Low-Cost Artificial Limbs using the Pressure Cast Technique

Peter Lee
Department of Mechanical Engineering
University of Melbourne, Melbourne

Noel Lythgo
Rehabilitation Sciences Research Centre
University of Melbourne, Melbourne
A. DESCRIPTION, CHANGES OR BENEFITS EXPECTED AND EVALUATION

1. Can the project be defined as “Proof of Concept”? Please elaborate.

Yes. This project will establish “Proof of Concept” for an innovative technique (Pressure Casting, PCAST) to produce high quality artificial limbs in developing countries where a large number of amputees are unable to access adequate services to obtain a good fitting prosthesis. The PCAST has several major advantages over current methods. These include:

- Low-cost.
- Highly portable.
- Not reliant on the skill and experience of a prosthetist.
- Use of full weight-bearing by amputee to produce the socket (better fitting).
- Removal of rectification stage (labour intensive and costly) used in current practice.

This project will be conducted in collaboration with the Vietnamese Training Centre for Orthopaedic Technologies (VIETCOT) in Hanoi, Vietnam. The PCAST will be tested in a realistic clinical environment that will lay the platform for the acceptance of the PCAST technique in developing countries worldwide.

2. Who or what will be benefited by this project?

The immediate beneficiary of this project will be the 50 amputee subjects participating in this trial. It is expected that the subjects will receive comfortable fitting artificial limbs. In addition, VIETCOT will benefit from the transfer of the PCAST technology and “first hand” experience in using the PCAST. The PCAST trial will enable VIETCOT to be a leader in PCAST implementation and training in Vietnam and neighboring countries. The success of this project will have a direct impact on lower limb amputees world-wide, especially in countries affected by landmines, high incidents of motor vehicle accidents and natural disasters like earthquakes. Cambodia, for example, has one lower limb amputee for every 290 people or about 40,000 amputees ¹. In Afghanistan alone, the International Committee of the Red Cross produced about 8,500 prostheses and orthoses from Jan – July 2008 ². Recent articles in the guardian.co.uk and msnbc.com titled “Haiti earthquake creating a generation of amputees, doctors warn” ³ and “Haiti amputees face dire quest for prosthetics” ⁴ respectively, highlights the severity of this problem. The commonality in these situations is the dearth of skilled/qualified prosthetists and the disproportionately high number of amputees, hence limiting the provision of artificial limbs. There is therefore an urgent need to fully develop and trial the PCAST technique, which aims to reduce skill dependency in fitting an artificial limb.

1 ¹ http://news.bbc.co.uk/2/hi/asia-pacific/3259891.stm
2 ² http://www.ikrk.org/web/eng/siteeng0.nsf/htmlall/afghanistan-update-210808?opendocument
3 ³ http://www.guardian.co.uk/world/2010/jan/21/haiti-doctors-warn-amputee-crisis
4 ⁴ http://www.msnbc.msn.com/id/35103003

3. Describe the project in non-technical language for the CASS Directors (a lay abstract)?

Abstract
The prosthetic socket is the most critical component in the artificial leg. It is the load bearing interface between the amputee’s stump and the entire artificial leg. The socket shape is uniquely customized to the amputee. Current socket fabrication technology is costly, labour intensive and overly reliant on the skill and experience of a prosthetist. In contrast, the Pressure Casting (PCAST) method aims to produce a unique socket shape using objective parameters such as stump anatomy, body weight and an evenly distributed pressure over the amputee’s stump, removing factors related to skill and manual...
dexterity. The aim of this study is therefore to evaluate the PCAST for clinical application in a developing country. Fifty volunteer unilateral trans-tibial amputees (amputation level below the knee) will participate in this study. The study will be conducted over a 1 year period, divided into three phases. Both short term (2 months) and long term (4 months) PCAST socket usage will be evaluated using well established questionnaires that include Prosthetic Evaluation Questionnaire (PEQ) and Amputee Mobility Predictor (AMPPRO). In addition, a specially designed questionnaire will be developed for clinicians’ feedback on the use of the PCAST. All socket fittings and evaluation will be carried out in Vietnam, in collaboration with the Vietnamese Training Centre for Orthopaedic Technologist (VIETCOT), in order to ensure a realistic environment for both patients and clinicians.

Background
The PCAST technique is currently under scientific investigation by a collaborative research team from the University of Melbourne, Rehabilitation Sciences Research Centre (Austin Health) and Royal Melbourne Hospital. The project is funded by the CASS foundation from Aug 2009 – Mar 2011. The work involves both qualitative and quantitative measurement techniques (clinical and biomechanical) to assess PCAST performance in a small group of amputees in Australia. The PCAST work in Australia has shown it can produce good fitting sockets that are relatively inexpensive and require little input from a skilled prosthetist. In order to fully assess the potential of the PCAST, it is vital to conduct a field trial in a country where large numbers of amputees are unable to access adequate services to obtain a good fitting socket. Finally, the cause of amputation, amputee’s population, and the clinical setup in Australia are vastly different to that of developing countries. In order for the PCAST to be accepted, a well controlled clinical and scientific trial conducted in a developing country is mandatory.

Figure 1 shows a modern trans-tibial prosthetic leg consisting of the socket, shank, foot and alignment components. The socket is complex in shape. It has to be comfortable, but at the same time provide adequate support during standing and walking. The prosthetist has to consider these factors and create a socket shape that directs forces to pressure tolerant areas of the stump while relieving load at pressure sensitive areas and yet maintaining a pressure distribution which is as uniform as possible so as to avoid areas of high local pressure. Each socket is therefore customized to the individual patient, and with current practices its creation is predominantly achieved by the prosthetist applying somewhat artisan techniques. The creation of a prosthetic socket is a labour intensive process as described in Figure 2.

Figure 2. Current practice using artisan techniques and stages of trans-tibial prosthetic socket fabrication.
Firstly, stump physical measurements are systematically recorded using measuring instruments and plaster wrap cast. These measurements form a guide for the amount of rectification (i.e. removal of errors) to be applied to the positive plaster model at a later stage. A plaster wrap cast is taken of the stump and a positive plaster model is created. The rectification or removal of errors to the plaster model begins by taking measurements of the model, and comparing them with those previously taken on the stump. Based on a standard dimension table and information acquired from past experiences, the amount of rectification can be derived, providing the desired dimensions on the plaster model, i.e. the dimensions of the final socket. The rectification process enables the soft tissue of a stump to be compressed at pressure tolerant areas and relieved at pressure intolerant areas, generating a socket that bears weight comfortably. The rectification process therefore requires a trained prosthetist, a Category 1 prosthetist (a bachelor degree level based on the International Society of Prosthetics and Orthotics (ISPO)). In many developing countries, this task is usually undertaken by a Category II orthopedic technologist instead. A good socket fit today is therefore highly dependent on the skills and experiences of the prosthetists or orthopaedic technologists.

The PCAST, in contrast, creates sockets without the need of a rectification process. If successful, the PCAST will have an immediate impact worldwide due to the lack of both ISPO Category I & II clinicians. Using objective parameters such as stump’s anatomy, body weight and an evenly distributed pressure over the amputee’s stump, we have shown that an acceptable socket fit could be produced using the PCAST. The simple ‘PCASTing’ process is shown in Figure 3. A plaster wrap is first applied to the subject’s stump. Prior to the plaster wrap hardening, the subject places his/her stump in the PCAST tank separated from the water by a diaphragm made of plastic bag. Pressure is introduced by letting water into the tank. The desired pressure is reached when the subject is able to stand unaided, supported by the water in the tank (Figure 4). During the casting process, the intact limb (good leg) is placed over a weighing scale to ensure half of the body weight is on the PCAST system. Upon the plaster wrap hardening, the tank is depressurized by letting the water out. The plaster wrap is removed from the subject’s stump and duplicated without any rectification to make the socket.

![Figure 3. PCASTing](image1)

![Figure 4. Subject’s half body weight supported by the PCAST system](image2)
Biomechanical studies comparing sockets made using hand casting by qualified prosthetist and PCAST have been previously published by the investigators.\textsuperscript{5,6,7} The most recent study funded by the CASS foundation (SM/08/1969) applied an extremely thin pressure sensors (96 sensors) inserted between the amputee’s stump and the socket to capture the stump/socket interface pressures. Stump/socket pressures provides the most direct quantitative measurements possible correlating socket fit to comfort (Figure 5).

The pressure readings from the 96 sensors were firstly grouped into rows (R1, R2, R3) defining areas of interests in the stump. The pressure data were averaged for all trials for the individual subjects. Prior to the process of averaging, the data was normalised to 100% of the gait cycle (i.e. the time when the heel contacts the ground to the next heel contact of the same foot). The anterior socket wall (front of the socket) and posterior wall (back of the socket) pressure profiles were useful in understanding how load is transferred from the ground to the stump via the socket, providing a quantitative indication of socket fit and comfort. Figure 6 and 7 show the pressure profiles at the socket wall for two subjects (subject 1 and 2) wearing the PCAST and hand cast sockets respectively. It could be seen that the pressure distribution recorded at the anterior wall were similar for both PCAST and hand cast. However, the posterior wall of the PCAST socket showed a more evenly distributed pressure associated with a reduction in localized pressure. This could lead to more comfortable socket fit. In summary, the biomechanical principles of the PCAST socket is similar to that of the hand cast, which is achieved by pressure and counter pressure developed at the socket wall. The more evenly distributed pressures in the PCAST are encouraging, indicating that the PCAST method could produce both functional and comfortable sockets.

Figure 5. Stump/socket interface pressure measurement

![Stump/socket interface pressure measurement](image)

The thin pressure sensors was inserted between the stump and socket without any discomfort.

Figure 6. Stump/socket interface pressure of Subject 1 wearing PCAST socket

![Stump/socket interface pressure of Subject 1 wearing PCAST socket](image)

Figure 7. Stump/socket interface pressure of Subject 2 wearing hand cast socket

![Stump/socket interface pressure of Subject 2 wearing hand cast socket](image)
Research Plans

The overarching objective of this study is to initiate a process for the PCAST to gain acceptability in countries in urgent need of prosthetic services. A robust scientific and clinical trial documenting patients’ outcome and clinicians’ feedback is therefore necessary.

The specific aims of this project are,
- **To evaluate the PCAST in a clinical setting in Vietnam, based on patients’ and clinicians’ feedback and quantitative biomechanical information.**
- **To develop a robust PCAST protocol requiring minimal skills for use in developing countries.**

Volunteer unilateral trans-tibial amputees in Vietnam will participate in the study. The study will be conducted at the Vietnamese Training Centre for Orthopaedic Technologist (VIETCOT) in Hanoi, Vietnam. The test subjects will sign an informed consent form conforming to the rules of the ethical committee of the relevant hospital authority in Vietnam and the University of Melbourne in Australia. The scope of work is schematically described in Figure 8.

**Subjects:** Unilateral trans-tibial amputees will be selected from VIETCOT’s large patient database. The subjects will be active wearer and users of their prostheses. This group of subjects will be able to provide quality feedback comparing their previous prostheses to that of the PCAST. In addition, they will require minimal physiotherapy or gait training prior to limb use. Nevertheless, an assessment of the amputees’ stump condition will be carried out by an experienced prosthetist. The assessment will include information regarding skin, state of tissue, circulation, pain, amputation, joint function and muscle strength. The level of activity of the subjects will be indicated using an activity level assessment survey (e.g. Prosthetic Evaluation Questionnaire (PEQ) and Amputee Mobility Predictor (AMPPRO)).

**PCAST socket fitting trial:** Each patient will be prescribed with a PCAST socket made entirely by VIETCOT’s technicians. A total of two VIETCOT’s technicians will be responsible for fabricating the PCAST sockets. The PCAST sockets will be assembled with low cost components (shank, ankle units and foot) designed by the International Committee of the Red Cross. The same technicians will
also be responsible for socket fitting, prosthesis alignment and gait evaluation for all subjects fitted with the PCAST socket. Each subject will be requested to use the PCAST limb for a minimum period of 4 months. A 4 month period was deemed sufficient because all participating subjects are already active wearers of their prostheses. During the 4 month period, the subject will be requested to visit VIETCOT at a 2 monthly interval for assessment. The assessment will include a detail examination of the subject’s stump conditions and activity levels using the PEQ and AMPPRO surveys. Finally, the two VIETCOT’s technicians will be asked to complete a survey documenting their experience on the use of PCAST for the specific subject. Findings will help identify the ease of use and possible areas of improvement.

**PCAST quantitative biomechanical assessment:** The subjects will participate in a customized obstacle course allowing assessment of daily activities like stair climbing, walking up and down slopes, and over narrow pathways. Using an instrumented gait mat (GAITRite, CIR Systems Inc, USA), the subjects’ gait wearing the PCAST socket can be comprehensively examined. Large amounts of subject specific gait data can be collected in relatively short periods of time. The GAITRite walkway system shown below is a portable instrumented carpet that can be used in a field setting. The standard walkway is 4m long x 0.6 m wide x 6 mm high and contains 13,824 sensors that sample at 80 Hz. Forty-one gait measures such as step length, foot angle, the path of the foot’s centre of pressure and the line of progression are immediately available upon the completion of a walk across the mat. Importantly, the system has been shown to be valid and reliable 8, 9, 10.

During the biomechanical assessment, the subjects will walk shod (sandals supplied) at least 6 times across the GAITRite (sample rate = 80 Hz) walkway at self-selected and fast speeds. The walkway will be placed on firm carpet such as carpet tiles or lino. Participants will also complete 6 trials at self-selected speed whilst barefoot. In order to achieve steady state gait across the GAITRite mat, an approach and departure distance of at least 2 body lengths will be employed. In total, up to 41 spatio-temporal parameters of gait will be collected (e.g. step length, step time, base of support). Key variables will be periods of stance (e.g. single and double support), step length symmetry, step width, step and stride length, cadence and walking speed. The information collected using GAITRite and the customized obstacle course will enable subject specific assessment of the PCAST socket fit.

**Project timeline:** A total of 50 subjects will be participating in the study. However, the study will be conducted in three phases consisting of 15, 15 and 20 subjects respectively. The scope of work for each phase is similar as outlined in Figure 8. By conducting the projects in phases, there are opportunities for phase two and three to be improved upon depending on the results of the preceding phases. Figure 9 shows the detailed timeline of the three phases and the project milestones. The entire duration of the project is expected to be 12 months. It is also worthwhile noting that all subjects, regardless of whichever phases, who are satisfy with the PCAST sockets will be encouraged to continue its use even after the 4 months evaluation period. This will provide opportunities for longer term PCAST socket assessment.
5. What must be achieved in order for the project to be considered successful?

An international awareness of the PCAST methodology. This will be achieved by peer review publications and presentation in international conferences. In addition, the collaboration with VIETCOT will provide credible results that will propel the adoption of PCAST in developing countries. A stretch goal is therefore to implement similar PCAST trials champion by other organizations (similar to VIETCOT) in other developing countries.

5. Who are the people undertaking the project work (include relevant qualifications)?

Peter Lee (Chief Investigator)
Qualifications: PhD. BEng.

Dr. Lee obtained his BEng in Mechanical Engineering (1st Class Hons. 1991) and PhD (1996) in Bioengineering from the University of Strathclyde, UK, and continued his post-doc in the same university from 1996–1998. He was a Research Fellow with the Biomaterials Group at the Institute of Materials Research and Engineering, Singapore from 1998–2001. In 2001, he joined the Defence Medical and Environmental Research Institute, DSO National Laboratories, Singapore, as the Head of the Bioengineering Laboratory. He was appointed as an Adjunct Associate Professor from 2002–2008 at the National University of Singapore, Division of Bioengineering. He joined University of Melbourne as a Senior Lecturer in 2008. His research
interests include Biomechanics for lower limb prostheses and orthoses; computer aided design and rapid prototyping methods for prosthetic socket manufacturing to improve artificial limb function and amputee acceptance; development of new materials and methods for low cost prostheses. He has considerable experiences in low cost prosthetics research. These included research collaboration with the International Committee of the Red Cross in Vietnam and Cambodia in mechanical testing of artificial limbs; received a research grant from the United States Agency for International Development (USAID) - Patrick J. Leahy War Victims Fund (2000) via the International Society for Prosthetics and Orthotics (ISPO) to evaluate low cost prosthetics foot from low income countries; and participated in the ISPO Consensus Conference on Appropriate Orthopaedic Technology for Low-Income Countries, Moshi, Tanzania, September 18–22, 2000.

Awards: Awarded Asian Pacific Travelling Fellowship by the International Federation for Biological and Medical Engineering, 2006; Conferred the title of Principal Member of Technical Staff (PMTS) in recognition of technical distinction attained in DSO National Laboratories, 2004; Achieved the Innovation Excellence Award from the Defence Science and Technology Agency, 2003; Awarded First Prize – Assistive Technology Invention Competition by The Society for the Physically Disabled, 2005; Honourable Mention – 8th Asian Innovation Award by Asian Wall Street Journal, 2005; Young Investigator Gold Award. 9th International Conference on Biomedical Engineering, Singapore. December 3rd - 6th, 1997.


Noel Lythgo
Qualifications: PhD, MApSci, Grad Dip Ex & Sport Sci, BEd
Position: Senior Research Fellow, Deputy Director, Rehabilitation Sciences Research Centre, University of Melbourne.

Teaching/Administrative career: Lecturer at the Australian Catholic University (ACU) and Deakin University specialising in biomechanics, exercise science, experimental design and statistics. Within the School of Exercise Science, Faculty of Health Sciences, ACU (1989-2004), he fulfilled the following roles: Acting Head of School, Honours and Year Level Coordinator, Laboratories Manager, Information Technology Convenor, School Executive Committee, Standing Committee for Post-graduate Courses and Student Appeals Committee. Currently (2004-2008) within the Rehabilitation Sciences Research Centre (University of Melbourne) he fulfils the following roles: Deputy Director, Movement Laboratory Coordinator and Senior Research Fellow. This Centre was established in late 2004. His role is to develop and manage the Movement Laboratory, support and initiate research. The main focus of the Centre is to develop the research infrastructure and acquire international standard equipment to support, develop and enhance cross-institutional and multi-disciplinary research in human mobility, locomotion and propulsion across the lifespan. To date, he has assembled a fully operational movement laboratory. Major equipment housed in the laboratory include an 8 camera VICON-Nexus Motion Analysis System, 3 AMTI force plates, 16 channel Zero Wire EMG system, 3 portable GAITRite systems, Biodex and Kincom dynamometers.

Academic career: Completed PhD in Gait Biomechanics in 2003 after 14 years as a lecturer at ACU. Completed MApSci in Gait Biomechanics in 1995, Grad Dip Ex & Sport Sci in 1992 and BEd in Mathematics and Physical Education in 1983. Lecturer (Biomechanics), School of Exercise Science, Australian Catholic University (1989-04). Promoted to Senior Research Fellow in 2004 in the School of Physiotherapy, Faculty of Medicine, Dentistry and Health Sciences, University of Melbourne. In 2004, appointed Deputy Director of the Rehabilitation Sciences Research Centre, Faculty of Medicine, Dentistry and Health Sciences, University of Melbourne.
**Research Grants:** He has obtained over $500,000 for a total of 25 grants that focus upon biomechanical and motor control aspects of human movement. In 2006, success in obtaining an Early Career Researcher Grant enabled me to test the gait patterns of 900 children ranging from 5 to 13 years of age. A recent grant from the Austin Hospital Medical Research Foundation has allowed him to conduct research in the field of amputee gait.

**Supervision:** Supervised 13 Honours students (8 first Honours), one Masters and five Doctorates to completion, and am currently supervising 2 Masters and 1 PhD students. One Honours student won the University medal at ACU. I have also played a major role in the biomechanical, instrumentation, experimental design and statistical aspects of 5 other PhD students, 4 Masters students and 10 Honours students at ACU and the University of Melbourne.

**Awards:** Honorary Fellow of the Australian Catholic University (2005-10).

**Publications, Presentations, Collaborations:** 65 peer reviewed publications, 64 conference presentations (3 national invited lectures), 6 expert witness presentations, 22 seminar/workshop presentations (e.g. Murdoch Childrens Research Institute) and collaborative work with organisations such as the Howard Florey Institute, Centre for Neuroscience (University of Melbourne), DSTO (Australian Defence Force), National Ageing Research Institute, Royal Children’s Hospital (Melbourne), Victorian Institute of Sport and Howard Florey Institute. In 2004, he published a book in the field of Biomechanics. This text is used for undergraduate teaching.

**Professional Affiliations:** Founding member of the Australasian Biomechanics Society and have served as the National and State Coordinator of Movement Science for the Australian Council for Health, Physical Education and Recreation.

**Grant Reviews:** NHMRC project grant (2005).

**Manuscript reviews:** 6 papers for Gait & Posture (Journal). Examined 1 PhD, 2 Masters and 7 Honours theses.

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**Jim Lavranos**

**Qualifications:** B. Arts, B. Prosthetics & Orthotics, Post Grad. Dip. Bioethics

**Position:** Senior Clinician, Prosthetic & Orthotic Dept. (Royal Melbourne Hospital, Royal Park Campus). Jim is a practicing clinician who manages a diverse patient case load requiring both prosthetic and orthotic intervention in the rehabilitation and definitive phases of management. He coordinates the VALP (Victorian Artificial Limb Program) clinic and compensable client caseload at RMH, as well as being involved in the DDC (Developmental Disability Clinic) and the spasticity clinic.

Jim supervises and supports the clinical staff at the facility on the more complex cases and is heavily involved in training and educating allied health staff and students in many prosthetic and orthotic related areas. Every year he is involved in the coordination and implementation of the Lower Limb Prosthetics Seminar which is aimed at medical and allied health professionals both nationally and internationally. He also leads much of the Research and Development at the department by identifying, field testing and trialing new techniques and technology and by organizing demonstrations through the major technology manufacturers and suppliers. Jim has recently introduced a Myo-electrics program for upper limb prosthetic management to the campus.

He is very active in promoting, supporting and conducting research within the Prosthetics and Orthotics Department. He has worked with Dr. Lee, Dr Lythgo and Austin Health Physiotherapy staff including Helen Connor (Amputee/Orthopaedic) on the P-cast system, having provided both clinical and technical feedback as well as input on direction and methodology. He has also shown a particular interest in partial foot prosthetics by working on functional prototypes and on silicon cosmetic designs with Dave Myers from the maxillofacial department, with the intention of pursuing testing in the near future. Jim regularly attends research and training based seminars (i.e. ISPO and AOPA) to keep up to date with all formal and anecdotal research programs.

**Past Experience:** Jim has extensive experience working in developing countries in a clinical, educational, research and administrative capacity. He has provided clinical and technical support, supervision and mentoring in Cambodia for VVAF (Vietnam Veterans of America Foundation) in their main Prosthetic and Orthotic facility and has provided similar services to Handicap
International in remote locations in India. He has also been a key consultant and lecturer in the establishment of a Bachelor Degree in Prosthetics and Orthotics at Mahidol University in Bangkok, Thailand. All along he has assisted both humanitarian and non-government organizations in the evaluation and development of appropriate technology.

Nguyen Hai Thanh


Position: Director of Vietnamese Training Centre for Orthopaedic Technologists. Chief of Vietnam’s Consulting centre for Orthopaedics. Lecturer in Prosthetics and Orthotics and Orthopaedics faculty at the University of Labour, Social Affairs.

Past Experience: Thanh has significant experience working in developing countries (Tanzania, Indonesia, Laos) in both clinical and educational research. He has provided clinical and technical support, supervision and mentoring for Ministry of Invalid, Labour and social Affairs and the International Committee Red Cross-Special Fund for Disable in Vietnam. He has published in international peer review journals in prosthetics and orthotics, and well know for his work in low cost prosthetics

Relevant publications:

6. Where will the work be done?

The PCAST trial will be conducted in VIETCOT, Hanoi, Vietnam. All PCAST fitting and subjects’ assessments will be conducted at VIETCOT. The investigators will be travelling to VIETCOT at the start of the project and on the 5th, 8th and the 11th month to participate in the subjects’ assessments and surveys (See Figure 9). Regular contacts will be made via emails and telephone calls with VIETCOT during the entire duration of the trial. The analysis of the data will be conducted jointly by the University of Melbourne and VIETCOT.

7. How long will the project take?

The project total timeline is 1 year as described in Figure 9. Three project milestones have been identified on the 6th, 9th and 12th month. Conclusive data may be available as early as 6th month after the completion of phase 1.

8. How will interested parties (i.e. A2) be informed of the outcomes/results of the project?

The results of this trial will be communicated via peer reviewed scientific publications. This study will also be reported at the largest gathering of prosthetist and orthotist in May 2012 at the 14th ISPO World Congress. Preliminary reports for Phase 1 and Phase 2 will be circulated (with CASS Foundation permission) to relevant organizations that will benefit from low cost prosthetic techniques. Finally, the findings in this project is expected to be newsworthy and of interests to the general public.

9. Is the applicant organisation collaborating with any other group or organisation in this work? If so, who?
The work involves the collaboration between the University of Melbourne (Department of Mechanical Engineering, Rehabilitation Sciences Research Centre) and VIETCOT. VIETCOT began as a project sponsored by the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH in 1994. GTZ is a service enterprise for developing cooperation with world-wide operations and is owned by the Federal Republic of Germany. In 2006, GTZ involvement with VIETCOT ended. It is currently under the administration of Vietnam’s Ministry of Labour, Invalids and Social Affairs (MOLISA). The training centre is staffed by approximately 13 locals with expertise in prosthetics and orthotics (P&O). The institute conducts a 3 year course for Category II orthopaedic technologists. VIETCOT is one of the most well known, established and respected P&O schools for training orthopaedic technologists in developing countries. In addition to students from Vietnam, students come from neighbouring countries like Cambodia, Thailand and Indonesia. More information on VIETCOT can be found at http://vietcot.netnam.vn. The main collaborator / researcher who will be involved in this project will be the director of VIETCOT, Mr. Nguyen Hai Thanh.

10. Provide names and contact details of external referees or referees at arms length, who have knowledge of the project and who may be able to comment thereon.

Referee #1 Professor David Morgan (Biomedical Engineering)
Centre for Biomedical Engineering
Monash University
Phone: 9905 3483
Fax: 9905 3454
Email: david.morgan@eng.monash.edu.au

Referee #2 Associate Professor Rezaul Begg
Biomechanics Unit, HMRP/CARES
Victoria University
Phone: 9919 1116
Email: rezaul.begg@vu.edu.au

Referee #3 Peter Poetsma
SFD Head of Regional Office
International Committee of the Red Cross
CAPADIFE–Oficina; De la Iglesia El Carmen, 21/2 cuadras al norte, Managua, Nicaragua
Email: managua.mag@icrc.org
Phone: + 505 2266 7803