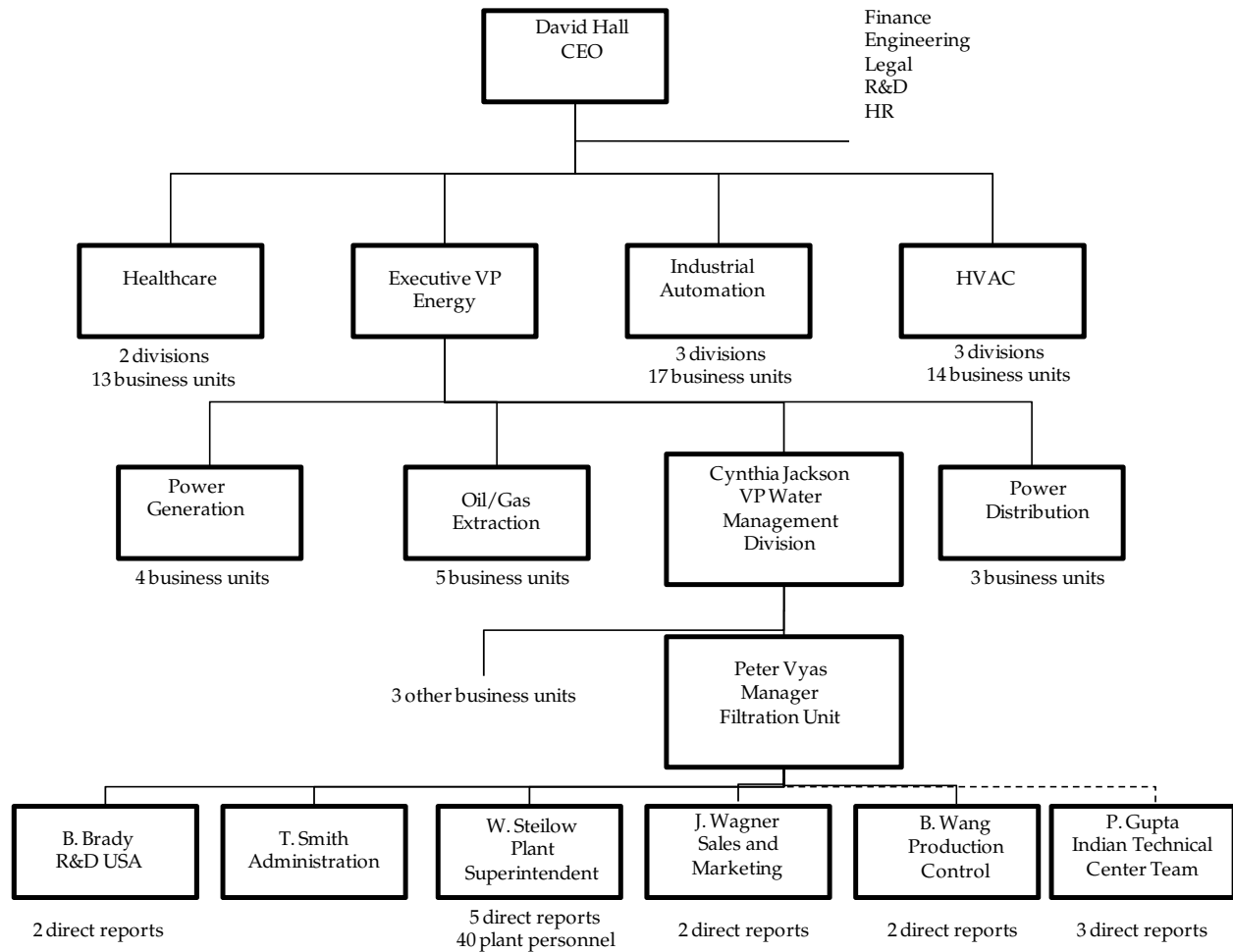
Exhibit 1 ART Organization with Filtration Unit Detail

Exhibit 2 Wagner's List of Potential Markets

Developing Nations

- Provide potable water solutions for areas with unsafe drinking water

U.S. Residential

- Landscape irrigation
- Pools
- In-house water recirculation for non-drinking purposes (e.g., laundry, dishwashers, etc.)

U.S. Commercial

- Restaurants
- Grocery stores
- Laundromats
- Linen/Uniform companies
- Farms
- Landscape irrigation

U.S. and Overseas Emergency Units

- Disaster relief
- Military

Exhibit 3 ART Mini Water Oxidation System—Development Committee Team Structure

New Product Introduction Team Members	
D. Verma	Laboratory Leader—Indian Technical Center
R. Patel	Product Development—Indian Technical Center
B. Wang	Manufacturing
H. Lewis	Quality Assurance
J. Wagner	Marketing (TEAM LEADER)
T. Smith	Project Administration
C. Cortez ^a	HVAC Division Representative
G. Steinberg ^a	Healthcare Division Representative

^a Member from another unit of ART added in Phase 2

Exhibit 4 Market Research: Summary Data

The U.S. Water Industry (Revenues in millions)^a	
Water Treatment Equipment	\$9,110
Delivery Equipment	\$11,660
Chemicals	\$4,020
Contract Operations	\$2,350
Consulting/Engineering	\$7,460
Maintenance Services	\$1,780
Instruments and Testing	\$1,400
Wastewater Utilities	\$34,130
<u>Drinking Water Utilities</u>	<u>\$35,070</u>
Total U.S. Water Industry	\$106,980
U.S. Residences (2000 Census)	
Total Housing Units	116 million
Single-Family Detached Homes	70 million
Drought Indicators (Palmer Drought Index 4/10/2006)	
% of the continuous U.S. in severe to extreme drought	13%
% of the continuous U.S. in moderate to extreme drought	26%

NOTE: Mini-Oxidation Systems are a "new-to-the-world" product with unknown market potential.

^a Source: Adapted from the Environmental Business Journal, 2006

Exhibit 5 Summary Sales and Profit Forecast for RIMOS

	2007	2008	2009	2010	2011
Forecast Sales (\$ millions)	\$ 5.45	\$ 7.08	\$ 8.86	\$ 10.89	\$ 13.07
Forecast Operating Income (%)	10%	15%	20%	20%	20%

Exhibit 6 Summary Risk Analysis and Risk Mitigation for RIMOS

Risk	Level	Plan
May not gain market acceptance	High	- Ensure HVAC distribution support - Highlight ART name - Supplement marketing budget for product launch
Product design flaws	Medium	- Monitor beta batch closely
Price point too high	Medium	- Quantify customer savings from increased water efficiency - Provide sales training to distributors
Emerging competition	Low	- Get to market first - Leverage ART global presence, technical support, supplier relationships, and distribution network