The Jaipur Foot: A Crucible of Connectedness

A Case Study

A true friend knows your weaknesses, but shows you your strengths; feels your fears, but fortifies your faith; sees your anxieties, but frees your spirit; recognizes your disabilities, but emphasizes your possibilities - William Arthur Ward

1. Background

The Jaipur Foot is a low cost, artificial lower limb manufactured in India that has transformed the lives of innumerable amputees in India, Afghanistan, Bangladesh, Dominican Republic, Indonesia, Kenya, Lebanon, Nigeria, Pakistan, Panama, Philippines, Rwanda, Somalia, Sudan, Trinidad, Uganda, Zimbabwe, Zambia and other countries. Its origins go back nearly half a century to the Indian state capital from which it derives its name.

The story goes back to 1968, when Dr. Pramod Karan Sethi was working as an orthopedic surgeon at the Sawai Man Singh (SMS) Hospital in Jaipur. The hospital’s rehabilitation centre provided treatment to amputees. However, the available western limbs were too expensive and rigid to allow the easy mobility and resilience that was needed by the common Indian people.

At around the same time, an ace craftsman by the name of Master Ram Chandra Sharma (fondly known as Masterji) was engaged by the SMS Hospital to teach the making of handicrafts to leprosy patients. He felt frustrated by the expensive and impractical foreign-made prostheses that he saw being fitted to the amputees.

Masterji resolved to create a better alternative that would be strong and flexible enough to withstand the rigours of manual labour, and also accommodate the full range of motions required for daily prayer at the temple or mosque.

To that end, Masterji worked together with the SMS doctors (including Dr. S.C. Kasliwal and Dr. Mahesh Udawat, apart from Dr. Sethi) to make a better prosthesis. Like every great innovation, their solution was simple and elegant. Instead of using costly alloys and polymers, they opted for a core of high-density foam rubber and wood - wrapped in vulcanized rubber. Pressed in a metal mould and heated, these components bound together to take on a form that was uncannily close to the shape of a real human foot. This was then attached to a sturdy wooden leg.

The resulting prosthetic foot (now known worldwide as the Jaipur Foot), consisted of a shell filled with sponge rubber, a stuffed piece for the meta-tarsals, and microcellular rubber for the heel that
was cut in places to allow for joint-like movement. This design was more flexible, and allowed the wearer to climb trees, pedal bicycles, and use Indian-style toilets.

In 1971, Dr. Sethi presented the Jaipur Foot to orthopedic surgeons from the UK’s Oxford University. They were duly impressed. Thereafter, during the early seventies, the Jaipur Foot transformed around 50 lives. But for Dr Sethi’s involvement, the Jaipur Foot would not have been recognized by the medical world.

However, Mr. Devendra Raj Mehta - an Indian Administrative Services officer and an MIT Sloan alumnus - believed that this simple innovation had much greater potential for social good. At that time, he was receiving physiotherapy at the SMS hospital after a debilitating accident in 1968 had crushed his right femur bone, and nearly left him dead.

Seeing patients queue up for the few fittings of the foot provided there, Mr. Mehta became consumed by the idea that this service should reach as many people as possible. In doing so, he turned the Jaipur Foot from a brilliant invention into the foundation of a formidable charitable concern.

In 1975, Mr. Mehta raised Rs. 4,00,000 in government aid and private donations to start the Bhagwan Mahavir Viklang Sahayata Samiti (BMVSS) in a modest way as a long-term human welfare project to provide the Jaipur Foot free of cost.

The BMVSS is a voluntary non-governmental, non-religious, non-sectarian, and non-political Society that exists for helping the handicapped persons, particularly those who lack adequate resources. It presently comprises of a factory, clinic and workshops, and employs around 173 people - including doctors, therapists, as well as administrative staff.

Over the last 40 years, BMVSS (popularly known as the Jaipur Foot Center) has grown into the world’s largest limb fitting society. It has transformed the lives of nearly 1.5 million people across 26 countries in Asia, Africa, and Latin America.

Cutting across geographical, religious, economic and gender bias, BMVSS welcomes all those in need with an open door policy.

2. **The Context**

In India, around five to six million people suffer from loco-motor disabilities. The loss of limbs is rampant due to accidents, land mine explosions and gunshot wounds, as well as the effects of diseases. Nearly 25,000 new cases get added to the amputee population every year.

Apart from being a physical loss, amputation is psychologically debilitating for the patient as well as the family members. It carries adverse economic consequences by virtue of the restrictions that
it places upon the productivity of the people. A combination of poverty and the lack of rehabilitation facilities have exacerbated the problem. This makes the fitment of artificial limbs an important economic, developmental as well as public health issue in India.

In the 1960s, only traditional limbs were being made in India. These foot pieces used the Solid Ankle, Cushioned Heel (SACH) design, and were made of laminated wood and rubber. As a result, the limbs were heavy and cumbersome to use. Hence, the percentage of rejection by patients was high.

These limbs were also too expensive to be within the reach of economically weaker sections of society, to which a vast majority of the amputee beneficiaries belong. Moreover, the time taken to manufacture a custom-made limb stretched up to several weeks.

In this context, the Jaipur Foot arose out of an amalgam of several factors - the prosthetic technology, deeply humane values, a patient-centric management system, and a donation-based funding arrangement. The art and practicality brought in by Ram Chandra Sharma blended with the science of Dr Sethi and the expansive vision as well as administrative genius of Mr. Mehta in order to provide the patients with rugged limbs that are fit for daily use.

2.1 The Bhagwan Mahaveer Viklang Sahayata Samiti (BMVSS)

BMVSS is the world’s largest organization serving the disabled people. Its vision is to facilitate the physical, social and economic rehabilitation of the disabled population around the world. Its focus is particularly upon the poor disabled who remain deprived of limbs, aids and appliances under the existing unaffordable health care system.

BMVSS has successfully expanded its operations in last 40 years without having a revenue model. A large part of its success may be attributed to its beneficiary-centric management practices. Scores of patients visit the BMVSS campus in Jaipur daily. 95% of these people fall below the poverty line. Most of the time, the security guard himself admits them. “You don’t need a doctor to certify that someone is missing a limb and needs help,” says Mr. Mehta.

The procedures for client admission, treatment and prosthetic fitting have been kept simple. Patients are provided with free lodging and boarding facilities till the time they are given prosthetic limbs, calipers or other aids. Very often, the Jaipur foot is custom-fitted within four hours of the patient checking in.

Outside of its own centers, BMVSS holds regular on-site field camps at various places in different parts of India. In addition, mobile clinics have been setup in 26 countries around the world. Doctors and technicians travel with equipment and materials to these camps, sometimes with a
mobile van. They provide on-the-spot fabrication, fitment and delivery of limbs and other aids in order to help patients who find it otherwise difficult to travel too far.

The backbone of BMVSS’s steady growth is rooted in highly scrupulous expenditure policies and penny-by-penny accounting, coupled with a suite of incredibly inexpensive, world-renowned prosthetics, aids and appliances. The foundation of its philanthropic activity rests upon the twin pillars of thriftiness and compassion.

For instance, to account for the grants received from the government, the Jaipur Foot organization maintains a detailed spreadsheet that spans 17 columns of information about its patients that include their signature and thumbprint. Mr. Mehta believes that since this money does not belong to them, it is their duty to be absolutely accountable for these funds.

A Jaipur limb costs presently around Rs. 2,500 to prepare. BMVSS fits around 20,000 limbs every year. It also provides 65,000 other people with calipers, hand-pedaled tricycles, wheelchairs, crutches, hearing aids, and other orthopedic aids and appliances.

BMVSS thus provides an exemplary instance of service to the people. Its beneficiaries comprises of people young and old, as also the rich as well as those at the Bottom Of the Pyramid. The objective is to help restore the glory of the disabled person’s life, and help advance the person’s dignity, self-respect, mobility as well as usefulness as a normal member of the community.

As a humanitarian organization, BMVSS knows no frontiers. It treats all its beneficiaries equally. The disabled all over the world are its concern, and assistance is provided to them without any geographical, gender or community bias.

BMVSS also undertakes and promotes research & development towards improving the existing artificial limbs, calipers and other aids so as to improve the quality and reduce the cost of the devices.

2.2 The Jaipur Foot Technology

Though the initial idea of Jaipur Foot has been constantly improved upon, the essence of the product remains intact - low cost, quick fabrication out of locally available materials, crafted by local artisans, lightweight and suitable for working people across the developing world. This prosthetic may be worn with or without shoes.

Once an amputee enters the Jaipur Foot Center, a caretaker is assigned to each patient until the Foot is fitted. There is a trauma counseling session to help the person accept the idea of having to live with the artificial limb.

Orthopedic specialists then inspect the level of amputation, and prescribe the Jaipur foot. Next, a foot technician takes correct measurements of the stump and the rest of the limb (for reference)
and proceeds to make a hollow cast. Plaster of Paris (POP) is poured into the cast to get a model of the amputee’s limb.

A pre-heated high-density polyethylene (HDPE) pipe or sheet is now pressed around the mould that results in an artificial limb assuming the natural shape of the missing limb. The POP mould is broken and removed from inside, and a rubber or polyurethane foot is then attached. Finally, the artificial foot is attached to the stump with leather belts to hold it in place. It looks just like a natural limb, and has a life of around five years.

The Foot is lightweight, and fits quite easily. Thereafter, the person learns many gait training exercises so as to get used to the artificial limb and build the required strength in the supporting muscles. Proper maintenance and care of the foot is also taught to the amputees.

The Jaipur Foot and its allied aids are made with the developing country lifestyle in view. Their design provides for mobility in all the three planes: a) dorsi-flexion and plantar-flexion, b) inversion and eversion, and c) transverse rotation. This allows amputees to sit cross-legged, squat, walk barefoot on uneven surfaces, climb trees, negotiate muddy terrain and even run without shoes.

Dow Chemicals (India) has made significant contributions towards the improvement of the Jaipur Foot. The company provided immense assistance towards the development, manufacture and launch of the polyurethane (PU) Jaipur Foot in May 2006.

This new prosthetic limb has better functionality and flexibility, and weighs far less than its predecessor that employed plastic or polymer. It is also visually and aesthetically more appealing due to its natural look.

The performance of the Jaipur Foot provides users with an affordable natural gait. It has enabled many amputees to lead a nearly normal life. Cycle-rickshaw operator amputees have been able to resume operations, while the farmer amputees have got back to farming. Many other individuals who lost their limbs can once again participate in their previous vocations.

One of the most celebrated cases is that of the Bharatanatyam dancer Ms. Sudha Chandran. In 1981, she met with a road accident in which her legs were wounded. Her right leg had to be amputated at the tender age of 17 years. Sudha overcame her disability with the help of a prosthetic Jaipur Foot. Subsequently, she went on to become a highly acclaimed dancer as well as film and television actress. With the help of the prosthetic, she performed at many international events - and became an inspiration for numerous people.

All this is made possible at just a fraction of the cost of the other foot prosthesis available in the developed world, and is made available to the beneficiaries totally free of charge. “The minute
you start charging for a service, the most vulnerable parts of society are the first to be marginalized. And that is precisely the segment of the people we most wish to serve,” explains Mr. D.R. Mehta. “If we divert even one penny from serving the poorest of poor, it is a moral sin and a legal wrong,” he believes.

3. The Operational Strategy

In order to provide limbs, aids and appliances to disabled beneficiaries at its centers, BMVSS follows an operational strategy whose salient features are as follows:

3.1 An open-door policy

Any disabled person may visit and register at the BMVSS centre at any time of the day or night, without any appointment. The admission system enables the patient as well as an accompanying attendant to get immediate board and lodge facilities (free of cost too).

3.2 One-stop-shop

Its centers are one-stop providers of artificial limbs, calipers etc. The beneficiary stays put at BMVSS for one to three days until (s)he satisfactorily receives the medically advised prosthetics and other aids.

3.3 Assembly line method

The entire process, from measuring and fabrication to fitting and training resembles an assembly line approach. The manufacturing processes are kept simple and practical, and are continuously refined along with the design of the product. While doing so, the product quality is never compromised.

3.4 Procurement at concessional rates

To keep costs under control, most input materials are sourced locally. On account of its demonstrated integrity and ethical dealings, many suppliers provide raw material to BMVSS at highly concessional rates. For instance, accessories such as socks are supplied at an 80% discount on the market price by a vendor that otherwise supplies these products to Reebok and Nike.

3.5 Reduction of Overheads

Special efforts are made to keep the overhead costs as low as possible. To that end, the 22 BMVSS centers across India operate largely from the local Government Hospitals. The hospital
premises are used for production as well as service to the patients. The society’s office bearers do not serve tea at their meetings, and also carry drinking water from their homes. Travel is not reimbursed unless inevitable towards the work at hand. At around 4% of the total budget, the administrative expenses of BMVSS are among the lowest in the world for any organization of its kind.

3.6 Recycling
The waste products generated during the manufacturing process of the Jaipur Foot are auctioned through open bidding. The buyers often recycle the waste. This makes the entire operation very environment friendly too.

3.7 Finances
BMVSS meets around one-third of its costs from the grants provided by the Ministry of Social Justice & Empowerment of the Government of India. A small portion of the cost is also met out from the interest income earned from the corpus of BMVSS that has been created over the last four decades. The rest of the expenses are met by donations of generous and caring individuals and institutions. A culture of scrupulous accountability has been inculcated through the performance of regular internal as well as statutory audits.

4. The Sustainability Challenge
In light of its noble mission, the main issue for BMVSS through its four decades of existence has been that of sustenance. This problem is likely to exacerbate in the future. Going forward, some of the specific challenges that BMVSS might face are as follows:

4.1 The Free of Charge model
Since BMVSS does not charge any money whatsoever from its beneficiaries, no revenue accrues to it directly. A little over half of its annual budget of around Rs. 150 million is met through uncertain and erratic donations and grants. However, donors and patrons are concerned that the “free-of-cost” and “free-for-all” model may not sustain in the future. Many experts also see nothing wrong in “making a business out of doing good”. However, this debate has only reinforced Mr. Mehta’s faith and belief in the present model. “It (the change in model) will happen only over my dead body,” he exclaims.
One way to improve finances is to increase the corpus. The stipulation in the Indian Companies Act (2013) that requires organizations to spend at least 2 percent of their net profits on Corporate Social Responsibility is likely to help bring in more funds.

4.2 No Patent

The prosthetic has not been patented due to the purely altruistic motivation behind its creation. As a result, cheap or inferior imitations have come up in the past using the “Jaipur Foot” name. This spoils its brand value.

4.3 Quality and Technology

The lack of ISO and other Quality certifications has prevented the spread of the Jaipur Foot in developed countries. Being handcrafted, it also suffers on consistency parameters. However, the collaborations with Dow Chemicals and ISRO for polyurethane technology has helped BMVSS to reduce the cost, weight and fabrication time of the Jaipur Foot while increasing its durability.

4.4 Demand Growth

There has been an exponential increase in the need for artificial limbs across the world. However, the Jaipur Foot centers are still very limited in number. Representation gaps need to be identified, and suitable partners are to be located in order to run more branch offices. This may call for a drastic re-ordering of the institutional values and priorities.

4.5 Cost Escalations

As the organization scales up, the administration expenses are likely to increase. The rising costs of raw material and manpower also keep pushing the budget.

4.6 Patient/Technician Ratio

In order to cater to the enormous volume of patients being served daily, and adhere to the policy of admission and discharge within 12 hours as far as possible, BMVSS is required to maintain a Patient to Technician ratio of 1:1. Most of its technicians are ex-patients who have received training and now earn a remuneration that is twice the Indian average per capita income. The challenge is to find and retain large number of employees who will faithfully abide by the mission of the organization.
4.7 Succession Planning

The Jaipur Foot initiative is not easily amenable to replication, because it is driven by the extraordinary vision and passion of Mr. DR Mehta. In order to sustain and grow the organization in the future, BMVSS needs another person with the same charisma and stature. After ‘experimenting’ with young professionals, social activists and retired bureaucrats, Mr. DR Mehta has chosen a ‘distant’ relative Mr. Bhupendra Raj Mehta to succeed him.

5. Accomplishments

Jaipur Foot is one of the most technologically advanced social enterprises in the world. It represents the triumph of Gandhian engineering, or the frugal approach to innovation. A biomechanical comparison of the Jaipur Foot with the SACH and Seattle Foot showed that its performance was more natural and closer to the movements of the normal human foot as compared to the other two. The prosthetic Foot shall soon be manufactured in Afghanistan too at the National Institute for Disabled (NID) in Kabul.

Further, the Stanford-BMVSS Jaipur Knee was developed as a result of the joint research between BMVSS and Stanford University. It was hailed by the Time magazine (November 23, 2009 issue) as one of the world's 50 best inventions for 2009. Made of self-lubricating, oil-filled nylon, this prosthetic knee is flexible as well as stable - even on irregular terrain.

Mr. D.R. Mehta has ceaselessly championed the cause of BMVSS for 40 years, even as he was engaged in an illustrious administrative career that included such high-profile positions as the Deputy Governor of the Reserve Bank of India (RBI), the Director General of Foreign Trade (DGFT) and the Chairman of the Securities and Exchange Board of India (SEBI). Thankfully, his efforts over the decades have not gone unrecognized.

BMVSS has been conferred with the National Award for the best institution working in the field of rehabilitation of the disabled in 1998, and the National Award for being the best institution for the handicapped in 1982.

The Government of India conferred the Padma Bhushan (its third-highest civilian award) on Mr. D. R. Mehta in 2008. The prestigious Rajiv Gandhi National Sadbhavana Award was presented to him in 2012. He was also conferred with the Clairmont Lincoln Ahimsa Award for 2014 in California, among many others.

Further, the Philippines Parliament felicitated Mr. VR Mehta and his wife in 2010 for their efforts towards providing Jaipur Foot and other prosthetics to the disabled in their country.
6. The Way Ahead

The mandate of BMVSS now extends beyond medical care. Training is provided at the Jaipur campus in a number of different disciplines. Its grounds also serve as a hub for the local community - a quiet space where students often come to pore over their books. An additional program exists to enhance the economic position of many of the amputees.

“Often, the solution is not simply to provide someone with an artificial limb, and then to send him or her away,” says Mr. Mehta. “We also have a duty to address their social problems - by helping them to earn money and become self-sufficient after they leave.” This is accomplished by providing equipment that allows previously unemployed patients to establish small businesses of their own. For instance, BMVSS provides the needy beneficiaries with all the utensils necessary to set up “tea and snack” stalls.

To maintain and enhance the product quality, BMVSS has entered into techno-commercial collaborations with reputed organizations such as Stanford University, Massachusetts Institute of Technology (MIT), the Indian Space Research Organization (ISRO), The Rehabilitation Institute of Chicago and also some of the Indian Institutes of Technology (IIT) as well as the National Institutes of Technology (NIT).

A major collaborative research project with Stanford University is also presently underway on the below-elbow artificial hand. The model that shall emerge is likely to be inexpensive, and functionally efficient too.

On being asked what message he wants to give to the masses, Mr. DR Mehta says, “Treat the suffering of others as your own, and help them. The joy that you will experience is unmatched and fulfilling.”

That is the true legacy of the Jaipur Foot.
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