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Aurolab: Bringing First-World Technology to the Third-World Blind

P. Balakrishnan (Bala), managing director, and R.D. Sriram, operations director, reviewed the floor plan of their new 110,000-square-foot plant facility, which was more than five times their existing space, as they pondered Aurolab's future. Started in 1992 as a nonprofit in-house producer of intraocular lenses (IOLs) for use in the Aravind Eye Hospital, Aurolab had experienced explosive growth since its founding. The Aravind Eye Care System, in south India, was still Aurolab's largest customer, but Aurolab now had many commercial and nonprofit entities as customers spread across 85 countries. With the construction of the new facility due for inauguration in June 2007, Bala and Sriram wondered what the medical device company should aspire to be. It had long overshot the needs of Aravind and now supplied many ophthalmic hospitals in India and abroad. One implication of the new setup was that Aravind would no longer be its single-largest customer. Another implication was that Aurolab could now strive to be a broad-line medical device/supplies company, beyond ophthalmic products and services. Yet another implication was that Aurolab could transform itself into a fully integrated manufacturer with a strong research and development (R&D) capability, as indeed many leading medical device/supplies companies were.

Aurolab was the manufacturing arm of the Aravind Eye Care System (Aravind), the largest volume eye care system in the world. Founded in 1976 as a charitable trust (nonprofit) in 2006, Aravind examined nearly 2 million outpatients and performed more than 250,000 surgeries. No other eye hospital in the world was even half this size. Roughly two-thirds of Aravind's patients received care free of charge or paid a small fee toward the cost of their care. The rest of the patients, who paid market rates, subsidized the hospital's operations, providing a healthy surplus of nearly 35% to 40% of revenues to fund Aravind's continuous expansion. This cross-subsidization model, along with a ruthless approach to cost efficiency, had allowed the hospital to grow at a phenomenal rate. (See **Table A** below.)

Professor V. Kasturi Rangan prepared this case with assistance from Joel Segre, MBA 2008. HBS cases are developed solely as the basis for class discussion. Cases are not intended to serve as endorsements, sources of primary data, or illustrations of effective or ineffective management.

Table A Aravind's Growth

	1977	1985	1995	2005
Outpatient Visits				
Free	2,500	155,000	400,000	1,100,000
Paying	15,000	90,000	300,000	700,000
Total	**17,500**	**245,000**	**700,000**	**1,800,000**
Surgeries				
Free	--	18,000	60,000	15,000
Paying	1,000	7,000	40,000	95,000
Total	**1,000**	**25,000**	**100,000**	**250,000**

Source: Aravind.

Origins: The Vision of Dr. V

Dr. Govindappa Venkataswamy (Dr. V) founded Aravind in 1976 upon his retirement as chief of ophthalmology at the government medical college and hospital at Madurai, India. Although he was 58 years old when he retired, Dr. V's work had hardly begun. Starting with 11 beds in the living room of his home, he recruited his extended family to join in his mission of eradicating needless blindness everywhere in the world, regardless of a person's ability to pay. He pioneered the use of eye camps as a way of reaching out to the rural poor in order to screen and bring into the base hospital those selected for surgery. He struck partnerships with local communities and philanthropic organizations to gain scale, especially in reaching out to poor patients in far-flung villages. With only about 12,000 ophthalmologists, India's capacity to treat its blind was severely handicapped. It was this production bottleneck that Dr. V unlocked by his innovative assembly line system for surgery. Patients were readied for surgery in groups, with qualified ophthalmic assistants doing almost all the preparatory work, including the anaesthetizing so that surgeons could focus on the surgery itself. When the procedure was completed, there was a quick refurbishing of appropriate supplies as the next patient was brought in and the treated patient was escorted to the recovery room. Each operating room, except those used for complicated surgeries such as retinal detachment, almost always had two or three operating tables as a way of efficiently utilizing the operating theater (OT) supporting staff. Dr. V's unwavering attention to costs and efficiency enabled the creation of a system whereby Aravind's doctors were almost six times as productive as their Indian counterparts (1,200 surgeries a year compared with 250). Today, the Aravind Eye Care System, headquartered at Madurai, had a total of 3,600 beds across five campuses. (See **Exhibits 1** and **2**.)

The most common cause of preventable blindness in the world was cataract, a condition whereby the natural lens of the eye clouds over time. In 2006, there were an estimated 18 million cataract blind people in the world, more than 80% of them in the developing world. India had over 6 million cataract blind, with roughly 3.8 million new cases occurring annually.[1,2] With a population of over a billion and a per capita income of about $600 (purchasing power parity, or PPP, $3,000), nearly 25% of Indians were considered to be below the poverty line.

[1] Pavithra Krisnan, "Infinite Vision," Aravind Eye Care System.

[2] *British Journal of Ophthalmology*, 74(6) (June 1990): 341–343.

In modern cataract surgery, known as ECCE, the ophthalmologist removes the clouded lens leaving the capsule and replaces it with an artificial implant known as an intraocular lens (IOL). Using an IOL, ophthalmologists can restore 20/20 vision to many patients and working vision to almost all. Without an IOL, cataract patients required thick external eyeglasses known as aphakic spectacles following an older surgical method called ICCE, which involved removal of the entire cloudy lens including the capsule because the surgery was performed without the precision offered by an operating microscope. The resulting vision was relatively poor, and loss or breakage of the glasses left patients functionally blind again. In developing countries especially, aphakic glasses were a poor solution, as nearly half of all patients lost or broke their glasses within a year of surgery.[3]

Prior to Aurolab's founding, the vast majority of IOL manufacturers and customers resided in wealthy countries. The primary hurdle to IOL adoption in India at that time was price. IOLs sold for nearly $200 a piece in the U.S. and western Europe, making IOL manufacturing among the most profitable segments of the industry. Strong profits in North America and Europe enabled American IOL manufacturers to donate some lenses to Aravind and other eye hospitals in the early 1980s. As Aravind's surgical volumes grew, however, donor organizations could hardly keep up.

The result put Aravind at a crossroads. Although IOL prices were coming down, Aravind and its patients could not afford to buy the implants in the open market. In the absence of more affordable IOL sources, the hospital would have to rely on the inferior ICCE surgery with aphakic glasses. To Dr. V, who believed that the poor deserved the same quality of care as the rich, this was simply unacceptable. Moreover, with the availability of the IOL implant, patients in their 40s and 50s came in for surgery having heard that they would be able to regain their vision fully and could go back to their livelihoods. Dr. V and his colleagues attempted to seek a way out, even as critics claimed that India was becoming "addicted" to a technology that it could not afford.

IOL manufacturing was considered extremely high tech at that time. It required the latest in precision machining, sterile technique, and quality control. While there were a few Indian companies specializing in ophthalmic products, even fewer had yet ventured into IOLs.[4] It was not immediately clear that IOL manufacturing was a good business opportunity in India, especially for an eye hospital with no prior experience in manufacturing.

Technology Transfer

Based on the need for affordable IOLs, Dr. V and other senior management at Aravind decided to start an in-house manufacturing facility. Aravind approached the Seva Foundation (an American nonprofit) for technology-transfer assistance. A group of people from Aravind and Seva, led by David Green at Seva, began thinking of solutions. Green had no prior experience in manufacturing or business planning but had been gathering donated IOLs for Aravind for years. As IOL donations dried up, he began taking a keener interest in IOL manufacturing. As his interests grew, he began visiting suppliers of the machinery used to produce IOLs. "The industry was maturing," he explained, "so there were more people out there willing to share knowledge and sell equipment." Finally, a small manufacturer in Florida, looking to expand its business, worked with Green and Aravind to transfer its expertise and production equipment to enable the start-up of Aurolab.

The cash required to start up, however, was more risk than Aravind could bear. Green and others raised a portion of the fund required from donors to support this experimental project. In the meantime, Dr. V called upon his family members with engineering backgrounds to run it and

[3] Taken from http://www.changemakers.net/journal/03january/herbst.cfm.

[4] Ibid.

recruited Dr. Balakrishnan, who had a Ph.D. in mechanical engineering and who was then serving as a research scientist at Industrial Technology Institute, Ann Arbor, Michigan. Aurolab was set up at a cost of about $400,000 in 1992 as a separate nonprofit (charitable trust under Indian law) to serve the needs of Aravind.

Organic Growth, 1992–2004

Under Bala's leadership, Aurolab began manufacturing IOLs in 1992, making about 35,000 lenses in its first year. The manufacturing yield of good-quality lenses was quite low in its initial year, but through dint of strict process and quality-control mechanisms, the yield surged and production costs were brought down to be able to price the IOLs at under $10 per piece initially, and subsequently to $5 per piece by 2004. Aurolab's primary customer was Aravind, and affiliation with this world-class institution gave it instant credibility. Doctors who came to train at Aravind from other parts of India and around the world became familiar with Aurolab products, and many recommended their adoption at their home institutions. The international nongovernmental organization (NGO) community, as well, recognized Aurolab's success and began buying in volume. Aurolab's production volume surged with plant expansions, and by 2006 it produced nearly 800,000 IOLs.

As mentioned earlier, nearly 60% of the nearly 250,000 surgeries performed at Aravind annually were highly subsidized. Of that percentage, 37% were completely free and 23% made a subsidized payment of Rs. 500 ($12). The other 40%, which were provided as differentiated services, paid a market price of nearly $100. The surplus margins gained from 40% of the market then provided the basic fuel to power the scale and reach Aravind's charitable mission—to provide eyesight for anyone in need regardless of their ability to pay. An article in the summer 2006 issue of *Innovations*[5] laid out the comparative cost components of cataract surgery in the U.S. versus those of Aravind. The cost in the U.S. was estimated at $1,800 as compared with Aravind's $18. (See **Exhibit 3**.)

Intraocular Lens Division

When Aurolab was started in 1992, its first product was Intraocular Lenses (IOLs) at a time when their import price was around $80–$150 per piece. Few Indian manufacturers were capable of making a high-quality lens, and the few that did charged a high price. Alcon, a U.S.-based manufacturer, was the world leader with nearly 50% share of the approximately $1 billion market for IOLs.

Aurolab, with its lower manufacturing and distribution costs combined with its philosophy of making eye care affordable, was able to initially price the IOLs at around $10–$12. Aurolab's IOLs were tested at U.S. laboratories and compare with the best of similar U.S. Food and Drug Administration (FDA)-approved IOLs. But to get the FDA approval, much more work and expense was necessary because of the requirement for demonstrating the effectiveness in live human trials of representative populations. Aurolab chose to invest its scarce resources in scaling up production rather than in clinical trials. It was, however, soon able to get the European Union's CE mark, which only required demonstrating product equivalency.

Much of the discussion so far on IOLs had focused on what was called the polymethyl methacrylate (PMMA) single-piece hard lens. By 2006, Aurolab had a capacity to produce and sell nearly 800,000 such lenses at a price under $4 per piece. By 2006, cataract surgical techniques as well as lens technology had advanced considerably beyond the second-generation IOL implantation

[5] Mahad Ibrahim, Aman Bhandari, Jaspal S. Sandhu, and P. Balakrishnan, "Making Sight Affordable (Part I): Aurolab Pioneers Production of Low-Cost Technology for Cataract Surgery," *Innovations*, Summer 2006, pp. 25–41.

technique. The two new types of lenses were "foldable" hydrophilic and hydrophobic varieties.[6] The following excerpt from *Innovations* (summer 2006 issue) provides the technology overview:

> The current state-of-the art is the foldable lens. Of the three types that Aurolab produces today, two are of hard polymer and the other is a soft, foldable lens. The primary advantage of the foldable lens is that it enables a surgeon to use a smaller incision during surgery—the folded IOL is inserted through this incision and unfolds into its proper form and position after the insertion. The smaller incision has many direct clinical benefits, including no need for sutures, faster recovery, less astigmatism, and fewer post-operative complications. However, the use of foldable lenses requires special equipment and additional microsurgical training. The foldable IOL is typically used with "phaco-emulsification," a procedure that utilizes ultrasound to liquefy the clouded lens before suction is used to remove it through a small incision.

As a result of the new techniques and technologies, the world price of the conventional PMMA lens made in developed economies had plummeted to about $20. The preferred lens type for patients and doctors in the U.S. was the soft hydrophobic lens, which was sold by leading U.S. companies for $100 to $125 a piece, but Aurolab once again, through a two-year technology development program, was able to reengineer the production of hydrophilic and hydrophobic soft lenses for an introductory price of about $20 and $40 per piece, respectively. Most of Aravind's free and subsidized surgeries still used the PMMA lens, but with the availability of the affordable soft lens, many of Aravind's paying patients elected to have the advanced technology for a premium. About 90% of the surgeries at Aravind and in the rest of India and other developing countries still used the PMMA hard lens, while in the developed world almost all cataract surgeries had converted to the soft-lens option.

Suture Needle Division

With the IOL division growing, Aravind and Aurolab, with the support of the Seva Foundation through Green, began looking for ways to reduce the cost of sutures, the second-most expensive consumable used in cataract surgery. Aurolab started its suture needle division in 1998 with technology obtained from Germany. Aurolab was the first company to manufacture the ophthalmic sutures in India.[7] The prices of ophthalmic sutures available from companies in the developed economies were high for the Indian market. Aurolab began selling sutures at a price of $30 per box when the prevailing price was $240 per box in the U.S. Prior to the cost reduction, ophthalmologists

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[6] The hydrophobic foldable lens is flexible and easily foldable at room temperature. A hydrophilic lens is a hydrogel similar to a soft contact lens. In dry conditions this lens is not foldable. When this material is hydrated in a saline solution, it becomes soft and foldable. A hydrophilic foldable lens is always stored in a saline solution. Since it becomes stiff when it is dry, this lens has to be folded and inserted into the eye within a specified time window. One of the largest ophthalmic companies developed the hydrophobic materials as a patented and proprietary material. Through appropriate marketing, they established this as a better material than hydrophilic and charged a premium price. Better biocompatibility, slow and controlled unfolding, and less postoperative complications such as posterior capsule opacification are some of the beneficial features of the hydrophobic lenses. Though hydrophilic lenses are widely used in Europe, the market in the U.S. has shifted completely to hydrophobic lenses, and the market in Europe is also slowly changing to hydrophobic lenses.

[7] Suture needle consists of a needle with a suture attached permanently in the center at the end opposite to the point of the needle. The needle is made from stainless steel wire, and various suture materials are attached to the needle. This type of suture needle is known as atraumatic, compared to the eye traumatic needle. An eyed needle similar to the popular sewing needle is traumatic since the suture passing through the eye of the needle has to be knotted or two suture strands are used. In atraumatic needles, the diameter of the suture is less than wire diameter of the needle and hence the suture goes through the wound with minimum trauma to the tissue. In atraumatic needles, it is also possible to attach a needle on either side of the suture (single armed or double armed) for optimum use of the suture material. Aurolab is one of the few companies producing the fine suture needles used in ophthalmology using a special type of stainless steel wire purchased from the U.S. Aurolab purchases the various suture materials primarily from the U.S. and attaches the suture material to the needle to produce ophthalmic suture needles.

in India and many developing countries often reused sutures (after sterilization) on multiple patients as a cost-saving measure. In developed countries, of course, the practice was shunned due to the risk of passing on the infection. In 2006, Aurolab continued to be the only Indian manufacturer of ophthalmic sutures. Due to changes in surgical techniques (small incision surgeries), the ophthalmic suture market was slowly shrinking but continued to be price sensitive. As a result, Aurolab's existing manufacturing equipment and processes were adapted to manufacture other types of micro sutures for plastic, hand, and cardiovascular surgery. It had started a small pilot operation to make and sell a full range of cardiovascular sutures to a chain of cardiac hospitals known for their low-cost/high-volume surgical model much like Aravind's. If successful, Aurolab would be able to stake out a leadership role in the micro sutures market and branch out of its sole dependence on the ophthalmic supplies market.

Pharmaceutical Division

Aurolab started its Pharmaceutical Division in 1997 to address the issues of:

- High prices of specialty drugs (retinal)
- High prices of imported drugs
- Nonavailability of certain drugs that were not commercially viable for producers in the developed world (orphan drugs)

Aurolab first began the production of ophthalmic pharmaceuticals using technical assistance from Moorfields Eye Hospital in England through its chief pharmacist. Later Aurolab developed its own expertise for formulating and producing various ophthalmic drugs. Its primary goal was to ensure adequate and consistent quality supply to Aravind at an affordable cost. For example, Aurovisc, a high-molecular weight solution of hydroxyproplyl methycellulose, was injected into the eye after incision to maintain and protect it during surgery. Aravind was able to reduce its cost from $2 to $1 for each surgery through local formulation and packaging in convenient single-use vials. Aurolab was not always successful in those areas where equivalent local raw material supplies were not available. But in many cases, by purchasing pharmaceutical agents from trusted vendors, Aurolab was able to formulate its ophthalmic drugs, drops, dyes, and surgical aids at a fraction of the cost of imports. Many drugs used in specialty ophthalmic surgeries such as retinal surgery were imported, and the prices were high. There were no local manufacturers for these products. Aurolab developed a range of high-quality and affordable retinal products such as indocyanine green dye, silicon oil, perfluoro octane, and triamcinolone acetonide. Even more importantly, this expertise gave Aurolab the ability to produce several products long abandoned by their western counterparts, such as the formulation of an antifungal drug that treated corneal ulcers caused by infections common in tropical environments. By 2006, Aurolab manufactured more than 50 ophthalmic drugs under Indian and international standards, including WHO-GMP certification for all ophthalmic drugs and the European Union's CE mark on several major products.

Blades Division

In 2005, Aurolab started its blade division to address the increasing demand for special ophthalmic surgical blades needed at Aravind hospitals for the new generation of IOL surgical techniques through a small specially shaped self-sealing incision in the cornea. Blades used in Aravind were for the most part Indian made using old-generation manufacturing processes. Aurolab saw the need to make blades using newer-generation technologies in order to improve the functional performance and consistency of these blades. In view of the above, Aurolab started its blade division

to develop and supply high-quality and affordable ophthalmic surgical blades to Aravind and other markets.

Aurolab started its surgical blades division using a combination of internal and external resources. It currently supplied Aravind and a handful of international NGOs. Managing Director Bala and a team from this division had actively engaged in a program to seek new-generation blade manufacturing technologies from leading companies abroad.

Aurolab's Green Laser Project

Based on the prediction of a rapid rise in diabetics and the future need for making diabetic retinopathy treatment affordable and accessible, Aurolab had initiated a project for the development of an affordable green laser photocoagulator widely used in the treatment of retinal diseases related to diabetic retinopathy. If not treated properly, diabetes could lead to the loss of vision by damaging the retina. The only way to arrest the advance of diabetic retinopathy was to treat it by lasers using equipment that currently cost $30,000. In order to gain expertise in this technology, Aurolab entered into a memorandum of understanding (MOU) with the Raja Ramanna Centre for Advanced Technology (RRCAT), a premier scientific research institution in India.

This development project, drawn from the pool of RRCAT's highly experienced laser technologists, was an attempt to produce green lasers indigenously at a competitive and affordable price. The hope was that such a venture would enhance accessibility and availability of these technologies, which were much needed in the treatment of diabetic retinopathy and other ophthalmic surgical procedures such as glaucoma and macular degeneration. Lumenis, the U.S.-based market leader in such equipment with a market share of 40%, sold about 1,600 units worldwide in 2006.

Sales and Marketing

Exhibit 4 provides Aurolab's income statement for the years 2006 and 2007. The rough breakdown of its revenue by geography, channel, and product is given in **Table B**, as follows:

Table B

	FY 2006 (%)	FY 2007 (%)
Domestic	56	56
Export	44	44
Aravind	15	13
Domestic Dealer	39	34
Domestic NGO	6	8
International Dealers	18	21
International NGO	22	23
IOL	62	60
Pharmacy	21	21
Sutures	16	17
Blades	0	1
Others	0	2

Source: Casewriter.

According to Vishnu Prasad, Aurolab's marketing manager, the price to each channel was somewhat different, reflecting their different commercial contexts. On average, large NGOs and Aravind received a 40% discount, domestic dealers a 30% discount, and local NGOs a 20% discount. Large international NGOs and dealers received a 40% discount and international NGOs a 20% discount of the export price. The differential between domestic and export price was about 15%. Until 2005, Aurolab had only two full-time sales representatives attempting to manage a customer base throughout India and around the world. Mitigating this direct sales burden was a network of for-profit distributors that promoted Aurolab products as part of a broader product offering. Its direct hospital customers numbered 180, and its domestic dealers 30. Its international dealers numbered 20, and NGOs 110.

Competitive Structure

The Indian industry for IOL making had progressed considerably since Aurolab's founding. By 2006, there were over a dozen IOL manufacturers in India, at least four of which had quality that met the CE mark.

In the Indian market, the three major players were Aurolab and two other manufacturers, Appasamy and IOCare. Appasamy had a comprehensive range of ophthalmic products covering surgical instruments, diagnostic and surgical equipments, pharmaceuticals, IOLs, and other surgical consumables. IOCare, which manufactured IOLs and contact lenses, had recently diversified into trading of equipment and pharmaceuticals. Aurolab estimated the Indian market for IOL lenses to be about 4 million in 2006. About 40% of this demand was from the nonprofit/NGO sector, 35% from the private sector, and 25% from the government sector. Aurolab estimated the market shares of Appasamy and IOCare at 30% and 25%, respectively. Aurolab, which had about 15% share, did not participate in government tenders. Only about 10% of the market was for imported products, though some indigenous manufacturers packed locally produced products as though they were shipped from outside India in order to mimic and extract the price of imported brands.

Aurolab introduced IOLs at a price that was affordable to the customer, forcing other manufacturers to reduce the premium that they charged. Despite the competitive environment, Aurolab was still able to charge a price that was affordable on the basis of its quality, its service, and to some extent its affiliation with Aravind. Dozens of ophthalmologists came to Aravind each year to learn the latest in high-volume surgery practices and used Aurolab products in the process. When Aurolab first began selling lenses, it was able to compete on price alone. In fact, its pricing was so affordable that it could demand 100% up-front cash payments upon order placement, a policy virtually unheard of in the ophthalmic industry. Most doctors and distributors expected between 30 and 90 days to pay for IOLs, and many requested as much as a year or more. As the Indian IOL marketplace became more crowded, competitors began to compete on price and services such as credit and inventory management.

Over time, Aurolab had progressed from being a low-cost leader with high quality to a more economically priced leader yet maintained its position as an innovative leader. Its PMMA lens was priced at $4 to $5, on par with local competitors. However, its hydrophilic lenses, at a price range of $25 to $35, commanded a 20% quality premium over local suppliers. Aurolab continued to be a favored brand among the leading surgeons both in India and the countries where its product was exported. However, in India, Aurolab's pricing was still a substantial discount to the price of imported products, which cost approximately $20 for PMMA, $100 for hydrophilic, and $125 for hydrophobic IOLs.

In 2006, the total market of ophthalmic drugs in India was estimated to be about $55 million. Aravind's share of the overall market was miniscule, only about 1%. Most of its sales were concentrated in the surgical adjunct segment. The top five local manufacturers had 70% of the market between them.

By 2006, several suture manufacturers had emerged, but very few carried the wide range of ophthalmic sutures that Aurolab offered, and none still had the technology to produce fine sutures.

Global Suppliers

While the global market for ophthalmic surgical equipment and supplies was estimated to be over $20 billion, the cataract and vitreoretinal market, Aravind's focused segment, was estimated to be roughly $3.5 billion in 2006. Cataract surgery was the most common ophthalmic surgical procedure, with over 2.5 million such procedures in the U.S. and 10 million procedures worldwide annually. Other types of procedures included vitreoretinal procedures, which were performed to treat conditions in the back of the eye such as retinal repair and intraocular infections.

The $3.5 billion market was roughly divided between IOLs (35%), equipment (26%), viscoelastics (11%), and the rest (28%). Alcon was the dominant player with 58% share of this market, followed by Advanced Medical Optics with 16% and Bausch and Lomb with 12%. All three were U.S.-based companies. Only the very largest companies like Alcon (sales of $3.9 billion in 2004) spanned all sectors of the industry. Most companies tended to specialize in one or two sectors. (**Exhibit 5** shows the breakdown of sales for the global IOL market.) The average R&D spending in the industry was about 8%, which even small IOL players like STAAR (2% market share) had to allocate in order to come up with new products and procedures that enhanced patient care and recovery.

Aravind had an excellent relationship with all the leading ophthalmic companies, being one of Alcon's largest customers in India. Aravind's relationships with these companies went beyond buying supplies and equipment. In fact, they collaborated on training, product development, and clinical trials. Alcon, for instance, had helped establish a phaco-emulsification surgery training facility at each of Aravind's five hospitals.

Aurolab's New Factory

The plan for the new facility, which had been designed to meet ISO 9000 standards and the FDA as well as U.K. MHRA standards, was to house the manufacture of IOL, suture, blade, and pharmaceutical products, with provision for additional expansion. The factory was built up with an operating area of 110,000 square feet. Of this, about 20,000 square feet was allocated to clean room facilities. A comprehensive water purification system consisting of reverse osmosis, electro deionization, and ultra filtration had been installed to generate and distribute the pharmaceutical grade waters. All supporting utilities such as plant steam, compressed air, and chilled water were designed to be brought in from isolated utility units outside the main manufacturing plant as required by world-class standards.

The facility included a dedicated state-of-the-art microbiology laboratory, which was capable of conducting sophisticated microbial tests and shelf-life studies. Designated areas had been allocated for research and development, wet labs, and instrument labs.

Developing Aurolab's Future

Until his death at age 88 in July 2006, Dr. V had involved himself in all aspects of Aravind's strategy and operations, including those of Aurolab. Now Bala and Sriram, as senior managers, felt

an even greater compulsion to lead the organization in a way that would be consistent with the vision laid by Dr. V.

R.D. Thulasiraj (Thulsi), with a business degree from a prestigious management school in India and a masters in public health from the University of Michigan, had worked very closely with Dr. V on Aurolab's board of trustees. He was also Aravind group's chief administrator in its first 20 years of operation. Reflecting on the challenges facing Aurolab, he offered three areas for immediate consideration:

1. **Innovation:** All major developments at Aurolab have been externally facilitated and in the initial period supported financially as well. Now Aurolab has the financial wherewithal to support the innovation process but has to enhance its organizational capacity. Innovation will need to transcend from being viewed as a developmental activity to a core strategy to maintain our competitive edge.

2. **Geographic reach:** Aurolab now supplies to several developing countries, and in many of them it has a significant market share. However, in many of the developing countries the ophthalmic activity (and thus the market) is only at 5% to 10% of the potential or what needs to be done. As these markets grow exponentially—10 to 20 times—will Aurolab be able to continue to maintain its market share with current strategies? Should we be thinking of developing local presence in some of the countries both for sales and manufacturing?

3. **Diversification:** The product range of Aurolab and the technologies employed, with some modifications, can address the needs of other health-care disciplines. However, the advantage enjoyed by ophthalmic products through association with Aravind Eye Hospital will not be available. We will have to forge new relationships like any other medical supplies company. Should we take this direction? What will be the implications on the ophthalmic product line and its mission of making eye care affordable?

Internally, there was some debate and discussion among the trustees of Aurolab regarding its future path. Some had argued for an unfettered growth as an independent device company, with the sole aim of bringing modern technologies in the medical field within easy reach of India's masses, just as it had done for ophthalmic care. It did not matter whether the end-use application was ophthalmology, cardiology, general surgery, ENT, or whatever. On the other hand, there were some members of the board of trustees who had cautioned against that approach. They had argued that Aurolab should stay within the ophthalmic space and do whatever was necessary to make Aravind Eye Care superior and affordable to the Indian masses. Migration into adjacent markets was considered a drift from its core mission.

Additional issues faced by Aurolab's top management team included questions of how aggressively they should pursue a commercial strategy. Thus far a bulk of Aurolab's production was used for internal consumption of the Aravind group of hospitals and any surplus production routed to other charitable hospitals and NGOs. A small group within Aravind had advocated a more aggressive commercial strategy of seeking for-profit markets, especially in the lucrative export markets of Europe and North America, as a way of following the social entrepreneurship route of raising as much surplus as possible to feed the core mission of bringing top-class R&D and products to the thousands of poor patients flooding its hospital system from all parts of the country.

On August 7, 2006, exactly a month after the death of Dr. V., Thulsi reflected wistfully on the enormous work of the Aravind system that Dr. V had managed to accomplish through family involvement and participation. Indeed, Bala, Sriram, and he were all members of Dr. V's extended family. (See **Exhibit 6** for a list of Aurolab's trustees and a brief description of their background.)

"There is a strong social fabric which facilitates the decision-making process and the overall governance. For the most part, it is informal. With time, these trustees who have grown and been with the organization will be replaced by those without this level of organizational memory, relationship, and involvement. Aurolab will need to reflect how to deal with this as we brace for changes at Aurolab with its world-class manufacturing and R&D facilities," concluded Thulsi.

Exhibit 1 Aravind Eye Hospital Locations

The five Aravind locations are shown as numbered sites.

Source: Casewriter.

Exhibit 2 Aravind Eye Hospitals Performance

PERFORMANCE 2005

ARAVIND EYE HOSPITALS

	MADURAI 1976	THENI 1985	TIRUNELVELI 1988	COIMBATORE 1997	PONDICHERRY 2003	TOTAL
OUTPATIENT VISITS						
Paying	330,913	54,427	171,040	234,935	137,470	928,785
Free (Direct & Camp)	274,304	49,127	134,506	217,928	117,248	793,113
Total Outpatient visits	605,217	103,554	305,546	452,863	254,718	1,721,898
SURGERIES						
Paying	42,341	2,961	14,170	22,930	10,732	93,134
Free (Direct & Camp)	61,734	7,326	22,842	40,472	21,727	154,101
Total Surgeries	104,075	10,287	37,012	63,402	32,459	247,235
CAMPS	368	91	250	382	244	1,335
SURGERY DETAILS						
Cataract Surgeries	73,141	8,519	27,331	45,464	24,484	178,939
Trabeculectomy & Combined procedure	2,458	20	919	1,172	510	5,079
Retina & Vitreous Surgery	1,572	1	204	1,095	306	3,178
Squint Correction	768	0	105	231	68	1,172
Keratoplasty	397	0	37	240	71	745
Pterygium	695	41	89	549	267	1,641
Ocular injuries	261	2	110	405	134	912
Lacrimal Surgeries	2,351	229	789	752	834	4,955
Other Orbit & Oculoplasty Surgeries	2,871	151	604	1,292	607	5,525
Others	2,762	206	566	2,448	1,221	7,203
Laser Procedures	15,437	1,118	6,026	9,354	3,957	35,892
LASIK Refractive Surgery	1,362	0	232	400	0	1,994
TOTAL	104,075	10,287	37,012	63,402	32,459	247,235

Source: Aravind Eye Care System Activity Report, 2005.

Exhibit 3 Comparison of Cataract Surgery Costs, India and United States

Cataract Surgery (USA)	$	%
Lab	31	2
Radiology	5	0
Operating Room	764	43
Supplies	313	18
Pharmacology	249	14
Other	399	23
	$1,731	**100%**

Cataract Surgery (India)	$	%
Operating Room	3.21	18
Supplies	7.38	40
Labor	1.80	10
Pharmacology	1.72	10
Other	3.87	22
	$17.98	**100%**

Source: Mahad Ibrahim, Aman Bhandari, Jaspal S. Sandhu, and P. Balakrishnan, "Making Sight Affordable (Part I): Aurolab Pioneers Production of Low-Cost Technology for Cataract Surgery," *Innovations*, Summer 2006, pp. 25–41.

Exhibit 4 Aurolab Income Statement, 2005–2006 (in $)

	Year Ended March 31, 2005	Year Ended March 31, 2006
Sales Revenues		
— Local	3,121,795	3,337,700
— Export	2,241,000	2,268,732
Total	5,362,795	5,656,432
Cost of Goods Sold (including depreciation)	1,987,790	2,362,277
Gross Profit	3,375,005	3,248,155
SG&A	507,916	680,470
Net Profit	2,867,089	2,60,685
Income from Investments and other minor operations	1,786,315	1,815,800
Profit transferred to Balance Sheet	4,653,404	4,419,85

Source: Aurolab.

Exhibit 5 Breakdown of Global Ophthalmology Market

I. GLOBAL CATARACT AND VITREORETINAL MARKET (2004 SALES—$3 BILLION)

Company	Market Share (%)
1. Alcon	58
2. Advanced Medical Optics	16
3. Bausch & Lomb	12
4. Staar	2
5. Others	12

Source: Jennifer Hsui, Phil Nalbore, and Sam Chang, "RBC Capital Markets," June 1, 2005, p. 6.

II. GLOBAL CATARACT AND VITREORETINAL MARKET (2004 SALES—$3 BILLION)

Product	Product Share (%)
IOLs	35
Phaco Equipment	16
Vitreoretinal Equipment	10
Viscoelastics	11
Others	28

Source: Jennifer Hsui, Phil Nalbore, and Sam Chang, "RBC Capital Markets," June 1, 2005, p. 6.

III. WORLDWIDE IOL REVENUES BY COMPETITOR

Company	2004
Alcon	$ 504
AMO	235
Bausch & Lomb	128
Pharmacia	21
Staar	32
Other	178
Total	**$1,178**

Source: Peter Bye and Allison Widman, "Citigroup Equity Research: Medical Supplies & Technology," p. 29.

Exhibit 6 Trustees and Background

Name	Aurolab Trust Position	Govel Trust Position (Aravind)
Mr. G. Srinivasan	**Trust President**	**Trust President (Aravind)**
Mr. R. D. Thulasiraj	**Secretary**	
Dr. P. Namperumalsamy	Trustee	Trustee
Dr. G. Natchair	Trustee	Trustee
Dr. S. Aravind	Trustee	Trustee
Dr. R. Kim	Trustee	Trustee
Dr. G. Nallakrishnan		Trustee
Mrs. Meenakshi		Trstee
Ms. Lalitha		Trustee
Dr. N. V. Prajna		**Secretary**
The President—Rotary Club Madurai		

G. Srinivasan: Brother of Dr. V (founder). Serves as the organization's Chief Financial Officer. Was primarily responsible for overseeing vast construction requirements of the fast growing chain.

R. D. Thulasiraj: Dr. V's nephew. Started as Aravind's Chief Administrative Officer before moving to a full-time position overseeing LAICO, an organization that trains ophthalmologists throughout India and the world in Aravind's management systems. Is also a key trustee of Aurolab.

Dr. P. Namperumalsamy and Dr. G. Natchiar: Dr. G. Natchiar, Dr. V's sister, was one of the first family members to throw her career into the fulfillment of Dr. V's mission. Rose to be the organization's chief surgeon before retiring to continue work on hiring, training, educating and motivating the vast network of nursing staff at Aravind. Married to Dr. Namperumalsamy, a world-renowned retina surgeon, who also joined the cause of Dr. V very early in his career. Dr. Nam serves as Aravind's chairman and is mainly instrumental in the organization's move to a higher emphasis on Research and Development. He was instrumental in persuading Aurolab to take on the Green Laser project.

Dr. S. Aravind: Mr. G. Srinivasan's son, trained in ophthalmology in India, with an MBA from the University of Michigan. Now serves as the Administrator of the Madurai Hospital and overseas expansion of Aravind services through other managed hospitals and vision centers in rural areas.

Dr. R. Kim: Son of Dr. V's other sister, trained in ophthalmology in India. Now serves as the Chief of the Retina and Vitreous Services at the Madurai Hospital and also serves as the project manager of the center of excellence in diabetic retinopathy at the Retinal Clinic.

Dr. G. Nallakrishnan: Brother of Dr. V, trained in civil engineering with a Ph.D. from the University of Illinois. An industrialist who established many business entities in construction, plastic processing, and ophthalmic equipment.

Mrs. Meenakshi: Wife of Dr. G. Nallakrishnan.

Mrs. Lalitha: Wife of Mr. G. Srinivasan.

Dr. N.V. Prajna: Son of Drs. P. Namperumalsamy and G. Natchiar; trained in ophthalmology in India. Now serves as Senior Medical Officer in the Cornea Clinic. Also overseas the medical education and training activities of the hospital and financial matters of the Govel Trust.

Source: Casewriter.