02 May 2014

The Hon. Gordon Rich-Phillips MLC
Minister for Technology
Victorian Government
121 Exhibition Street
Melbourne 3000

Dear Minister,

I am pleased to submit to you the Victorian Life Sciences Computation Initiative's 2013 Annual Report.

As we enter this final year of the first phase of this initiative it is very pleasing to report that all the key performance indicators set for the enterprise have already been met. Our job now is to ensure that we can sustain and embed the facility and its highly skilled staff into the Australian research landscape and continue the fine work we see documented in this Report.

The University has already reaped rewards from its substantial contributions to the enterprise. Having promised to contribute at least $12.5m in cash in the first five years, through the period 2009-2014, this University will have made a cash contribution to VLSCI of $12.85m. Further, our counterparts at Monash and La Trobe Universities have also acknowledged the benefits flowing to their own institutions and have already committed to contribute cash to sustain the Initiative in the future.

This Report documents some of those benefits and outcomes. In the details we see international and national collaborations, employment opportunities, career and technical developments and a growing community engaging in this exciting field of computational biology. This is setting us up to be well-placed to play our part in this emerging industry, where it was reported, exactly one year ago in the HealthcareITNews, that the global bioinformatics market, valued at nearly $3.2 billion (US) in 2012, is forecast to grow to nearly $7.5 billion by 2017 (according to Wellesley, Massachusetts-based PCC Research).

It is particularly noteworthy for the University to see the level of engagement there is across the research community with the IBM Research Collaboratory for Life Sciences-Melbourne, with many high-profile and high-use projects relying on their expertise and in turn, passing on opportunities for training our students and for them to find careers beyond the academy. With the planned relocation of VLSCI within the Carlton Connect precinct, along with the IBM Research and Development Laboratory, it is expected that the relationship will deepen.

We thank you and the Victorian Government for making this opportunity available to Victorian researchers and their collaborators and for your ongoing interest in its progress.

Yours sincerely,

[Signature]

Professor James McPherson, FAA
Deputy Vice-Chancellor (Research)

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ABOUT THE VLSCI

The Victorian Life Sciences Computation Initiative (VLSCI) combines collaborative research expertise with high end computing. The critical infrastructure and expertise offered by VLSCI has become essential to local life science research through its support and growth of the thriving specialities of Bioinformatics, Computational Biology and Computational Imaging.

WHAT DOES THE VLSCI DO?

The VLSCI empowers the life science research community through access to state of the art resources, centralised computational expertise, know-how and training services. It:

• provides a world-class computational service that supports the transformation of life sciences research through high end computing
• provides a leading computing facility with the capability to address much larger life sciences research problems than previously addressed in Australia
• facilitates greater research collaboration within Victoria, nationally and internationally
• develops skills in computational biology, bioinformatics, advanced simulation and modelling, data management and more generally the application of advanced computing in life sciences
• supports industry development through the uptake of computational research in life sciences
• collaborates with Australia’s major infrastructure and networking activities such as NeCTAR to support and increase access for researchers across Australia
• works with Australia’s other high-end computer centres to promote Australia’s capacity in high-end computing and to create standard access processes.

WHY HAS THE VLSCI ACHIEVED SUCCESS?

The state-of-the-art equipment and high-level experience and expertise enables Australian research to compete globally and attract international funding.

The Peak Computing Facility (PCF) includes the biggest supercomputer dedicated to life science research in the world. Staff offer specialist technical expertise including hardware and software documentation and services to maximise user experience and ensure efficient access to computing resources appropriate to life sciences research.

The Life Sciences Computation Centre (LSCC) has built specialist teams to support researchers and drive capacity-building activities. Active across Australia, these expert teams have been spread across multiple research institutions to accelerate life science computation:

• The University of Melbourne - High Throughput Genomics
• Monash University - Computational Bio-imaging
• La Trobe University - Molecular Modelling

The Outreach and Skills Development Program provides a diverse program of events and activities to engage researchers, students, stakeholders, experts and the public in life sciences computation.
A specialist high-end facility focussed on the unique skills and services needed to remain competitive in life sciences computation.

**INFRASTRUCTURE**
- IBM Blue Gene/Q supercomputer - 4 racks
- High memory X86 systems for Genomics, Proteomics, Imaging applications
- Complemented by over 240 licensed software applications specific to life sciences
- Petascale computing

**EXPERTISE**
- Scientific and technical advice
- Scientific and technical collaboration
- IBM Research Collaboratory for Life Sciences
- Formal training and documentation
- Depth of life science project experience within team
- Skills development, community capacity building and educational resources

THE VLSCI SOLVES REAL ISSUES FACED BY RESEARCHERS

VLSCI provides the infrastructure, scale, expertise and scope to meet the biosciences industry’s needs.

**ISSUE EFFICIENCY**
- Data management and processing associated with high end computing projects require dedicated resources and expertise.
- VLSCI enables faster, smarter, practical research outcomes.

**ISSUE COST**
- High end computing capital expenditure and operating costs prevent go-it-alone approaches by researchers.
- VLSCI makes research cost effective – researchers don’t need to attempt to buy, run, develop and understand their own clusters.

**ISSUE EXPERTISE**
- Constant changes to best practice approaches, resources available and what can be achieved through computational research.
- The VLSCI provides entry point expertise without the difficulty and expense of engaging an in-house dedicated expert in these fields, and can help recruit the right expert as the research team’s need grows.
- VLSCI creates jobs that inspire and retain Australian computational biology talent, attracts top international bioinformaticians and nurtures the training of new experts.

**ISSUE STAFFING**
- Costs for a full-time computational researcher are likely to exceed the budget (or need) for any one particular research project, and scarcity of computational researchers makes direct recruitment difficult.
- VLSCI is delivering effective support for new tools and disciplines including bioinformatics, molecular dynamics and imaging in Victoria.
I am pleased to endorse this 2013 Annual Report of the Victorian Life Sciences Computation Initiative (VLSCI). I do so on behalf of the VLSCI Steering Committee, which includes senior nominees from Melbourne, Monash and La Trobe Universities, the Walter and Eliza Hall Institute (WEHI), Melbourne Health, the National Computational Infrastructure (NCI) and IBM, in addition to the Chair of the VLSCI Scientific Advisory Committee and the VLSCI Director, Professor Peter Taylor.

To fulfill its responsibility for reviewing all aspects of the operation of the VLSCI and for providing recommendations and strategic advice to the host institution, The University of Melbourne (The University), through the Deputy Vice-Chancellor (Research), the Committee met four times during the year, on 5 March, 21 May, 13 August and 10 December.

Much of the attention of the Committee during 2013 was focused on review of the VLSCI operations and its substantial achievements to date and especially on the important challenge of assuring the VLSCI’s long-term sustainability beyond December 2014. This followed a major emphasis on sustainability planning during 2013 and involved commissioning and oversight of a substantial volume of high quality supporting documentation as a basis for strategic advice to The University.

The Steering Committee continued to be impressed by the overall progress and take-up of the VLSCI capabilities and was pleased to see the arrival and commissioning of the new IBM (Dataradix x386 ‘Barcoo’ system in July marking the completion of all sub-stages of the VLSCI Stage 2 Peak Computing Facility (PCF) upgrade. The PCF continued to perform extremely well whilst 75% of the available Blue Gene/Q Service Units continued to be offered via the National Computational Merit Allocation Scheme (NCMAS) in order to contribute to meeting the national demand for access to high end computing facilities.

The subscription-based project support model through institutional and project-based contributions to the Life Sciences Computation Centre (LSCC) generated substantial external funding and led to the introduction of a new ‘Molecular Modelling’ theme located at La Trobe University.

The Committee was pleased with the impact of VLSCI’s outreach effort including the Director’s August presentation to the Victorian Biotechnology Advisory Council and a public symposium held as part of The University’s ‘Festival of Ideas,’ which combined a public event with a research showcase day on 3 October at which a number of 2013 users displayed their work. The calibre of media stories generated throughout the year was pleasing, including the filming by ABC TV of a significant story on the ‘Environmental Modelling’ research performed on VLSCI facilities for the ‘7.30 Report!’ (3 April), a front cover feature on The Age’s ‘Melbourne Magazine’ (April) of a polio virus model, with mention of VLSCI on the inside front cover and a story inside, and several opinion pieces by the Director in publications such as The Financial Review (7 January).

In support of its efforts to assist the VLSCI and The University to develop a robust strategy for achieving the long-term sustainability of this important initiative, on the advice of the Committee, The University engaged SPP (Strategic Planning Partners) to assist with development of an overarching ‘Sustainability Plan’, which was submitted to the Victorian Government Department of State Development, Business and Innovation (DSDBI) on 30 April 2013.

A ‘Business Case for Transitional Funding Support’ was submitted to DSDBI on 10 October. Following a ‘Request for Quotation’ process, a ‘Benefits Realisation Analysis’ was conducted by ACIL Allen Consulting and submitted to DSDBI on 26 November.

In response to advice from these reports and with the support of the Steering Committee, VLSCI opened discussions with various parts of the Federal Government during the year, to increase awareness of the national value of the VLSCI and begin to make the case for ongoing support at the Federal level for this important piece of research infrastructure. The Committee was also satisfied with the positive interactions arising from Sustainability discussions as part of an initial campaign to engage with senior personnel within various stakeholder institutions. The initiation of an awareness-raising campaign highlighting the benefits of the VLSCI was also supported by the Committee.

After a busy year involving much external interaction and consultation, the Committee wishes to acknowledge their assessment that the VLSCI has been fully satisfied with the positive interactions arising from Sustainability discussions as part of an initial campaign to engage with senior personnel within various stakeholder institutions. The initiation of an awareness-raising campaign highlighting the benefits of the VLSCI was also supported by the Committee.

The Steering Committee is satisfied with progress towards the long-term sustainability of the VLSCI and commends the VLSCI Director and staff for their achievement in transforming life sciences research in Victoria, as reported in this Annual Report. We share their assessment that the VLSCI has much to offer the national life sciences research community in years to come, and we strongly support them and their stakeholder organisations’ efforts to ensure that the long-term vision for VLSCI as the national peak computing facility for the life sciences in Australia is achieved.

John W. Zillman
Chair
Assessor, Dr Mike Sargent, AM FTSE.
FROM THE DIRECTOR

It is my pleasure to commend to you my fourth VLSCI Annual Report. The data and stories contained herein document a complex operation which in four action-packed years has become an integral part of Australia’s research infrastructure. Further, it offers a successful model for building Australia’s capacity, skills and expertise in high-end and, more specifically, life sciences computation.

VLSCI commenced operations in 2010 as a Victorian Government Initiative designed to strengthen Victorian research capabilities and outcomes in the growing field of computational biology. Stakeholders, quite correctly, anticipated the exponential growth in data arising from the Human Genome Project and other technologies that make up the ‘Biological Revolution’, such as bio-imaging and molecular modelling. As predicted back in 2009, in January 2014 key industry player, Illumina, announced its new genomic sequencing system with the words, Illumina introduces the HiSeq X Ten Sequencing System - Breaks Barriers. This model of engagement is one that has attracted attention across the bioinformatics community in Australia and overseas as a successful way to address the many issues experienced by this fledgling community. This significant high performance computation (HPC) facility demonstrates that Victoria’s investment in this industry is serious and sustained. The concentration of resources helps to excite young people about a career in computational biology and it delivers results – including clinical implementation of new knowledge to which our people have contributed.

Having achieved all our stated objectives and delivered on all key performance indicators, those of us closely connected to the fast-paced developments occurring in computational biology feel that our work has only just begun.

After much reflection, research and planning in 2013, it became clear that a resource such as this should be supported and available nationally. In anticipation of this move, we had already made 15% of the IBM BlueGene/Q available nationally through National Computational Merit Allocation Scheme (NCMAS) (refer p.13). This Annual Report now documents the outcomes from researchers who took up this opportunity. One user commented: We have not fully exploited VLSCI resources in the past but given the increasing load on National Computational Infrastructure (NCI), VLSCI will be very important in ensuring that we have adequate access to high performance computing facilities.

Further to this end, the consultants conducting the Benefits Realisation Analysis Report (refer p.10) were asked to help us refine our Annual Reporting process to extract more accurate and useful data for existing stakeholders and to support our case for ongoing Victorian and national funding through national infrastructure funding schemes. Much of this data collected is included in this Annual Report and the rest is being shared with other Australian supercomputing centres and stakeholders to inform planning for future resource needs.

VLSCI is now a crucial part of research infrastructure and a centre for scientific and technical expertise servicing the important biosciences sector in Victoria. Were VLSCI to wind-up at the end of 2014, 90% of compute resources currently available to Victorian researchers would disappear, at a time when the high-risk, high-return biotechnology sector is once again starting to envision real returns from clinical genomics, precision medicine, environmental modelling and drug discovery – all of which rely on highly-skilled and well-equipped people to deliver results.

As one of our major users, Prof. Kerry Hourigan, Monash University, writes: It takes considerable effort to build up such a facility and once this step has been taken, it needs only modest effort to keep it going.

VLSCI Director Prof. Peter Taylor (l) with NCI Director and VLSCI Resource Allocation Scheme Committee (RAS Committee) Chair, Prof. Lindsay Botten at the Research Showcase held in October. Image: Casamento Photography.
As required in VLSCI’s Grant agreement with the Victorian Government, an external evaluation was conducted during 2013. In researching their report, ACIL Allen Consultants interviewed staff, major users and stakeholders. The final report was submitted in November. Entitled Evaluating the VLSCI: A Benefits Realisation Analysis, it was overwhelmingly positive about developments to date and gave useful advice on strategies for tackling the challenges of the future to ensure VLSCI remains a strong and viable resource for Australian research and industry.

EXECUTIVE SUMMARY

The ability to access supercomputers allows researchers to apply new, data intensive, technologies such as genomics in life sciences research. It also helps to accelerate the application of research results into changes in disease detection and diagnosis, developing new drugs for treatment of illnesses and drive changes in clinical practice. All of these things will have profound impacts on the health and wellbeing of populations in Australia and around the world.

The ten key findings of the Analysis were that VLSCI
• is the world’s top life sciences research supercomputer
• is a powerful mechanism for supporting life sciences research
• enables world class research by Victorian life sciences researchers
• supports Victoria’s strong reputation in life sciences
• is highly effective at increasing collaboration
• is delivering benefits now
• will deliver more benefits in the future
• needs to transition to a more sustainable future
• should become more national in its approach
• governance arrangements need to evolve.

These findings have informed the Business Plan 2014 and continue to inform sustainability planning for the future. The full report may be requested from VLSCI Communications.

VLSCI remains a strong and viable resource for Australian research and industry.

The VLSCI possesses research focus and expertise specifically in applications of computation to life sciences.

As opposed to other HPC facilities, VLSCI possesses research focus and expertise specifically in applications of computation to life sciences, including computational structural biology (particularly important to this project). Thus in addition to HPC facilities, VLCSI also provides access to expertise, and intellectual and technical input into the project through seminars, meetings and support. VLSCI also facilitates collaboration in life sciences computation. It has provided a vital resource (both facilities and personnel) for the establishment and continuation of this project. We have made significant progress in understanding conotoxin interactions with neuronal receptors, which is leading towards development of viable drug therapies for brain diseases. A good example is our recent work on modified “dicarba” toxins. Towards this end, VLSCI has also enabled us to strengthen our cross-institute collaborations nationally and internationally. These collaborations will continue to yield research outputs leading, ultimately, to better health and treatment outcomes. VLSCI has also helped us establish further links with the existing computational biology community, and these will also ultimately benefit our research outcomes. VLSCI is an enormously vital resource and I would like to see it continue to develop as it has since its inception.

Feedback from Dr Andrew Hung, Health Innovations Research Institute, RMIT University

TOXIN BINDING TO MEMBRANE PROTEINS: TOWARDS NOVEL TREATMENTS IN NEUROPATHOLOGY
**RESEARCH ACTIVITY**

**EMPLOYMENT**

Chief Investigators allocated resources on VLSCI systems, reported on additional staff/students taken on as a result of their 2013 VLSCI project:

- Undergraduate students (predominantly UROP projects)........................................... 37
- PhD students.............................................................................................................. 48
- Post-graduate students.............................................................................................. 27
- Other.......................................................................................................................... 4

**GRANT INCOME**

Chief Investigators allocated resources on VLSCI systems, reported on the importance of access to VLSCI facilities and their grant funding success:

- Extremely important................................................................................................... 39
- Moderately important ................................................................................................ 10
- Important.................................................................................................................... 19
- Somewhat important.................................................................................................. 9
- Not very important..................................................................................................... 14
- N/A.............................................................................................................................. 7

When asked about new funding applications which had been made as a result of work done on VLSCI systems, chief investigators reported that over $10m in predominantly Australian grants had been applied for, with $2.5m received and another $5.3m yet to be advised.

Chief Investigators were asked to nominate what sources of grant income they accessed for work being carried out by them on VLSCI systems. This table summarises the data (note that the years 2016, 2017 and 2018 only contain secured funds to date):

<table>
<thead>
<tr>
<th>INCOME YEAR</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>FUNDING SOURCE</td>
<td>$52,125,803</td>
<td>$48,776,943</td>
<td>$41,831,915</td>
<td>$34,894,649</td>
<td>$21,327,942</td>
<td>$7,235,714</td>
</tr>
<tr>
<td>International</td>
<td>$5,821,628</td>
<td>$5,657,291</td>
<td>$1,726,000</td>
<td>$1,606,000</td>
<td>$1,606,000</td>
<td>$856,000</td>
</tr>
<tr>
<td>ARC</td>
<td>$3,744,283</td>
<td>$2,588,688</td>
<td>$2,733,390</td>
<td>$2,254,718</td>
<td>$11,960,754</td>
<td>$7,235,714</td>
</tr>
<tr>
<td>NH &amp; MRDC</td>
<td>$15,929,446</td>
<td>$13,774,974</td>
<td>$11,877,969</td>
<td>$9,920,824</td>
<td>$7,782,186</td>
<td>$7,235,714</td>
</tr>
<tr>
<td>Other, Vic.</td>
<td>$3,269,049</td>
<td>$2,840,715</td>
<td>$125,714</td>
<td>$12,857</td>
<td>$12,857</td>
<td>$12,857</td>
</tr>
<tr>
<td>Other</td>
<td>$2,169,049</td>
<td>$2,169,049</td>
<td>$2,169,049</td>
<td>$2,169,049</td>
<td>$2,169,049</td>
<td>$2,169,049</td>
</tr>
</tbody>
</table>

**COLLABORATIONS, NON-VICTORIAN ACTIVITY**

Chief Investigators allocated resources on VLSCI systems reported on the extent of their reliance upon collaborations to carry out projects. Of the 94 respondents, 64 reported they were working on projects with collaborators from other institutions, with 20 being Australian, 31 overseas and 9 with industry partners. Overseas collaborations extended to Japan, Egypt, France, UK, USA, New Zealand, Germany, the Netherlands, Sweden, Norway, Canada, UAE, Slovenia and Switzerland. As part of these collaborations, a total of 27 overseas users were accessing VLSCI systems in 2013, from Germany, China, USA, UK, Turkey, France, New Zealand, Denmark and Poland.

Interstate Australian users came from the Universities of Adelaide, Queensland, Sydney, Sunshine Coast, Western Australia, Wollongong and New South Wales, Curtin University and the Australian National University and are represented as National Computational Merit Allocation Scheme (NCMAS) users or as collaborators with Victorian researchers.

On a local scale, it has been an important factor in Monash University gaining the highest ERA 2012 ranking of a 5 in Biomedical Engineering and in Interdisciplinary Engineering... it has been of great benefit to a number of Australian Research Council grants for which high powered computing has been essential. Kerry Hourigan, Monash University, Project: Prediction and Imaging of Vulnerable Plaque Evolution and Rupture

VLSCI is a wonderful facility to mention in the Research Environment sections of our grant applications. I firmly believe that this has assisted us in obtaining our grants by increasing the “scores” that we received for this aspect of our grant applications.

David Grayden, University of Melbourne, Project: Computational Neuroscience: Modelling the brain at microscopic, mesoscopic and macroscopic levels
OUR PEOPLE

DIRECTORATE
Prof. Peter R. Taylor  Director
Ms Karin Diamond  Business Manager
Ms Monalisa D’souza  Executive Officer (to Feb. 2013)
Ms Fiona Kerr  Executive Officer (from Apr. 2013)

Ms Claudia Curcio  Reception/Administration Assistant

OUTREACH & COMMUNICATIONS
Ms Helen Gardiner  Communications and Development Manager
Dr Christina Hall  Communications Officer

PCF
Dr Yacs Hanepai  PCF Manager
Mr Bob Danani  HPC Specialist
Dr Andrew Isaac  Specialist Programmer
Mr James Kelly  HPC Specialist IBM (to Nov 2013)
Dr Jeff Tan  HPC Specialist IBM (from Aug 2013)
Dr Michael Kuper  Computational Molecular Scientist
Mr Mark Nelson  HPC Specialist IBM (to Sept. 2013)
Mr Matthew Wallis  HPC Specialist IBM (from Sept. 2013)
Mr Brett Pemberton  Systems Administrator (to Oct. 2013)
Dr Matthew Hodges  Systems Administrator (from Nov. 2013)
Dr Bernard Popa  Specialist Programmer
Mr Chris Samuel  Senior Systems Administrator
Mr Carl Thomas  Storage and Infrastructure Administrator
Ms Jin Zhang  Systems Administrator

LSCC (all from Central precinct unless otherwise noted)
A/Prof. Andrew Lonie  Head of LSCC
Ms Charlotte Anderson  Bioinformatician/Research Assistant (from Feb. 2013)
Dr Dieter Bulach  Research Scientist (South Eastern precinct)
Ms Jessica Chung  Biostatistician/Research Assistant (from Feb. 2013)
Dr Ira Cooks  Research Scientist (Northern precinct)
Ms Harriet Dashnow  Research Scientist (from Dec. 2013)
Dr Enis Afgan  Research Scientist
Dr Nathan Hall  Senior Research Scientist (Northern precinct)
Dr Nuwan Goonasekera  Software Engineer
Mr Simon Gladman  Research Scientist (South Eastern precinct)
Dr Chol-hee Jung  Research Scientist
Mr Yousef Kowsar  Scientific Software Developer (from May 2013)
Dr Khalid Mahmood  Research Scientist
Ms Liz Mills  Systems Administrator/Scientific Developer (to Dec. 2013)
Dr Juan Nunez-Iglesias  Research Scientist (South Eastern precinct)
Dr Amanda Ng  Computational Biomedical Imaging Scientist (South Eastern precinct)
Dr Dieter Bulach  Research Scientist (South Eastern precinct)
Dr Gayle Philip  Research Scientist
Dr Torsten Seemann  Senior Research Scientist (South Eastern precinct)
Dr Clare Stoggett  Research Scientist
Dr Michael Thomas  Molecular Modelling Scientist (Northern precinct)

IBM
Dr John Wagner  IBM Manager
Dr Matthias Reumann  IBM Researcher (to Feb. 2013)
Dr Daniel Dehne  IBM Postdoctoral Researcher (from Feb. 2013)
Dr Stephan Moore  IBM Researcher
Dr Matthew Downtown  IBM Researcher

I/O TANGENT MANAGEMENT
UNIVERSITY OF MELBOURNE/COMPUTATIONAL BIOINFORMATICS & INTEGRATIVE GENOMICS COMMITTEE

RAS COMMITTEE  - Resource Allocation Scheme Committee
LSCC - Life Sciences Computation Centre
PCF - Peak Computing Facility
### SUPERCOMPUTER SYSTEMS

The VLSCI Peak Computing Facility (PCF) represents a significant investment in High Performance Computing, providing computer processing infrastructure and computational expertise to Victorian Life Sciences researchers and their collaborators. It is a world class petascale facility with four systems built on two architectures (BlueGene/Q and x86). Each system offers varying memory and data-handling capacities to suit the large memory computational resources required from genomics through to high capacity processing of computational imaging data.

### 2013 HIGHLIGHTS

- **New IBM x86 system “Barcoo” installed in July 2013**, doubling capacity available to users and adding high-memory nodes for big genomics jobs.
- All x86 systems were upgraded to run the most recent version of RedHat, and to adopt the same scheduler, called SLURM, as is used on the BlueGene/Q.
- Resource allocation applications for 2013 saw a record number of applications for access to resources: 70 in round 6 and 21 in round 7.
- With 15% of the BlueGene/Q system made available at the national level through the National Computation Merit Allocation Scheme, a total of 11 applications successfully applied for resources.
- As at November 2013, ranking No. 48 in Top 500, No. 30 in Top Green 500 and equal No. 7 in Graph 500.
- Refer pages 64-85 for all projects running on VLSCI systems in 2013.

### IBM BLUE GENE/Q - AVOCA
- Peak performance of 838.86 teraFLOPS.
- 65,536 PowerPC based 1.6GHz cores.
- A total of 64TB RAM.
- Interconnect between compute nodes forms a five-dimensional torus providing excellent nearest neighbour and bisection bandwidth.
- Suitable for large-scale parallel processing.
- Compute nodes run a custom lightweight operating system called Compute Node Kernel (CNK) that is similar to Linux and mostly POSIX compliant.
- The head node runs the RH6 6 operating system, a variety of Linux.

### SGI ALTIX XE CLUSTER - BRUCE
- Peak performance of 11.6 teraFLOPS.
- 128 nodes with 24GB RAM per node.
- 20 nodes with 48GB RAM per node.
- 6 nodes with 144GB RAM per node.
- Connected to a high speed, low latency QDR Voltair Fabric InfiniBand switch for inter-process communications.
- The system runs the RH6 6 operating system, a variety of Linux.

### IBM IDATAPLEX X86 SYSTEM - MERRI
- Peak performance of 7.3 teraFLOPS.
- 688 Intel Nehalem compute cores running at 2.66GHz.
- 3 nodes with 96GB RAM and 8 cores per node.
- 44 nodes with 48GB RAM and 8 cores per node.
- 3 nodes with 1024GB RAM and 16 cores per node.
- Connected to a high speed, low latency GDR Voltair InfiniBand switch for inter-process communications.
- The system runs the RH6 6 operating system, a variety of Linux.

### IBM IDATAPLEX X86 SYSTEM – BARCOO (NEW IN JULY 2013)
- Peak performance - compute nodes currently performing at 20 teraFLOPS - with Xeon Phi cards running nominally at 1 teraFLOPS each.
- 1120 Intel Sandybridge compute cores running at 2.7GHz.
- 67 nodes with 256GB RAM and 16 cores per node.
- 3 nodes with 512GB RAM and 16 cores per node.
- 20 Xeon Phi 5110P cards installed across 10 nodes.
- Connected to a high speed, low latency Mellanox FDR14 InfiniBand switch for inter-process communications.
- The system runs the RH6 6 operating system, a variety of Linux.

### STORAGE INFRASTRUCTURE:
- 100TB Panasas Parallel Data Store (attached to Brucia).
- 700TB GPFS Parallel Data Store (shared by Barcoo, Merri and Avoca).
- 1PB HSM tape system, made available through GPFS (shared by Barcoo, Merri and Avoca).

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**SUPERCOMPUTER SYSTEMS**

Since July 2012, operating at the petascale
THE PEAK COMPUTING FACILITY SERVICES

SYSTEMS SUPPORT SERVICES

VLSCI uses a help request ticketing system to ensure user requests are dealt with promptly and efficiently.

This chart shows that 1292 help request tickets were dealt with by the PCF staff in 2013. This compares with 912 in 2012 and generally reflects increased demand by new users to the systems and with users making adjustments to the new job scheduler, SLURM.

REPORTING

VLSCI users are required to submit quarterly usage reports to their online account and indicate the amount of ‘in-kind’ contributions people have made to the Initiative through activity being generated through access to the facility. By this measure, in 2013 there was a substantial increase in researcher interactions and contributions continue to be over budget for the Initiative. For more information, refer to the Financial Reports from pages 96-97. In-kind contributions are fully accounted for in the Financial Supplement to 2013 Annual Report which is available upon request to the Business Manager.

SOFTWARE

All backlog requests for generic and specialist Life Sciences software have been fulfilled and new requests continue to be implemented according to user demand.

JOB QUEUING TIME

For all jobs that ran for one hour or greater, a measure is taken of how many waited for less than their estimated job time to begin executing. That is, the job remains in a queue for less time than its total estimated run time. While VLSCI aims to achieve 50% or greater, this indicator is consistently much higher:

<table>
<thead>
<tr>
<th>MACHINE</th>
<th>NAME</th>
<th>2011 (%)</th>
<th>2012 (%)</th>
<th>2013 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SGI x86</td>
<td>Bruce</td>
<td>76.0</td>
<td>85.5</td>
<td>91</td>
</tr>
<tr>
<td>iDataplex x86</td>
<td>Baroo*</td>
<td>83</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iDataplex x86</td>
<td>Merri</td>
<td>73.5</td>
<td>86.0</td>
<td>88</td>
</tr>
<tr>
<td>BlueGene/Q</td>
<td>Avoca</td>
<td>97.5</td>
<td>96.0</td>
<td></td>
</tr>
<tr>
<td>BlueGene/P</td>
<td>Tambo**</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Baroo came online in late July 2013
** Tambo was decommissioned in mid 2012

ANNUAL REPORTING AND SATISFACTION SURVEY

ACIL Allen Consulting recommended an overhaul of the annual reporting process for users and a more detailed questionnaire was produced for the 2013 reporting year. The information collected informs much of this Report. Among the 94 respondents, overall user satisfaction remains very high and staffing levels committed to this important Initiative remain a key reason for this.
### SYSTEM USAGE
The distribution of usage between Institutes for the period 1 January to 31 December 2013.

<table>
<thead>
<tr>
<th>INSTITUTE</th>
<th>Usage (JOBS COMPLETED)</th>
<th>TOTAL CPU TIME (HOURS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Melbourne</td>
<td>412,200</td>
<td>1,015,234</td>
</tr>
<tr>
<td>Monash University</td>
<td>301,000</td>
<td>399,660</td>
</tr>
<tr>
<td>RMIT University</td>
<td>108,100</td>
<td>117,994</td>
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<tr>
<td>The Royal Childrens Hospital</td>
<td>83,100</td>
<td>101,416</td>
</tr>
<tr>
<td>VIDRL</td>
<td>79,553</td>
<td>114,218</td>
</tr>
<tr>
<td>NCMAS</td>
<td>65,300</td>
<td>61,555</td>
</tr>
<tr>
<td>The Florey Institute of Neuroscience and Mental Health</td>
<td>57,900</td>
<td>44,672</td>
</tr>
<tr>
<td>La Trobe University</td>
<td>31,700</td>
<td>33,648</td>
</tr>
<tr>
<td>St Vincents Hospital</td>
<td>26,700</td>
<td>22,319</td>
</tr>
<tr>
<td>Walter and Eliza Hall Institute of Medical Research</td>
<td>24,100</td>
<td>23,161</td>
</tr>
<tr>
<td>LSECC</td>
<td>23,800</td>
<td>24,629</td>
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<tr>
<td>Deakin University</td>
<td>23,500</td>
<td>24,504</td>
</tr>
<tr>
<td>University of Ballarat</td>
<td>18,600</td>
<td>19,366</td>
</tr>
<tr>
<td>IBM</td>
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<td>33,572</td>
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<tr>
<td>VLSCI</td>
<td>12,000</td>
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<tr>
<td>CSIRO</td>
<td>6,000</td>
<td>6,000</td>
</tr>
<tr>
<td>Murdoch Childrens Research Institute</td>
<td>5,000</td>
<td>5,000</td>
</tr>
<tr>
<td>National Herbarium of Victoria</td>
<td>5,000</td>
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<tr>
<td>Swinburne University of Technology</td>
<td>4,000</td>
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<tr>
<td>Burnet Institute</td>
<td>3,000</td>
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</tr>
<tr>
<td>Department of Environment and Primary Industries Victoria</td>
<td>2,000</td>
<td>2,000</td>
</tr>
<tr>
<td>Peter MacCallum Cancer Centre</td>
<td>1,000</td>
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</tr>
</tbody>
</table>

**73%**

**2,705,674 JOBS COMPLETED ON THE SYSTEM**

**338,724,141 TOTAL CPU TIME (HOURS)**

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### COMPUTER RESOURCES
Allocated by discipline

The Resource Allocation Scheme Committee (RAS Committee) is a peer review committee awarding compute resources based upon merit. The research fields of projects running on VLSCI systems over 2013 may be categorised into the following broad discipline areas: Molecular Modelling & Dynamics, Cardiac Modelling, Device Design, Neuroscience, Cancer Genetics, Applied Modelling, Genomics, Computational BioImaging and BioEngineering. Resources were allocated to projects by discipline in 2013 approximately as follows:

- Molecular Modelling
- Cancer Genomics
- Applied Modelling
- Device Design
- Neuroscience
- Cardiac Modelling
- Genomics
- Computational BioImaging
- BioEngineering

*Utilisation is derived by dividing actual usage by the amount of resources (CPU hours) allocated. This figure is an average of the two systems. The x86 systems’ utilisation figure is 97% and reflects the software suitability and high adoption of these systems by bioinformatics projects in particular. The BG/Q utilisation figure is 72% and this reflects the greater complexity of the work designed to use such tremendous capacity, where there is more time needed to design and refine each project to maximise the usage and to ensure large parallel jobs can be run efficiently. Refer to the IBM Collaboratory report on pages 30 to see some of the larger projects being created to take advantage of this capacity.*

Dr Vera Hansper
PCF Manager
2013 was a successful and transformative year for the LSCC with staff engaging with researchers from a wide range of research institutes in subscription-based collaborations, having spent the previous two years building a significant profile in bioinformatics experience and expertise, and demonstrating utility to the Victorian community. The LSCC is now well established as:

- a ‘shop-front’ for researchers looking for expertise and advice on data analysis, experimental planning and grant preparation
- a hub for collaborative supervision and training of students in cross-disciplinary computational biology research
- a professional and supportive environment for in-house bioinformaticians and computational biologists with the potential for career progression at a time when this profession is still being established.

Staffing reached capacity in 2013, with 27 full-time equivalent experts now located across Melbourne’s Central, Northern and South-eastern research precincts, across the research ‘themes’:

The LSCC started 2013 with two institutional subscribers: the Cancer Council Victoria and the Eastern Hill medical precinct (through the Department of Medicine, St Vincent’s Hospital). Another 40 projects were supported with LSCC resources, and over the year, ten of those opted to formally subscribe to the service. At the start of 2014, 20 institutes were signed up for a range of project-based and institutional subscriptions, with staff allocated accordingly:

<table>
<thead>
<tr>
<th>SUBSCRIBER</th>
<th>PROJECT(S)</th>
<th>INST/ PROJECT</th>
<th>LSCC THEME</th>
<th>FTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancer Council Victoria</td>
<td>Genetic and epigenetic risk factors in breast, colorectal, prostate cancer</td>
<td>Inst</td>
<td>Genomics</td>
<td>2</td>
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<tr>
<td>Eastern Hill Precinct – SVI, SVH, CERF</td>
<td>EMPhy project, genetic risk factors in eye disease</td>
<td>Inst</td>
<td>Genomics</td>
<td>1</td>
</tr>
<tr>
<td>La Trobe Institute of Molecular Sciences</td>
<td>Various basic and applied genomics research projects</td>
<td>Inst</td>
<td>Genomics</td>
<td>1</td>
</tr>
<tr>
<td>La Trobe Institute of Molecular Sciences</td>
<td>Various projects + capacity building</td>
<td>Inst</td>
<td>Molecular Modelling</td>
<td>1</td>
</tr>
<tr>
<td>Monash Health Translation Precinct</td>
<td>Various biomedical genomics research projects</td>
<td>Inst</td>
<td>Genomics</td>
<td>1</td>
</tr>
<tr>
<td>Monash University - Biomedical Sciences</td>
<td>Novel RNAseq method development</td>
<td>Project</td>
<td>Genomics</td>
<td>0.8</td>
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<tr>
<td>Monash University - Central Clinical School / Alfred Hospital</td>
<td>Various biomedical genomics research projects</td>
<td>Inst</td>
<td>Genomics</td>
<td>1</td>
</tr>
<tr>
<td>Monash University - Psychology</td>
<td>IMAGE-HD: neuroimaging in Huntington’s Disease</td>
<td>Project</td>
<td>Computational Bioimaging</td>
<td>2</td>
</tr>
<tr>
<td>NeCTAR Endocrine Virtual Laboratory</td>
<td>Genomics workflows and variant registries for endocrine disease</td>
<td>Project</td>
<td>Genomics</td>
<td>1</td>
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<tr>
<td>NeCTAR Genomics Virtual Laboratory</td>
<td>Infrastructure for genomics in Australia</td>
<td>Project</td>
<td>Genomics</td>
<td>3</td>
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<tr>
<td>Peter Mac - International Cancer Genomics Consortium</td>
<td>Tumourigenesis and drug resistance in ovarian cancer</td>
<td>Project</td>
<td>Genomics</td>
<td>0.8</td>
</tr>
<tr>
<td>Royal Melbourne Hospital - Surgery</td>
<td>Understanding metastasis in prostate cancer</td>
<td>Project</td>
<td>Genomics</td>
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<tr>
<td>University of Melbourne - Centre for Translational Pathology</td>
<td>Clinical genomic tests for ovarian cancer</td>
<td>Project</td>
<td>Genomics</td>
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<tr>
<td>University of Melbourne - Dental School</td>
<td>The Oral Health CRC: understanding microbial populations in dental disease</td>
<td>Inst</td>
<td>Genomics</td>
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<td>University of Melbourne - Genetic Epidemiology</td>
<td>Genetic risk factors in breast cancer</td>
<td>Project</td>
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<td>Various genomics research projects</td>
<td>Inst</td>
<td>Genomics</td>
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<tr>
<td>University of Melbourne - School of Population Health</td>
<td>Genetic risk factors in breast cancer</td>
<td>Project</td>
<td>Genomics</td>
<td>0.5</td>
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<tr>
<td>General consulting</td>
<td>Infrastructure and capacity building</td>
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<tr>
<td>General consulting</td>
<td>Infrastructure and capacity building</td>
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<td>N/A</td>
<td>2</td>
</tr>
<tr>
<td>General consulting</td>
<td>Various projects + capacity building</td>
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<td>Molecular Modelling</td>
<td>1</td>
</tr>
</tbody>
</table>

In 2013, subscriptions accounted for $645,000 of income to the LSCC and projected subscription income for 2014 is over $1million. Subscribers acknowledge the benefits of getting direct access to the LSCC’s resource allocation on VLSCI systems and the capacity-building work of embedded LSCC staff who deliver formal and informal skills development and training. In turn, these subscriptions enable the LSCC to expand, develop tools, build resources and expertise and offer further career development for staff.
OTHER LSCC 2013 HIGHLIGHTS

The LSCC is now effectively operating ‘at capacity’ in terms of staffing and budget and the staff have highly complimentary skills and expertise to offer the research community. The Monash-based Victorian Bioinformatics Consortium (VBC) is fully engaged in supporting LSCC subscriptions and projects – effectively acting as the Monash node of the LSCC Genomics theme and staff interact extremely effectively across nodes – as was originally envisaged when the LSCC was established. The Genomics theme has established a series of expertise groups that have been highly successful in advising on research project planning and analysis approaches to multiple researchers and students; and community engagement and support is strong.

The LSCC Computational Bioimaging theme has built a very successful embedded support and collaboration model with the Department of Psychology at Monash University, plus further successful embedded support and collaboration model with the School of Molecular Sciences Department of Chemistry, La Trobe Institute for Molecular Science, this group has already developed a regular meeting program, established online training materials for students and researchers and is focused on adding value to existing VLSCI users through direct support and conference sponsorships.

In 2013 the Outreach program assisted with the growth of this community of researchers in this field in many ways. After an approach by RMIT Vice- Chancellor’s Senior Research Fellow, A/Prof. Toby Allan, the Outreach program supported the 4th Workshop on Computational Modelling of Proteins and Membranes in July and the November Australian Society for Biophysics meeting. A biophysicist, A/Prof. Allen was attracted back to work in Australia after ten years working at UC Davis, USA and he maintains a number of important international collaborations.

A/Prof. Smith also welcomed new staff member Dr Michael Thomas and together they worked with Dr Michael Kuiper, VLSCI’s Molecular Scientist, to develop useful methods for drug docking and large job management on a high capacity computational resource, and shared it with the research community through GITHUB. Additional methods include those for visualisation and animation. Concurrently, the resources were introduced to MM students and researchers in the MM capacity-building seminars and conferences supported by the Outreach program.

Adding value to existing VLSCI users through direct support and conference sponsorships.

A NEW THEME – MOLECULAR MODELLING AND DYNAMICS

Following analysis of the numbers and types of projects running on VLSCI systems (refer Computer Resources allocated by Discipline on p. 21), the decision was taken to expand the genomics theme to incorporate integrated biology. A/Prof. Brian Smith, Principal Research Fellow, Deputy Head of School, Faculty of Science, Technology and Engineering, School of Molecular Sciences Department of Chemistry, La Trobe Institute for Molecular Science, this group has already developed a regular meeting program, established online training materials for students and researchers and is focused on adding value to existing VLSCI users through direct support and conference sponsorships. In 2013 the Outreach program assisted with the growth of this community of researchers in this field in many ways. After an approach by RMIT Vice- Chancellor’s Senior Research Fellow, A/Prof. Toby Allan, the Outreach program supported the 4th Workshop on Computational Modelling of Proteins and Membranes in July and the November Australian Society for Biophysics meeting. A biophysicist, A/Prof. Allen was attracted back to work in Australia after ten years working at UC Davis, USA and he maintains a number of important international collaborations.

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EXAMINATION OF THE SPECIFIC MECHANISMS OF VACCINE-DERIVED POLIOVIRUS ANTIViral DRUG INTERACTIONS

The existing polio virus modeling work carried out on the BGD by Jason Roberts at VIDRL, with support from Dr Michael Kuiper, continued to deliver results in 2013 with significant progress made in the reconstruction of non-polio enteroviruses. Three genomgroups of EVA71 were reconstructed, coincident with an outbreak of the virus in Australia that was associated with a number of deaths and paralysis cases in children during 2013. Further work on these viruses continues in collaboration with other research groups. Sequence data representing the full capsid of variants of the newly described virus EV-C96 and the novel virus EVA120 discovered by VIDRL were obtained and preliminary models constructed, with a number of manuscripts prepared for publication at year end.

The research continued to attract collaborators throughout the WHO Reference Laboratory network worldwide.

MAJOR BENEFITS TO THE RESEARCH COMMUNITY TO DATE BY THE LSCC

Advocacy for local and national funding and infrastructure: The LSCC has strategically identified and applied for external funding and resource opportunities on behalf of collaborators, including programs such as National Collaborative Research Infrastructure (NCRIS), National eResearch Collaboration Tools and Resources (NeCTAR), the Research Data Storage Initiative, VLSDI and NCI compute infrastructure. An example is the significant funding of LSCC staff from the national Genomics Virtual Laboratory (GVL) program, with LSCC staff developing the GVL training materials and now training collaborators in its use.

Leveraging common platforms, tools, pipelines, training: Bioinformatics units/ centres typically spend considerable time establishing and maintaining analysis platforms, best-practice workflows and training materials that are then used by staff across multiple projects. The LSCC focuses this effort through economies of scale so that a broad set of best practice ‘industrial scale’ reproducible genomic analyses are then made available to all staff and collaborators.

Community building and training: The LSCC has also solidly established itself as a centre for capacity and community building in bioinformatics and computational biology, hosting regular meetings with representation across the Victorian bioinformatics community and developing infrastructure (such as the GVL), resources and training programs to enable researchers at all levels to employ best practice for a range of life science computation applications.

The LSCC has strategically identified and applied for external funding and resource opportunities on behalf of collaborators, including programs such as National Collaborative Research Infrastructure (NCRIS), National eResearch Collaboration Tools and Resources (NeCTAR), the Research Data Storage Initiative, VLSDI and NCI compute infrastructure. An example is the significant funding of LSCC staff from the national Genomics Virtual Laboratory (GVL) program, with LSCC staff developing the GVL training materials and now training collaborators in its use.
### LSCC CAPACITY BUILDING

#### PROJECTS

<table>
<thead>
<tr>
<th>PROJECT TITLE</th>
<th>RESEARCHER</th>
<th>INSTITUTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interaction of PRMT5 with short hairpin RNA in Erythroid leukemia</td>
<td>A/Prof. David Curtis</td>
<td>Alfred</td>
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<tr>
<td>Immune profile of schizophrenic patients with drug sensitivities</td>
<td>Dr Kathryn Ronaldson</td>
<td>Alfred</td>
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<tr>
<td>Why is Voriconam Resistance becoming more common in Australia</td>
<td>Prof. Paul Johnson</td>
<td>Austin</td>
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<tr>
<td>Genetic and epigenetic effects of L-sulfonamide</td>
<td>Prof. Graham Giles</td>
<td>Cancer Council</td>
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<tr>
<td>Sequence analysis of exosomal RNA</td>
<td>A. Prof. Andrew Hill</td>
<td>Monash</td>
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<tr>
<td>Targeted sequencing of a myopia linked gene region to identify disease associated changes</td>
<td>A/Prof. Paul Barst</td>
<td>CERA</td>
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<tr>
<td>Identification of genetic variants associated with myopia and ocular biotrna</td>
<td>Dr Maria Schetelig</td>
<td>CERA</td>
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<tr>
<td>The role of genetics and epigenetics in the development of Multiple Sclerosis</td>
<td>Dr Judith Field</td>
<td>Florey</td>
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<tr>
<td>Towards healthier ageing</td>
<td>A/Prof. Cassandra Szoke</td>
<td>La Trobe</td>
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<tr>
<td>Stress transcriptomics: development of traps to reduce the incidence of summer mortality in abalone</td>
<td>Dr Jan Strugnell</td>
<td>La Trobe</td>
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<tr>
<td>Pipeline for polymorphism mapping in parasitic nematodes</td>
<td>Dr Grant Warwick</td>
<td>La Trobe</td>
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<tr>
<td>Genomics and Proteomics of the Apple scab fungus</td>
<td>Dr Kim Flummer</td>
<td>La Trobe</td>
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<tr>
<td>Global Arts DB: An international database of art species abundances and morphological traits</td>
<td>Dr Heloise Glibb</td>
<td>La Trobe</td>
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<tr>
<td>Pipeline for polymorphism mapping in parasitic nematodes</td>
<td>Dr Wannick Grant</td>
<td>La Trobe</td>
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<tr>
<td>Population Genomics using RAD-Seq</td>
<td>Dr Nick Murphy</td>
<td>La Trobe</td>
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<tr>
<td>Dicotsysten Germans Project</td>
<td>Prof. Paul Fisher</td>
<td>La Trobe</td>
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<tr>
<td>Differential Expression of Membrane Proteins under Heat Shock</td>
<td>Prof. Nick Horganowski</td>
<td>La Trobe</td>
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<tr>
<td>Caphapthol Toxin Proteomics</td>
<td>Dr Jan Strugnell</td>
<td>La Trobe</td>
</tr>
<tr>
<td>Differential Expression in the study of Myopia</td>
<td>Prof. Shea Creerther</td>
<td>La Trobe</td>
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<tr>
<td>High throughput genomic activities within the Life Sciences Computation Centre (LSCC)</td>
<td>A/Prof. Andrew Lone</td>
<td>LSCC</td>
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<tr>
<td>Unveiling the genetics of common epilepsies</td>
<td>Dr Michael Hildebrand</td>
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<td>Genome wide DNA methylation profiling of Childhood B Cell Acute Lymphoblastic Leukaemia</td>
<td>Dr Nicholas Wong</td>
<td>MCRI</td>
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<td>Function of grgipalin genes in peridontal disease</td>
<td>A/Prof. Stuart Dauprier</td>
<td>MobiDental</td>
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<td>Integrated analysis of high content screening outputs to identify regulators of bladders cancer</td>
<td>Dr Elizabeth Williams</td>
<td>MTP</td>
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<tr>
<td>Assembly and annotation of all bacterial genomes in the NCBI Sequence Read Archive</td>
<td>Dr Torsten Saemann</td>
<td>Monash</td>
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<tr>
<td>Targeting macropathways as a strategy for chronic inflammatory lung disease therapy</td>
<td>Dr Margaret Forbes</td>
<td>Monash</td>
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<tr>
<td>Registration of CT and MRI images for advanced segmentation and visualisation of anatomy</td>
<td>Dr Colin McHenry</td>
<td>Monash</td>
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<tr>
<td>Measurement and prediction of vulnerable plaque formation and rupture</td>
<td>Dr Pauline Assenmat</td>
<td>Monash</td>
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<tr>
<td>Understanding antibiotic resistance in Acinetobacter baumannii</td>
<td>Dr John Boyce</td>
<td>Monash</td>
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<td>Comparative genomics to decode Lippolyasaccharide diversity in Leptospirosa</td>
<td>Dr Gerald Murray</td>
<td>Monash</td>
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<tr>
<td>Investigation of mobile elements in Clostridium difficile</td>
<td>A/Prof. Dena Larsen</td>
<td>Monash</td>
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<tr>
<td>Human haplotyping sequencing of sorted chromosomes</td>
<td>Dr Nick Murphy</td>
<td>Monash</td>
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<tr>
<td>Evolution of Dichelobacter nodosus and the spread of Ovine Footrot through Europe</td>
<td>Prof. Julian Paoli</td>
<td>Monash</td>
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</table>

### PROJECTS

<table>
<thead>
<tr>
<th>PROJECT TITLE</th>
<th>RESEARCHER</th>
<th>INSTITUTE</th>
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<tbody>
<tr>
<td>The transcriptional profile of an in vivo mouse infection of Clostridium perfringens</td>
<td>Prof. Paul Herteg</td>
<td>Monash</td>
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<tr>
<td>Identifying antibodies to Stachybotis infection in Chinese water buffalo</td>
<td>Dr Michael de Veer</td>
<td>Monash</td>
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<tr>
<td>Minipig pedigrees as a model for human mitochondrial disease</td>
<td>Prof. Justin John</td>
<td>Monash</td>
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<tr>
<td>Transcriptome of the sprzy mouse, a model for human embryo development</td>
<td>Dr Hayley Dickinson</td>
<td>Monash</td>
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<tr>
<td>Neumaging in Huntington's Disease</td>
<td>Prof. Nadie Georgiou-Karastianis</td>
<td>Monash</td>
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<tr>
<td>Molecular Epidemiology of Viroto chickenan associated with the choleri outbreak in Papua New Guinea</td>
<td>Dr Andrew Greenhill</td>
<td>Monash</td>
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<tr>
<td>Imaging the process of life</td>
<td>Prof. Christophe Marchale</td>
<td>Monash</td>
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<tr>
<td>3-Seq: a novel method for quantitative analysis of gene expression in eukaryotic transcriptomes</td>
<td>Dr Teitke Biehler</td>
<td>Monash</td>
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<td>Using NGS to resolve deep phylogenetic relationships within terrestrial molluscs and bristle tsetse</td>
<td>Dr Adrian Mauvais</td>
<td>Monash</td>
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<td>High throughput genomic activities including International Cancer Genomics Consortium projects such as Tumourgenesis and drug resistance in ovarian cancer</td>
<td>Prof. David Bowtell</td>
<td>Peter Mac</td>
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<td>High throughput genomic activities</td>
<td>A/Prof. Ian Campbell</td>
<td>Peter Mac</td>
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<tr>
<td>Deep sequencing the functionality of genetic data through integrative bioinformatics approaches</td>
<td>Dr Kaylene Simpson</td>
<td>Peter Mac</td>
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<td>Identification of breast cancer predisposing genes using genome sequencing</td>
<td>Dr Maria Doyle</td>
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<td>VCCC: Human DNA Variation Repository</td>
<td>Dr Andrew Fallovia</td>
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<td>Characterising the activation and mobilisation of transposable elements in intestinal cancer</td>
<td>Dr Robert Ramsay</td>
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<td>Determining the molecular profile of lethal prostate cancer</td>
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<td>A description of the intestinal bacterial community of the premature infant</td>
<td>Dr Leah Hickey</td>
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<td>Genomic and Transcription Characterization of Mycopapilleral Adenocarcinoma</td>
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<td>Transcriptome analysis of lymphatic malignation endothelial cells</td>
<td>Dr Caroline Taylor</td>
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<td>Novel biomarkers of endothelial disruption, platelet activation and myocardial ischemia in CVD</td>
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<td>The mechanism of accelerated type 1 diabetes in non-obese diabetic mice deficient in granzymeA</td>
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<td>Pathogen Genomics and Genetics Program</td>
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<td>Targeted sequencing of ESRT1 and other hormone metabolism genes and risk of breast cancer</td>
<td>Prof. John Hopper</td>
<td>UoM</td>
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<tr>
<td>Transcriptomic profiling of glioma stem cells: sub type analysis and molecular target discovery</td>
<td>Dr Theo Mantamadziota</td>
<td>UoM</td>
</tr>
<tr>
<td>Cancer Predisposition Gene Identification</td>
<td>Dr Daniel Park</td>
<td>UoM</td>
</tr>
<tr>
<td>Using RNAseq to understand how Staphilococcus aureus Respond and Adapts to Antibiotics</td>
<td>A/Prof. Tim Striewar</td>
<td>UoM</td>
</tr>
<tr>
<td>Understanding how bacteria cause persistent infection</td>
<td>A/Prof. Ben Howden</td>
<td>UoM</td>
</tr>
<tr>
<td>Developing algorithms for biomarker identification in human cancer tissue sections</td>
<td>Dr Anne Thompson</td>
<td>VCB</td>
</tr>
</tbody>
</table>
The project has yielded the following outcomes:

- a fully featured whole genome sequencing analysis pipeline that provides high-quality somatic mutation calling for cancer samples
- a fully featured RNA-SEQ analysis pipeline that incorporates state of the art software for performing differential expression analysis
- a high impact publication looking into subclonal origin of lethal prostate cancer (in preparation)
- a high impact publication looking into hormone driven structural rearrangements in cancer (in preparation)
- an ongoing collaboration with researchers from the Cancer Genome Project at the Wellcome Trust Sanger Centre, Cambridge UK
- a successful NHMRC grant application for studying lethal prostate cancer (NHMRC APP1047581, AUD$689,673 2013-2015).

The LSCC subscription provided critical resources for this project that otherwise would have been sought overseas. The sheer scale in terms of size and processing power required to analyse these genomics data meant that a high-performance computing facility was required, along with the expertise to utilise it. By engaging Dr Clare Sloggett in the LSCC we were given access to someone who could provide the expertise and carry out rapid and high quality development of analysis pipelines.

The capability now developed as a result of this project allows us to perform sophisticated genomic analyses comparable to top research institutes around the world. Without the subscription, this project would not have been possible to carry out locally.
One of the most exciting new opportunities is a deep collaboration with all three nodes of the ARC Centre of Excellence in Plant Cell Walls. This work involves computational investigations of plant cell wall polysaccharide synthesis, interactions and degradation: building and simulating molecular models of cellulose synthase like proteins in collaboration with Dr Monika Doblin at the Melbourne node; modelling cellulose microfibrils and polysaccharide interactions in the context of building a computational model of the plant cell wall, in collaboration with Dr Tony Bacic, UoM node and Dr Mike Gidley at the Brisbane node; and using molecular modelling and dynamics to investigate evolutionary adaptation of substrate specificity in β-glucanases with Prof. Stan Skafidas, UoM, Dr Natalie Gunn, structural biologist, IBM Research Australia, and internships are incorporated with Dr Geoff Fincher at the Adelaide node.

The Collaboration also began working on Apoipoprotein E (apoE), an important blood protein involved in lipoprotein clearance and metabolism. The protein exists as three major isoforms that differ by single amino acid substitutions at position 112 and 158. The apolipoprotein E4 (apoE4) isoform is a major risk factor for late onset Alzheimer’s disease (LOAD) with E4/E4 homozygotes having a >95% chance of developing LOAD by the age of 65. Work has commenced with collaborators at La Trobe University, A/Prof. Matthew Perugini and PhD student Shane Gordon, looking at the poorly understood molecular mechanisms of this genetic link in this form of Alzheimer’s.

Finally, as part of an ongoing collaboration with A/Prof. Ross Bathgate and Dr Daniel Scott at the Florey Institute of Neuroscience and Mental Health, and Prof. Stan Skafidas, UoM, Dr Natalie Gunn, structural biologist, IBM Research Australia, has been performing small angle X-ray scattering (SAXS) using the Australian Synchrotron in order to better understand the stability of G protein coupled receptors (GPCRs) in detergents, as well as validate the high-resolution molecular models which have been developed. This new work adds an exciting new approach to IBM’s drug discovery platform development, and represents the first time an IBM researcher has used the Australian Synchrotron directly.

Collaboratory staff continued to be involved in a wide range of teaching, skills development, student mentoring and supervision and communications and outreach activities at VLSCI. Specific roles are listed below. Outreach activities and internships are incorporated with others documented from page 44.

IBM Collaboratory researchers are involved in many of the large-scale projects which are allocated resources on VLSCI systems through the peer review process. These projects are listed amongst the active projects in 2013 on page 62 of this Report.
VLSCI Communications, with assistance from NCI, IVEC (Pawsey Centre) and V3 alliance, planned, coordinated, implemented and staffed the Australian HPC booth at Supercomputing 2013 in Denver, Colorado, USA from 17-22 November.

With other partners from Monash University’s MASSIVE facility, Swinburne University’s Centre for Astrophysics and Supercomputing, RMIT and La Trobe Universities’ Trifid system and CSIRO, over 25 representatives from high-end computing organisations in Australia joined over 10,000 participants. VLSCI’s Senior Systems Engineer, Chris Samuel, presented in the SPXXL (international IBM Facility user group) program on the July installation and commissioning of VLSCI’s latest high-memory IBM iDataplex x86 system ‘Barcoo’, which initiated a move across to the new scheduling system ‘Slurm’ for all machines. Key staff from VLSCI, NCI and IVEC presented at the booth’s Tim Tam Talks and fielded enquiries from researchers, technical experts and prospective employees and students. The Communications team were part of a session entitled: High Performance Communication for High Performance Computing (hpc-hpc), sharing a short video and report about the Melbourne Knowledge Week event held on 30 October: Personalised Medicine - the Hope and the Hype. Throughout the week social media activity was generated through a series of news items, including documenting the live demonstration of the transfer from the Aspera booth of a 10Gb file to the University of Queensland in less than a minute.

With the SC13 Top500* announcements, Avoca remained in the Top500, and is now at 48. Avoca also retained its equal 7th ranking in the Graph 500, the official benchmark for data intensive supercomputers, with IBM’s three major BlueGene centres taking the top three places.

(*For details re Top500, refer page 16 of this Report – Supercomputer Systems*)
At the request of the Resource Allocation Scheme Committee (RAS Committee) Thursday 3 October became a showcase of research being conducted through VLSCI.

Included in the program for The University’s Festival of Ideas, the first hour of the day was opened to the public, with four lively presentations made by four high profile researchers using substantial VLSCI resource allocations. They demonstrated how supercomputing has impacted their research to an audience of 60 stakeholders and 40 members of the public and including Victoria’s newly appointed Lead Scientist, Dr Leonie Walsh and Steering Committee Chair, Prof. John Zillman. The public presentations included:

- John Hopper, A novel method for genome-wide scanning of regions associated with breast cancer risk
- Tania Kameneva, Computational neuroscience approach to the challenges of retinal prostheses
- Robin Gasser, Parasite Genomics & Genetics Program
- Michael Kuiper, Modelling pore-forming toxins and drug design

These talks were followed by a networking session to allow the audience to speak further with the presenters. The remainder of the day involved impressive oral and poster presentations of research outcomes by almost 50 project leaders with RAS allocations in 2013 to an audience of the VLSCI RAS Committee and various research peers. It was a very lively and successful day.
INTERACTIONS
The VLSCI twitter account, @vlsci, is one the many ways users get up-to-date systems news as well as learn about outreach opportunities. As part of activities for the Australian HPC booth at Supercomputing 2013, VLSCI also hosts and maintains the @australianhpc twitter account.
IN THE NEWS

Public and media interest in VLSCI’s supercomputers and the Victorian researchers working on them remained strong throughout 2013. Ongoing public interest in the Victorian Infectious Diseases Laboratory’s (VIDRL) exciting enterovirus work (which includes the poliovirus) led to a front page and accompanying feature story in the Fairfax media’s Melbourne Magazine’s April 2013 edition. Published in several Australian States, its circulation in Melbourne alone reached over 150,000 people. This was followed in August by a feature on VIDRL’s work on ABC TV’s science show Catalyst.

Additional media included in particular, two features in the biotechnology industry journals Australasian Biotechnology and Australian Life Sciences, a six minute feature on ABC TV’s 7.30 report, several opinion pieces submitted by Director, Prof. Peter R. Taylor and science stories in major daily newspapers including the national circulation Financial Review.

ESTIMATED MEDIA VALUE

| National television        | 190,000* |
| Major daily newspapers    | 132,600  |
| National radio            | 117,000  |
| Industry news             | 48,000   |
| **TOTAL**                 | **$285,600** |

*These figures are calculated according to media monitoring conventions that take the cost of buying the equivalent media space and applying a conservative multiplier of three to arrive at an approximate national equivalent value. This calculation does not consider whether people acted on such information but it also does not incorporate a measure of the extended coverage VLSCI stories received through associated social media and internet activity generated by the original stories.

$285,600 ESTIMATED MEDIA VALUE

Kind permission to reproduce Melbourne Magazine images granted from Fairfax syndication.

3 APRIL, ABC TV 7:30 REPORT

Endangered tortoises in Western Australia have been given a fighting chance with the help of a Melbourne based supercomputer.

Dr Michael Kearney, University of Melbourne ecologist working with Nicola Mitchell and Matthew Hipsey from the University of Western Australia was featured in this story about the environmental modelling he had contributed to this search for relocation options for the critically endangered Western Swamp Tortoises. The study was published in the international journal Biology.

Dr Michael Kearney fronts the cameras for the ABC TV story.

27 FEBRUARY, THE AUSTRALIAN

Visit by Allan Jones, CEO, Allen Institute for Brain Science to launch the Victorian node of the International Neuroinformatics Coordinating Facility.

22 MAY, AUSTRALIAN LIFE SCIENTIST

Feature article written by LSCC Head, A/Prof. Andrew Lonie

2013 VICTORIAN LIFE SCIENCES COMPUTATION INITIATIVE ANNUAL REPORT

13 SEPTEMBER, WWW.UNIMELB.EDU.AU

Aussie researchers on international radar

Bionic eye researchers working with the Victorian Life Sciences Computation Initiative.

23 JULY, WWW.BIONICVISION.ORG.AU

Bionic Vision Australia published an online story explaining VLSCI’s role in an important part of the work of this major ARC-funded project.

Endangered tortoises in Western Australia have been given a fighting chance with the help of a Melbourne based supercomputer.

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23 JULY, WWW.BIONICVISION.ORG.AU

Bionic Vision Australia published an online story explaining VLSCI’s role in an important part of the work of this major ARC-funded project.
12 AUGUST,
GENERAL MEDIA COVERAGE
VLSCI systems user Dr Kat Holt’s work in genomics, maths and supercomputers led to her being awarded an L’Oreal Women in Science award.

9 NOVEMBER, ABC RADIO NATIONAL, SCIENCE SHOW
Recipient of VLSCI PhD top-up scholarship Bernd Merkle talked about his work studying causes of Alzheimer’s disease with host Robin Williams.

A MONASH University doctoral student has developed a software program with the potential to allow researchers to examine the deposition of metals in the brain as a potential cause of Parkinson’s disease.

Monash Biomedical Imaging researcher Amanda Na’s work won her a coveted Google Summer of Code internship. This gives her the opportunity to collaborate with two researchers from the University of Melbourne’s Victorian Life Sciences Computation Initiative into a PhD candidate from Monash.

INDUSTRY ENGAGEMENT

Australian Bioinformatics Network member
Ausbiotech member
VLSCI stories published in Australasian Biotech and Australian Life Sciences journals
Bio21 Cluster’s Innovating for Victoria’s Health Exhibition contributing exhibitor Displayed in Federation Square, Melbourne during Melbourne Knowledge Week
BioMelbourne Network member
eResearch Australia 2013 sponsor and exhibitor at Brisbane in October
GVL NeCTAR-funded Genomics Virtual Laboratory partner
HPC500 High Performance Computing industry body accepted as member
IBM Deep Computing Institute Director attended as Board Member
ICT for Life Sciences Forum sponsor of Forum and Graeme Clark Oration
IDC International Data Corporation subscriber
INCF Co-sponsor with MASSIVE of Victorian node under 3 year joint agreement, and co-sponsor of node launch event held in February
ISC2013 International Supercomputing Conference 2013 Presentation by Communications Manager, Facility Manager attended, Leipzig, Germany in June
MASSIVE Host to Computational Bioimaging theme in conjunction with Monash Biomedical Imaging
NCI National Computational Infrastructure Director attended Board meetings as member
Supercomputing 2013 Australian HPC booth, Denver, USA in November Attendance by Director, Facility Manager, Systems Administrator & Communications team
Tertiary Education Manager’s Conference presented by Business Manager Hobart, September
Texas Advanced Computing Center Director attended Strategic Advisory Board Meeting as member Denver, USA in November
Victorian Government’s Technology Voucher Program registered provider
Victorian Platform Technologies Network member and exhibitor Inaugural VPTN industry showcase, Melbourne Town Hall, October
CAREER DEVELOPMENT FOR COMPUTATIONAL BIOLOGISTS

Supporting skills development in students and sharing expertise amongst research groups is central to VLSCI activities.

- PhD top-ups - supporting exceptional students with annual stipends
- M.Sc. (Bioinformatics) - providing student bursaries to projects
- Internships - hosting talented postgraduates over their Summer recess
- Undergraduate Research Opportunities Program (UROP) - co-sponsoring Program and providing direct stipend support to computational biology projects for undergraduates
- Sponsorship of conferences & meetings
- Travel grants
- Workshops

INTERNSHIPS 2012-2013

LEFT TO RIGHT, TOP TO BOTTOM: Igor Grossman (Monash University) delivers his internship research project findings; Supervisor Ira Cooke and Intern Brett Sheil (La Trobe University); Supervisor Bernard Pope and Intern Sori Kang (VLSCI, University of Melbourne); Intern Lee Yeoh and Supervisor Nathan Hall (La Trobe University); Intern Alexander Henry and Supervisor Michael Kuiper (VLSCI); Supervisor Clare Sloggett and Intern Jessica Chung (VLSCI/NICTA). OPPOSITE: Blake Riley receives his ‘Best Life Sciences Computation Presentation’ Award at the 2013 UROP Conference Day from VLSCI Director, Peter Taylor.

“Through this internship, I got valuable experience in life science and learnt how interesting it is to work in the bioinformatics field. Therefore, I can say that this internship has provided me with more options to choose my career path.”

Sori Kang

“The internship was overall a very positive experience which enabled me to learn a lot in a short period of time. This project has proved an incredibly useful starting point to my PhD project.”

Brett Sheil

“This internship has helped me learn a variety of programming and computational techniques. It has also introduced me to the world of computational biology and molecular modelling, which is now an interesting career option for me.”

Alexander Henry

VLSCI provides substantial funding towards the administration of the Undergraduate Research Opportunities Program as well as direct support to numerous projects through student stipends. The largest ever field of applications was received in the first round of 2013, with 277 students vying for 48 projects - 16 of which comprised computational or bioinformatics research. Across the two rounds in 2013, VLSCI provided a part-stipend to 11 projects. The University of Melbourne and its affiliated research institutes, Monash University and its affiliates, Deakin University, Swinburne University, RMIT and various industry groups were engaged in the Program.

Over 100 people attended the UROP Conference Day on 10 July, including the Minister for Technology, the Hon. Gordon Rich-Phillips, who opened the proceedings and keynote speaker, Prof. John Carroll, Head of the School of Biomedical Sciences, Monash University.
SKILLS DEVELOPMENT

A recent recruit to the LSCC, Harriet Dashnow, is a perfect example of how VLSCI provides opportunities for life scientists to develop skills to equip them for a career in bioinformatics. With an undergraduate background in Genetics, Biochemistry, Molecular Biology and Psychology, Harriet became increasingly aware that to make a real contribution to biology she would need to embrace increasingly high throughput technologies. Harriet actively sought out internships that provided hands-on experience in both the laboratory and data analysis aspects of next-generation sequencing. This included a VLSCI Summer Internship at Bio21, working in a team with expertise in bioinformatics, pathogenomics and computer science to developing software that detects resistance genes in next-generation sequencing data from pathogenic bacteria. This gave Harriet the opportunity, so early in her career, to make a real contribution to the public health community. Her research continued after being offered work as a Research Assistant, which broadened her previous experience that included a year-long autoimmune disease project at SVI as part of the VLSCI-funded UROP scheme.

During her time enrolled in the Master of Science (Bioinformatics) program, Harriet and was awarded a VLSCI bursary for her excellent marks, and as part of the program she was able to build on her long-term laboratory Technical Assistant position at MCRI with a research placement with leading Bioinformatician, Alicia Oshlack. This research project continues today as part of a subscription by the ANU and MCRI with the LSCC, where Harriet was employed as a Bioinformatician in 2013.

Harriet is now developing a set of current best practice guidelines, including protocols to assess the quality of pipeline components, in particular variant callers. The hope is to evaluate the clinical bioinformatics pipeline being developed by the Melbourne Genomics Health Alliance - a collaboration of seven organisations in the Parkville precinct - to implement clinically driven exome sequencing. The demonstration project involves patients with epilepsy, acute myeloid leukemia, hereditary colorectal cancer, Charcot-Marie-Tooth disease and childhood syndromes, and Harriet has been working with genetic counsellors and physicians to develop a list of appropriate genes to analyse.
Refer Glossary (p.96) for all abbreviations used in all tables in this Report.

**TRAINING WORKSHOPS**

<table>
<thead>
<tr>
<th>WORKSHOP TITLE</th>
<th>DATE</th>
<th>PRESENTER</th>
<th>ATTENDED</th>
<th>PARTICIPANTS’ INSTITUTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Movie Making for Molecular Modelling (3hr)</td>
<td>25 Jan</td>
<td>Michael Kuiper</td>
<td>5</td>
<td>VLSCI, SVI, MIPS</td>
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<tr>
<td>Using Unix effectively (3x2hr)</td>
<td>6 March</td>
<td>Bernard Pope</td>
<td>8</td>
<td>UniM, Monash, Deakin, WEHI, Peter Mac</td>
</tr>
<tr>
<td>20 March</td>
<td></td>
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<td>15</td>
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</tr>
<tr>
<td>26 March</td>
<td></td>
<td></td>
<td>15</td>
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<tr>
<td>Using Unix effectively</td>
<td>9 April</td>
<td>Bernard Pope</td>
<td>11</td>
<td>Peter Mac</td>
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<tr>
<td>Introduction to high performance computing at VLSCI (3hr)</td>
<td>17 April</td>
<td>Andrew Isaac</td>
<td>14</td>
<td>UniM, WEHI, Monash, MCRI</td>
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<tr>
<td>Simon Wiel</td>
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<tr>
<td>Mark Nelson</td>
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<tr>
<td>Introduction to molecular modelling and visualisation for life sciences (3hr)</td>
<td>24 April</td>
<td>Michael Kuiper</td>
<td>15</td>
<td>RMET, Monash, UniM, La Trobe</td>
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<tr>
<td>Variant Detection (Full day)</td>
<td>29 April</td>
<td>Charlotte Anderson</td>
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<td>MCRI</td>
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<td>Tonsten Saemann</td>
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<td>Andrew Lome</td>
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<tr>
<td>Intermediate molecular modelling and visualisation for life sciences (3hr)</td>
<td>01 May</td>
<td>Michael Kuiper</td>
<td>15</td>
<td>La Trobe, Monash, RMET, UniM</td>
</tr>
<tr>
<td>Introduction to molecular modelling and visualisation for life sciences (3hr)</td>
<td>14 May</td>
<td>Michael Kuiper</td>
<td>18</td>
<td>University of Melbourne MSc (Bioinformatics) students</td>
</tr>
<tr>
<td>Computational Modelling of Proteins &amp; Membranes (1hr)</td>
<td>9 July</td>
<td>Michael Kuiper</td>
<td>80</td>
<td>National – participants of the 4th Workshop on Computational Modelling of Proteins &amp; Membranes (at RMET)</td>
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<tr>
<td>Python for Bioinformatics 1 (1.5hr)</td>
<td>14 August</td>
<td>Dieter Bulech</td>
<td>10</td>
<td>Monash</td>
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<tr>
<td>Simon Gladman</td>
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<td>David Powell</td>
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<tr>
<td>Bernard Pope</td>
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<tr>
<td>Python for Bioinformatics 2 (1.5hr)</td>
<td>21 August</td>
<td>Dieter Bulech</td>
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<tr>
<td>David Powell</td>
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<td>Introduction to bacterial genomics (4hr)</td>
<td>28 August</td>
<td>Dieter Bulech</td>
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<td>Simon Gladman</td>
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<td>Introduction to Bioinformatics (1hr)</td>
<td>10 September</td>
<td>David Powell</td>
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<td>Monash Health Translation Precinct</td>
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<td>Introduction to Galaxy (1hr)</td>
<td>11 September</td>
<td>Simon Gladman</td>
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<td>Introduction to Galaxy Workflows – Intermediate Galaxy (1hr)</td>
<td>18 September</td>
<td>Simon Gladman</td>
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<td>Python for life Sciences (3hr)</td>
<td>26 September</td>
<td>Bernard Pope</td>
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<td>GROUPS; postgraduate career researchers from UniM, WEHI, NICTA, Deakin</td>
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<tr>
<td>Introduction to Bacterial Genomics (4hr)</td>
<td>October</td>
<td>Dieter Bulech</td>
<td>36</td>
<td>Fukuoka University, Japan</td>
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<td>Python for Bioinformatics 3 (1.5hr)</td>
<td>23 October</td>
<td>Dieter Bulech</td>
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<td>Monash</td>
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<tr>
<td>David Powell</td>
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**VLSCI STAFF CONTRIBUTIONS TO UNIVERSITY TEACHING**

Refer Glossary (p.96) for all abbreviations used in all tables in this Report.

<table>
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<th>FACULTY, UNIVERSITY</th>
<th>LECTURER/S</th>
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<td>MSc(Bioinformatics)</td>
<td>Postgraduate</td>
<td>MGSS, UniM</td>
<td>Andrew Lorrie (Coordinator) Michael Kuiper Dieter Bulech Tonsten Saemann</td>
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<td>Algorithms for Functional Genomics</td>
<td>Graduate / Postgraduate</td>
<td>Computing &amp; Information Systems, UniM</td>
<td>Clare Sloggett (Coordinator in 2013) Bernard Pope Juan Nunez-Iglesias Gayle Philip David Powell Dieter Bulech Simon Gladman Tonsten Saemann</td>
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<td>Foundations of Computing</td>
<td>Undergraduate</td>
<td>Computing &amp; Information Systems, UniM</td>
<td>Bernard Pope (Coordinator)</td>
</tr>
<tr>
<td>Introduction to Bioinformatics</td>
<td>Undergraduate</td>
<td>Medicine, Nursing &amp; Health Sciences, Monash</td>
<td>Dieter Bulech</td>
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<td>Genetics (GENE65 6) &amp; GENH65</td>
<td>Undergraduate</td>
<td>La Trobe</td>
<td>Nathan Hall</td>
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<td>Computational Fluid Dynamics (ENGR9224)</td>
<td>Graduate/Postgraduate</td>
<td>Engineering, UniM</td>
<td>Steve Moore (BM)</td>
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<td>Applied High Performance Computing (MCE19031)</td>
<td>Graduate/Postgraduate</td>
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<td>Steve Moore (BM)</td>
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<td>Neural Information Processing (BME90002)</td>
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<td>Engineering, UniM</td>
<td>John Wagner (BM)</td>
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**CONFERECE AND TRAVEL GRANTS**

Refer Glossary (p.96) for all abbreviations used in all tables in this Report.

<table>
<thead>
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<tbody>
<tr>
<td>Lee Yeoh</td>
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<td>Bio2R/UoM</td>
<td>EBI/Welcome Trust Summer School in Bioinformatics, England, Welcome Trust Sanger Institute, University of Glasgow</td>
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<tr>
<td>Arun Konagurthu</td>
<td>Sr Lecturer</td>
<td>Monash</td>
<td>ISMB2013 and 3D-SIG2013, Germany</td>
</tr>
<tr>
<td>James Coller</td>
<td>Postgraduate student</td>
<td>Monash</td>
<td>ISMB2013, 3D-SIG2013, and Student Council Symposium Germany</td>
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<td>Yousef Konwar</td>
<td>Postgraduate student</td>
<td>UoM</td>
<td>MIRPRO 2013 Conference, Croatia</td>
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<td>Patrick Charchar</td>
<td>Postgraduate student</td>
<td>RMIT</td>
<td>ONEETP Masterclass workshop, University of Cambridge, UK</td>
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<tr>
<td>Nina Erfanian Sawdi</td>
<td>Postgraduate student</td>
<td>UoM</td>
<td>Conference on Implantable Auditory Prostheses, California, USA</td>
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<tr>
<td>Bemal Mortal</td>
<td>Postgraduate student</td>
<td>UoM</td>
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<td>Cyrus Keong</td>
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<td>Jane Hawkey</td>
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<td>Introduction to Phylogenetics Analysis Workshop, University of Sydney</td>
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<td>Mahlab Mirmomeni</td>
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<td>Heman Morales</td>
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<td>Ashish Saini</td>
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### SPONSORSHIPS AND CONFERENCES

Refer Glossary (p.96) for all abbreviations used in all tables in this Report.

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<tr>
<td>30 January-1 February</td>
<td>International Brain Research Organisation/Asia Pacific Regional Committees (IBRO/APRC) Advanced Computational Imaging Workshop (Monash Biomedical Imaging)</td>
<td>Fully funded accommodation and catering for students.</td>
<td>24 postgraduate students</td>
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<tr>
<td>9-13 February</td>
<td>38th Lome Conference on Protein Structure and Function (Lome)</td>
<td>Primary sponsor, attended with info booth to announced new VLSCI MM theme.</td>
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<tr>
<td>22 February</td>
<td>Sponsorship of the Victorian node of the International Neuroinformatics Coordinating Facility (INCF), including the Inaugural Neuroinformatics Launch/Workshop</td>
<td>Primary co-sponsor of INCF over 3 years, including sponsorship of international guest speaker at Launch/Workshop</td>
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<td>29 April</td>
<td>Graeme Clark Oration activities (Melbourne Convention and Exhibition Centre)</td>
<td>Sponsored event, hosted a group of UROP students at Oration and Oration Dinner.</td>
<td>1800 Oration attendees, 600 Dinner attendees</td>
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<td>1-2 June</td>
<td>Govhack</td>
<td>Provided Prize.</td>
<td>900 nationally</td>
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<tr>
<td>8 July</td>
<td>Computing &amp; Information Systems Doctoral Symposium (University of Melbourne)</td>
<td>Provided/Awarded Prizes.</td>
<td>130</td>
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<tr>
<td>10 July</td>
<td>UROP Conference Day (Monash University)</td>
<td>In addition to ongoing UROP sponsorship, provided a prize for Best Computational Biology Presentation. Of the 4 staff attending the event, including participating in the judging panel</td>
<td>100 attendees, 27 presenters</td>
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<tr>
<td>11 July</td>
<td>12th Melbourne Protein Group Student Symposium (La Trobe University)</td>
<td>Sponsored program of careers talks.</td>
<td>150 attendees from 29 universities, research institutes and companies</td>
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<tr>
<td>20-24 October</td>
<td>eResearch Australasia (Brisbane)</td>
<td>Information booth, 4 staff attended.</td>
<td>450 delegates</td>
</tr>
<tr>
<td>25-27 October</td>
<td>HealthHack (Thoughtworks, Melbourne)</td>
<td>Provided prizes.</td>
<td>50 participants including researchers, software developers</td>
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<tr>
<td>30 October</td>
<td>Personalised Medicine dinner presentation, Knowledge Week event (William Angliss Institute)</td>
<td>Organised and funded event.</td>
<td>50 public, 15 researchers</td>
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<tr>
<td>30 October</td>
<td>SORRI Student Brain Symposium 2013 (Monash Institute of Pharmaceutical Sciences)</td>
<td>Provided monetary support, and sponsored Best Computational Imaging Poster prize.</td>
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<tr>
<td>4-5 November</td>
<td>Biochemists And Molecular Biologists Bito21 Institute Graduate Retreat (Bito21 Institute)</td>
<td>Provided canvas bags.</td>
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<td>13 November</td>
<td>PC4G – Programming Challenge for Girls (Vitm)</td>
<td>Sponsored catering for female high school students, staff member lectured/facilitated.</td>
<td>22 students from 7 schools</td>
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### SPONSORSHIPS AND CONFERENCES

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<tr>
<td>24-27 November</td>
<td>Australian Society for Biophysics Conference (ASB)</td>
<td>Covered travel expenses for international guest speaker.</td>
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<td>27 November</td>
<td>Metagenomics@Melbourne Symposium (Bio21)</td>
<td>Sponsored event, provided VLSCI information booth.</td>
<td>132 registrants from hospitals, government agencies, universities.</td>
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<tr>
<td>28 November-1 December</td>
<td>4th Australasian Cognitive Neuroscience Conference (Monash University)</td>
<td>Best PhD Student Oral Presentation in Computational Neuroscience.</td>
<td>267 registrants from 50 national/international research institutes &amp; organisations.</td>
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Ms Helen Gardiner
Communications and Development Manager
Almost half of the currently available medicines act on a single group of molecules - G protein-coupled receptors (GPCRs), which can trigger cellular responses to a wide range of ailments such as heart disease, infections, respiratory disorders, digestive and other conditions. New drugs are predicted to emerge from a deeper understanding of GPCRs at the molecular level. The race is on.

Understanding drug interactions at the molecular level

Monash University researchers are using the unique number-crunching power of supercomputers to look at aspects of GPCRs in a way that would have been unimaginable even a few years ago. The research has attracted the interest of the large European pharmaceutical group, Servier.

The body’s capacity to adapt to environmental conditions such as heat and cold is well understood at the physiological level – shivering heats up the muscles, sweating cools them down. That is Biology 101. But what happens at the cellular level is less obvious: how is information about the external environment transmitted to the cells to trigger a response that can adapt the whole body to the ambient temperature?

The story of how this is done, and the role played by this large and complex class of proteins (GPCRs) formed the substance of the 2012 Nobel Prize for Chemistry. GPCRs form a communication link between the external and internal environment of cells and as such are targets of nearly 50% of current pharmaceuticals. Drugs outside the cell can act on GPCRs sitting within the membrane to stimulate internal cellular responses and treat many common health complaints.

What makes the development of new drugs difficult is getting that ground level understanding of these proteins is hard, due to their complex crystal structure. GPCRs are made up of a set of seven linked helices each of which spans the cellular membrane and this complexity has meant that most of the thousands of GPCRs encoded by the human genome have remained a mystery.

A research group at the Monash Institute of Pharmaceutical Sciences (MIPS) in Parkville, advised by 2012 Nobel Laureate Professor Brian Kobilka who won the Prize for his work in GPCRs, is using the supercomputing resources of the Victorian Life Sciences Computation Initiative (VLSCI) to expand our knowledge of these complex molecules and their interactions.

“We’re hoping to create predictive models of GPCRs which allow us to understand how certain ligands (binding molecules) bind to them,” says Professor Patrick Sexton, leader of the Drug Discovery Biology group at MIPS. “That could allow us to predict other ligands that might bind, and possibly to look for new drug targets.”

Building and testing those models demands a lot of computer power. Previously, running computer simulations to test different docking models could take six weeks – now with the VLSCI supercomputers, this computing time has been slashed to a couple of days. All of this work has not gone unnoticed. In 2012, MIPS signed a significant agreement with Les Laboratoires Servier, to collaborate on GPCRs research. The agreement provided MIPS researchers with access to substantial funding and resources, allowing them to apply their expertise in identifying novel GPCR targets and drug design tools to modify the activity of existing drugs of interest to the company.

For further information about this research contact Professor Patrick Sexton at patrick.sexton@monash.edu or visit the VLSCI website at www.vlsci.org.au

“.”

Dr Thomas Gadd at work in the VLSCI high performance computing facility, Parkville, July 2013.

Tim Thwaites, Science Writer
### ACTIVE PROJECTS IN 2013

All projects allocated resources through the Research Allocation Scheme Committee process which were active in 2013 are listed here (refer Current Research on the VLSCI website for exact dates for each)

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### ROUNDED 5

<table>
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<th>NO.</th>
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<tr>
<td>VR0069</td>
<td>Examination of the Specific Mechanisms of Vaccine-Derived Poliovirus Antiviral Drug Interactions</td>
<td>Mr Jason Roberts, Dr Bruce Thorley, Dr Andrew Hung</td>
<td>VIDRL, RMIT</td>
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**PRESENTATIONS**


Roberts, J. H., Molecular Dynamics Simulation of Viruses, RMIT University, 4th Workshop On Computational Modelling of Proteins and Membranes, Australia.

Roberts, J. H., Refinement of the wild poliovirus capsid structure by atomic molecular dynamics simulation of a complete virion, CSIRO Computational and Simulation Sciences and sledger Annual Conference, Australia.

Roberts, J. H., Supercomputer Simulation of Newly Discovered and Novel Enteroviruses, Australian Institute for Bioengineering and Nanotechnology Special Seminar, Australia.

Roberts, J. H., Atomic Molecular Dynamics Simulation of Viruses, RMIT University, Invited lectures, Australia.

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### ROUNDED 6

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<td>VR0001</td>
<td>Structural dynamics of myxoma virus peptide for cancer therapy</td>
<td>Dr Atsuyo Itoh, Dr Elana Pinovski</td>
<td>RMIT</td>
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**PRESENTATIONS**

Saunders, N. R., Barrier mechanisms in the developing brain, University Da Minho, Portugal.


Saunders, N. R., Transport mechanisms in the developing choroid plexus, University of Bern, Switzerland.

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Refer Glossary (p.30) for all abbreviations used in all tables in this Report.
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<td>VR0004</td>
<td>Computational Drug Formulation</td>
<td>Dr David Chalmers</td>
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<td>Parasite Genomics and Genetics Program</td>
<td>Prof. Colin Pouton</td>
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<td>Toxin Binding to Membrane Proteins: Towards Novel Treatments in Neuropathology</td>
<td>Dr Andrew Hung</td>
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<td>Komprida, S., Hung, A., Clark, R. J. D., Adams J. D., alpha-Conotoxin RegI alpha nACHR mutants studies improving selectivity and potency, Biophysical Society Meeting, USA.</td>
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<tr>
<td>Gobin, A., Gury, H., Hung, A., Clark, R. J. D., Adams J. D., alpha-Conotoxin RegI alpha nACHR mutants studies improving selectivity and potency, Biophysical Society Meeting, USA.</td>
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<tr>
<td>Gale, T., Czajkowski, E. &amp; Stern, L., Generating the Cilia Structure of a Rat Kidney, Doctoral Colloquium, University of Melbourne, Australia.</td>
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<tr>
<td>Gale, T., Czajkowski, E. &amp; Stern, L., Generating the Cilia Structure of a Rat Kidney, Doctoral Colloquium, University of Melbourne, Australia.</td>
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<tr>
<td>VR0108</td>
<td>A Computational Model for Heat Transfer and Blood Flow through Multi-Stenotic Arteries</td>
<td>Prof. Andrew Ooi</td>
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<td>Saha, S., Klewicki, J. C., Ooi, A. B. Blackburn, H. M., Comparison of thermal scaling properties between turbulent pipe and channel flows via DNS, in preparation.</td>
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<td>VR0201</td>
<td>Modelling pore-forming toxins</td>
<td>Prof. Michael Parker</td>
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<td>PR</td>
<td>Presentations</td>
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<tr>
<td>Parker, M. W., Membranes pores – Ion and trans, 2nd Membrane Protein Symposium, Academia Sinica, Taiwan.</td>
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Shear induced platelet aggregation: characterising shear forces in in-vitro geometries.

Computational Modelling of G protein-coupled receptors

Exploiting unique mechanical responses of cells for disease diagnosis and management

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VICTORIAN LIFE SCIENCES COMPUTATION INITIATIVE ANNUAL REPORT 2013
VICTORIAN LIFE SCIENCES COMPUTATION INITIATIVE ANNUAL REPORT 2013

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<td>VR0052</td>
<td>Modelling, testing and searching human vision</td>
<td>Dr Andrew Turpin</td>
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<td>McKendrick, A. M., What can vision tell us about cortical excitability in migraine?</td>
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<td>Brain Mapping: Variability and Conviction in Tracing Retinal Nerve Fibre Bundles and Comparison to a Computational Model</td>
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<td>Principles of Ophthalmology and Visual Science</td>
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<td>Chong, L., McKendrick, A. M. &amp; Turpin, A., Automated stimulus choice in condensed grids for assessment of visual field defects, ARVO 2013, USA.</td>
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<td>Gog, S., Moffat, A., Culpepper, J., Turpin, A. &amp; Wirh, A., Large-scale pattern search using reduced-space on-disk suffix arrays, EEE Transactions on Knowledge and Data Engineering.</td>
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<td>VR0056</td>
<td>Neuroanatomical changes in childhood-onset epilepsy</td>
<td>Prof. Graeme Jackson</td>
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<td>Direct Numerical Simulation of Newtonian and non-Newtonian fluid in Wall-bounded flow</td>
<td>Prof. Ivan Marusic</td>
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<td>Dynamic characterisation of bioreversible systems</td>
<td>Prof. Phoebe Chan</td>
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<td>Population genomics of bacterial pathogens</td>
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<td>Dr Matthias Reumann</td>
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<td>AProf. Tim Shaw</td>
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**PRESENTATIONS**

Inouye, M. T., Davey, H., Raven, L., Pope, B. J., Schultz, M., Zobel, J. & Holt, K. E., Short read sequence typing: rapid analysis of genome data for public health laboratories, Molecular Microbiology Meeting, Australia.

Ingle, D., Phylogeny and virulence of atypical enteropathogenic E. coli, Lome Infection and Immunology, Australia.

**PUBLICATIONS**


**PRESENTATIONS**

Mimomori, M., Resolving Ambiguity in Genome Assembly using High Performance Computing, Genome informatics conference, USA.

Mimomori, M., Resolving genome assembly ambiguity using HPC, Supercomputing conference, USA.

Mimomori, M., Conway, T., Reumann, M. & Zobel, J., Resolving ambiguity in genome assembly using High Performance Computing, Big data and healthcare analytics, Australia.

**PUBLICATIONS**

Wubben, J., Cold Enzymology: Offers Insights into Evolution of Enzyme Guanylation Structure, Melbourne Protein Group, Australia.

Penagini, M. A., Multiple Personalities of a Pesticide Target from an Important Plant Pathogen, 21st International AAC Conference, Japan.

Penagini, M. A., From Molecular Evolution to Rational Inhibitor Design of a Promising Anti-TB Target, JJSS University, India.

**PRESENTATIONS**


**PRESENTATIONS**

Coombes, G. & Stinear, T. P., Outbreaks linked to a single chicken farm, BMC Genomics.


**PUBLICATIONS**

Makalic, E., Schmidt, D. & Hopper, J., DEPendency of associations on the number of Top Hits (DEPTH), 28th Australasian Joint Conference on Artificial Intelligence, New Zealand.

Makalic, E., Schmidt, D. & Hopper, J., DEPendency of associations on the number of Top Hits (DEPTH), invited presentation at the Alfred Hospital for VICBiostats, Australia.

**PUBLICATIONS**


**PRESENTATIONS**

Hsu, H. K., Computational studies of the protein beta-sheet, PhD Completion Seminar, Australia.

Hsu, H. K., Computational studies of the protein beta-sheet, Guest Lecture (COMP90016, UniMelb).

**PUBLICATIONS**

Chairs, D., Computational methods in drug design and development, Monash, Sunway, Malaysia.

Chairs, D., Computational methods in drug design, University of Malayx, Malaysia.

Thomas, T., Scanlon, M. J., Yuriev, E. & Chairs, D. K., Ligand binding pathways in fatty acid binding proteins.

Thomas, T., Yuriev, E. & Chairs, D. K., Molecular dynamics of GPDPs.

La, J., Fang, Y., Tachdijian, G. & Chairs, D., In Silico mapping of potential binding pockets in human immunodeficiency virus type 1 reverse transcriptase.

**PRESENTATIONS**

S. W., Towards activated homology models of the human M1 muscarinic acetylcholine receptor: model generation, refinement, enrichment studies and agonist/antagonist selectivity, Journal of Molecular Graphics and Modelling.

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<td>VR0138</td>
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<td>Dr Mattaeus Meffin</td>
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<td>Prof. Nigel Lovell</td>
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**PRESENTATIONS**

**PUBLICATIONS**


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**PRESENTATIONS**

**PUBLICATIONS**


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**PUBLICATIONS**


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<td>Charged protein-lipid interactions and the regulation of membrane ion channel function.</td>
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</table>

**PUBLICATIONS**

Boitsov, C., Vorobyov, I. & Allen, T. W., Ion conduction and conformational flexibility of a bacterial voltage-gated sodium channel, Proceedings of the National Academy of Sciences, USA.  

| Li, L. B., Vorobyov, I. & Allen, T. W., The Different Interactions of Lysozyme and Arginine Side Chains with Lipid Membranes, Journal of Physical Chemistry B. |


| VR2032 | Exploring protein-surface interactions for engineering nanomaterials for biomedical applications | Dr George Yaraschuk         | RMET      | 320000              |

**PRESENTATIONS**


| VR2033 | Structure-Function Relationships for Materials-binding Peptides via Advanced Conformational Sampling | A/Prof. Tiffany Walsh        | Deakin    | 4100000             |

**PRESENTATIONS**


Sultan, A. & Walsh, T. R., Peptide-Surface Interactions at the Aquaporin-Titanium Interface, MRS (Materials Research Society) Fall Conference, USA.


| VR2044 | Assessing thermal effects of electromagnetic fields on people in realistic environmental conditions | Prof. Andrew Wood          | Swinburne | 800000              |

**PRESENTATIONS**


Oehme, D., Multi-scale Computational Modelling of Plant Cell Walls: An Update, ARC CoE in Plant Cell Walls Retreat, Australia.

Oehme, D., Building Homology Models of Cell Proteins, ARC CoE in Plant Cell Walls Node Meeting, Australia.

| Basic, T., 8th Annual George Olovscience Symposium, USA |

**PUBLICATIONS**

Gibbons, N., Computational Modelling of Plant Cell Walls, Seminar at the Centre for Plant Integrative Biology, Nottingham, UK.

**PR0232** Transitions in Biopolymers: The buckling of DNA  
Prof. Aleko Ovcharenko  
UoM  
45000

**PRESENTATIONS**  
**PUBLICATIONS**  
Dagrosa,E., Applying torque to twist storing lattice polymers, AustMS 2013, Australia.  

**PR0236** Modelling post operative arthroplasty in Tatology of Faltot patients  
Dr Andrea Pflaumer  
IBM  
832070

**PRESENTATIONS**  
**PUBLICATIONS**  

**VR0240** Statistical Implication of HLA and KIR Alleles and Studies of Disease in Diverse Human Populations  
Dr Steven Moore  
MCRI  
360000

**PRESENTATIONS**  
**PUBLICATIONS**  

**PR0250** Modelling protein-carbohydrate recognition  
Prof. Elizabeth Yurie  
Monash  
900000  
Dr Paul Ramsland  
Bunnet

**PRESENTATIONS**  
**PUBLICATIONS**  
Turner, E., Sugar footprints in the snow: In-silico mapping of carbohydrate ensembles in protein binding sites.  
Boston Glycobiology Discussion Group, USA.  
Thomas, T., Scoat, M., Yuriue, E. B & Chainoms, D. K., Ligand binding pathways in fatty acid binding proteins, 37th Annual Conference of the Australian Society for Biophysics, Australia.

**VR0251** Investigating targeted drug delivery through optimising release points  
Prof. Andrew Ooi  
UoM  
200000  
Dr Steve Moore  
IBM  
AProf. David Prior  
SVH  
Prof. Mark Cook  
SVH

**PRESENTATIONS**  
**PUBLICATIONS**  

**VR0252** The hydrophilic effect and protein folding  
Dr Angue Grey-Weale  
UoM  
3100000  
Dr Susha Abraham  
UoM  
Prof. Paul Mahoney  
UoM

**PRESENTATIONS**  
**PUBLICATIONS**  
Liu, M., Berford, G., 9-Grey-Weale, A. An explanation for the hydrophilic effect. Invited and travel paid by Forchungszentrum Jilin (not a conference), Germany.  
Liu, M., Berford, G, 9-Grey-Weale, A., An explanation for the hydrophilic effect, University of Sydney invited talk, Australia.

**VR0253** Next Generation Sequencing to identify key genes for defence against a fungal pathogen of canola  
Dr Rohan Lowe  
UoM  
41000

**PRESENTATIONS**  
**PUBLICATIONS**  

**VR0254** The genome sequence of the parasitic dinoflagellate Heterocotylus  
Dr Rosa Walter  
UoM  
515000

**PRESENTATIONS**  
**PUBLICATIONS**  

**VR0255** Optimising blood flow in arterised arteries: a fluid mechanics approach incorporating optical coherence  
AProf. Peter Banks  
UoM  
2000000  
Prof. Andrew Ooi  
UoM  
Dr Daniel Chung  
UoM  
Dr Olivier Cabrit  
UoM  
Dr Stephen Moore  
IBM

**PRESENTATIONS**  
**PUBLICATIONS**  

**VR0256** Molecular simulation of actin dynamics in the malaria parasite: the track of parasite gliding motor  
Dr Wilson Wong  
WEHI  
2600000

**PRESENTATIONS**  
**PUBLICATIONS**  
Baum, K., Kuper, M. J. & Wong, W., Structural insights into actin filament disassembly from the malaria parasite, Grenoble, CNRS, France.  
Baum, K., Kuper, M. J. & Wong, W., Structural insights into actin filament disassembly from the malaria parasite, Cure Institute, Paris, France.  
Baum, K., Kuper, M. J. & Wong, W., Structural insights into actin filament disassembly from the malaria parasite, WEHI Institute Seminar, Australia.  
Baum, K., Kuper, M. J. & Wong, W., Structural insights into actin filament disassembly from the malaria parasite, Regensburg Actin Meeting 2014, Germany.

**VR0257** Simulations of the Bacteriophage Lysin Phyc  
Dr Sneha Abraham  
Monash  
100000

**PRESENTATIONS**  
**PUBLICATIONS**  
<table>
<thead>
<tr>
<th>NO.</th>
<th>PROJECT TITLE</th>
<th>CHIEF INVESTIGATORS</th>
<th>INSTITUTE</th>
<th>VLSCI SERVICE UNITS</th>
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<tbody>
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<td>VR0258</td>
<td>Examining the connection between defective mRNA splicing and colon cancer</td>
<td>AProf. Joan Heath</td>
<td>VEHU</td>
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<td><strong>PRESENTATIONS</strong></td>
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<tr>
<td></td>
<td>Love, C., Sakthianandeswaren, A., Doggett, K., Biggles, T., Oronan, N., Sieber, O. &amp; Heath, J. K., Examining the connection between defective mRNA splicing and colon cancer, AMATA 2013, Australia.</td>
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<tr>
<td>VR0259</td>
<td>Interactions of Chemokines with Sulfated Tyrosine Residues in Chemokine Receptors</td>
<td>AProf. Martin Stone</td>
<td>Monash</td>
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<td>VR0260</td>
<td>Determinants of the substrate specificity of the complement initiating proteases</td>
<td>Prof. Robert Pike</td>
<td>Monash</td>
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<td>VR0261</td>
<td>Co-Evolutionary Dynamics of Culture and Social Structure</td>
<td>Prof. Garry Robins, Prof. Yoshisha Kashima, Dr Alex Sivale</td>
<td>UoM</td>
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<td></td>
<td>Sivale, A. &amp; Robins, G., Ultramicron distribution of cultural vectors in an extended Axelrod model, INSDA 2013, China.</td>
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<td>VR0262</td>
<td>Examination of the Specific Mechanisms of Vaccine-Derived Poliovirus Antiviral Drug Interactions</td>
<td>Mr Jason Roberts</td>
<td>VSLRI</td>
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<td><strong>PRESENTATIONS</strong></td>
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<td></td>
<td>Roberts, J. A., Computational Biophysics, Case study: In-Silico Reconstruction of Poliovirus, AMSI Summer Symposium in Bioinformatics, Australia.</td>
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<td></td>
<td>Roberts, A. J., Supercomputer Modelling of a Complete Human Viral Pathogen: Poliovirus, Theoretical and Computational Biology Group, Baclan Institute, University of Illinois, United States.</td>
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<td>VR0263</td>
<td>Whole-genome characterisation of the genetic landscape of colorectal cancer</td>
<td>Dr Oliver Sibber</td>
<td>VEHU</td>
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<td></td>
<td><strong>PUBLICATIONS</strong></td>
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<td></td>
<td>Mouradov, D., Doggett, C. &amp; Sibber, O. M., Colorectal cancer cell lines are representative models of the main molecular subtypes of primary cancer, (in preparation).</td>
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<th>NO.</th>
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<td>VR0264</td>
<td>A longitudinal study of brain volume and cognitive decline following stroke</td>
<td>Dr Heath Pardoe, Prof. Geoffroy Donnan, Dr Amy Bradtmann, Dr Toby Cumming</td>
<td>Monash</td>
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<td><strong>PRESENTATIONS</strong></td>
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<td>Cumming, T., Physical activity is associated with cognition after stroke, but only for tasks presented visually, the 8th Congress of The International Society for Vascular Behavioural and Cognitive Disorders, Canada.</td>
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<td></td>
<td>Warder, E., Spinal cord compression atrophy occurs within the first year after ischaemic stroke, the 8th Congress of The International Society for Vascular Behavioural and Cognitive Disorders, Canada.</td>
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<td>VR0370</td>
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</table>

**PUBLICATIONS**

The effects of SIFT on the reproducibility and biological accuracy of the structural connectome

**PRESENTATIONS**

Smith, R. E., Touriño J.D., Calamante, F. & Connolly, A. Towards robust structural connectomics, Epilepsy Melbourne Retreat, Australia.

Smith, R. E., Touriño J.D., Calamante, F. & Connolly, A. Evidence for the improved biological interpretability of white matter connectivity derived following intrainagm filtering using SIFT, Proceedings of the ISMRM, USA.

Smith, R. E., Touriño J.D., Calamante, F. & Connolly, A. The effects of SIFT on the reproducibility and biological accuracy of the structural connectome. (in preparation).

**PUBLICATIONS**


**VLCI SERVICE UNITS**

38000
GOVERNANCE
STRUCTURE & RELATIONSHPES

COMMITTEES

UNIVERSITY REFERENCE GROUP

The University of Melbourne formed the VLSCI Steering Group in August 2008 to direct the development of the VLSCI. With the appointment of the VLSCI Steering Committee the group was transformed into a University Reference Group to provide advice to The University on recommendations of the Steering Committee. The group has reviewed The University’s responsibilities in the Grant Agreement particularly for the financial model and risk management plan. This Group met a total of five times in 2013, in January, February, March, May and June.

Prof. Liz Sonenberg  Pro Vice-Chancellor (Research Collaboration), UoM
Prof. James McCluskey  Deputy Vice-Chancellor (Research), UoM
Prof. Peter R Taylor  Director, VLSCI
Prof. John Zillman  Chair, VLSCI Steering Committee
Mr John Bruzziarianti  Director, Major Projects, UoM
Ms Karin Diamond  Business Manager, VLSCI (Observer)
Ms Fiona Kerr  Executive Officer, VLSCI (Secretary)

VICTORIAN LIFE SCIENCES COMPUTATION INITIATIVE SUSTAINABILITY PLANNING SENIORS GROUP (ARISING OUT OF THE VLSCI LIASON GROUP)

Representatives of The University of Melbourne and the Department of State Development, Business and Innovation continue to liaise regularly to review the implementation of the approved Business Plan. Three meetings were held in 2013, in May, August and September.

Mr Grantley Maitles  Deputy Secretary, DSDBI
Ms Amelia King  Senior Policy Officer, CRC Bid Support Program
Dr Mark Kosten  Director, VLSCI, La Trobe University
Mr Matthew Dummott  Director, Science & Technology Policy, DSDBI
Prof. James McCluskey  Deputy Vice-Chancellor (Research), UoM
Prof. Liz Sonenberg  Pro Vice-Chancellor (Research Collaboration), UoM
Prof. Peter R. Taylor  Director, VLSCI

Dr Mike Sargent, Independent Assessor, attended the September meeting by invitation. Mr Ben Apiad and Ms Michelle Paragia of Strategic Planning Partners (SPP) also attended the September meeting.

STEERING COMMITTEE

The role of the Steering Committee is to provide advice to The University on the overall Initiative and especially with strategies, policies and performance of the VLSCI. The Committee met four times in 2013, in March, May, August and December.

Prof. John Zillman AO  Chair
Prof. Paul Bonnington  Director, eResearch Centre, Monash University
Prof. Trevor Kilpatrick  Director, Melbourne Neuroscience Institute, UoM
Dr Mark Kosten  Director, eResearch, La Trobe University
Mr Ian Smith  Pro Vice-Chancellor, Research & Research Infrastructure, Monash University
Prof. Tony Bacic  Chair, VLSCI Scientific Advisory Committee
Prof. John Zillman  Chair, VLSCI Scientific Advisory Committee
Prof. Peter R. Taylor  Director, VLSCI

SUSTAINABILITY SUBGROUP

The Sustainability Subgroup comprises nominated representatives of the VLSCI Steering Committee. The Committee is convened at the request of the Steering Committee to consider specific matters that may require further examination or consideration. The Committee met four times in 2013, twice in January, once in March and once in May.

Prof. John Zillman  Chair, VLSCI Steering Committee
Prof. Peter R Taylor  Director, VLSCI (Chair)
Dr Mark Kosten  Director, eResearch, La Trobe University
Prof. Trevor Kilpatrick  Director, Melbourne Neuroscience Institute, UoM
Prof. Paul Bonnington  Director, eResearch Centre, Monash University
Ms Fiona Kerr  Executive Officer, VLSCI (Secretary)

Mr Simon Wilkins and Mr Timothy Morris of SPP attended by invitation the first meeting held in January. Ms Jane Gardam of DSDBI, Mr Simon Wilkins and Mr Timothy Morris attended the second meeting held in January. Ms Amelia King of DSDBI attended the meeting held in March. Ms Amelia King and Mr Matthew Dummott of DSDBI attended the meeting held in May.
SCIENTIFIC ADVISORY COMMITTEE
The Scientific Advisory Committee advises the Director on the appropriate use of the LSCC and the PCF. It also considers opportunities to initiate new research areas and collaborations to take advantage of the capabilities of the LSCC and the PCF. With the departure of Prof. Saint, Prof. Karen Day, the incoming Dean of Science, The University of Melbourne, subsequently designated Prof. Tony Bacic as Chair. The Committee met once in 2013 in February.

Prof. Robert Saint (Chair), Dean, Faculty of Science, UniM (until February 2013)
Prof. Tony Bacic (Chair) Director, Bioc21 Institute
Prof. David Bowtell Head, Cancer Genomics & Genomics in Cancer Institute
Prof. Mark Ellisman Director, National Center for Microscopy & Imaging Research Chemistry, University of California, San Diego
Prof. John Hopper Director (Research), Melbourne School of Population Health, UniM
Prof. Mark Ragan Head, Genomics and Computation Biology Division, Institute for Molecula Science, VG
Prof. Terry Speed Laboratory Head, Bioinformatics, WEHI
Prof. Rick Stevens Argonne National Laboratory, The University of Chicago (to February 2013)
Prof. James Whistock ARC Federation Fellow and Program Leader, WEHI Research Fellow, Department of Biochemistry and Molecular Biology, Monash University
Prof. Marc Wilkins Director, Ramaciotti Centre
Prof. Jason Roberts* (Chair) Director, Computational Biology Centre, IBM
Prof. Dr. Ayjay Royyuru* (Chair) Director, Computational Biology Centre, IBM
Prof. Peter Taylor (Chair), VSLO
Prof. Justin Zobel* Program Leader and Principal Research Fellow, NICTA, Head, Department of Computing and Information Systems, UniM
Prof. Liam O’Conner* Theme leader, Proteomics, LSCC Division, NSW, and Personalised Medicine, WEHI (left and 2012)
A/Prof. Brian Smith* Theme leader, Molecular Modeling, LSCC (new in 2013)
Prof. Gary Egan* (Chair) Director, Monash Biomedical Imaging, Monash University
Ms Fiona Kerr (Secretary) Executive Officer, VSLO

*Professors Zobel, Smith and Egan are invited to attend this meeting as observers in their role as LSCC theme leaders.
A/Prof. Andrew Lonie (LSCC Head), Dr Vera Hansper (VSLO PCF Manager) and Dr John Wagner (Manager, IBM Research Collaboration for Life Sciences – Melbourne) also attended the February meeting.

LSCC EXECUTIVE COMMITTEE
The LSCC Executive is comprised of the LSCC Head, the VSLO Director and the current LSCC Theme Leaders. Note that this guarantees representation for each hub institution, as each hub is host to at least one Theme Leader. The role of the Executive is to provide strategic research management of the LSCC. The Committee met once in 2013 in May.

Prof. Peter R Taylor (Director, VSLO (Chair)
A/Prof. Andrew Lonie Head, LSCC, VSLO
Prof. Justin Zobel Program Leader and Principal Research Fellow, NICTA, Head, Department of Computing and Information Systems, UniM
Prof. Gary Egan Director, Monash Biomedical Imaging (MBI), Monash University
A/Prof. Brian Smith Faculty of Science, Technology and Engineering, Director, La Trobe Institute for Molecular Science, La Trobe University
Ms Fiona Kerr Executive Officer, VSLO (Secretary)

LSCC ADVISORY COMMITTEE
The LSCC Advisory Committee (LAC) is a superset of the LSCC Executive with the addition of one member of the VSLO SAC and one member of the LSCC Steering Committee. Project and (human) resource requests are considered by the LAC bi-annually and it also decides on LSCC resource allocations to projects (and thus determination of LSCC Approved Activities). In this way the LAC provides budget oversight. The LAC operates as a resource allocation committee, advising the Director what projects should be supported, for how long, and with what LSCC resources. The Committee met once in 2013 in August.

A/Prof. Andrew Lonie Head, LSCC, VSLO (Chair)
Prof. Peter R. Taylor Director, VSLO
Prof. Gary Egan Director, Monash Biomedical Imaging, Monash University
A/Prof. Brian Smith Faculty of Science, Technology and Engineering, Deputy Head, La Trobe Institute for Molecular Science, La Trobe University
Prof. Terry Speed Laboratory Head, Bioinformatics, WEHI
Prof. Trevor Kilpatrick Director, Melbourne Neurological Institute, UniM
Prof. Justin Zobel Program Leader and Principal Research Fellow, NICTA, Head, Department of Computing and Information Systems, UniM
Ms Fiona Kerr Executive Officer, VSLO (Secretary)

PCF ADVISORY COMMITTEE
The PCF Advisory Committee comprises active users on the machines in the PCF. They provide valuable feedback about the user experience and advice to the PCF Manager on the operations and performance of the PCF. Whilst the Committee did not formally meet in 2013 members provided out-of-session advice and consultation on specific issues as they arose.

Dr Mike Kulper Molecular Modeling Scientist, VSLO
Dr Vera Hansper PCF Manager, VSLO (Chair)
Mr Jason Roberts Senior Medical Scientist, National Entomology Reference Laboratory, WHO Polymyelitis Regional Reference Laboratory, Victorian Infectious Diseases Reference Laboratory
Ms Denise Wootten Faculty of Pharmacy and Pharmaceutical Sciences, Monash University
Ms Melissa Buses Department of Chemistry, La Trobe University
Mr Colin Hales Department of Electrical and Electronic Engineering, UniM
Mr Evan Thompson Computational neuroscientist, Flinders Neuroscience and Mental Health Institute
On a request from The University, the Steering Committee accepted the responsibility for control over the establishment of the Resource Allocation Scheme Committee (RAS Committee) and responsibility for the appointment of its members. Applications to the Resource Allocation Scheme are reviewed by the RAS Committee that determines the resource grants for each application. This Committee also advises the PCF Manager on the appropriateness of Start Up Applications that may be received at any time of the year and this would normally be conducted out-of-session rather than through a formal meeting. This Committee met twice in 2013 in May and December.

Prof. Lindsay Botten (Chair) NCI, Australian National University
Prof. David Abramson Director, Research Computing Centre, UQ
Prof. Debra Bernhardt Group Leader, Australian Institute for Bioengineering & Nanotechnology, UQ
Prof. Ben Cooks Research Director, Biosciences, Victorian Department of Primary Industries
Dr Vera Hansper PCF Manager, VLSCI (Secretary)
Prof. Richard Huggins Department of Mathematics & Statistics, UoM
Prof. Rao Kotagiri Department of Computing & Information Systems, UoM
A/Prof. Brian Smith Faculty of Science, Technology and Engineering, Deakin University
A/Prof. Salvy Russo School of Applied Sciences, RMIT University
Dr Jing-Jia Luo Centre for Australian Weather & Climate Research, Bureau of Meteorology
A/Prof. Ashley Buckle NHMRC Senior Research Fellow, Department of Biochemistry and Molecular Biology, Monash University
A/Prof. Tiffany Walsh Institute for Frontier Materials, Deakin University
Ms Helen Gardiner (VLSCI Communications and Development Manager), Mr Brett Pemberton (VLSCI PCF Systems Administrator), Dr Andrew Isaac (VLSCI PCF Specialist Programmer) and Ms Fiona Kerr (VLSCI Executive Officer) attended the meeting held in May. Ms Helen Gardiner, Dr Matthew Hodges (VLSCI PCF Systems Administrator), Dr Andrew Isaac and Ms Fiona Kerr attended the meeting held in December.
The University administers the Initiative’s funds in accordance with the terms and conditions of the Grant. Interest received on the Grant funds is generated in accordance with the terms and procedures.

In-Kind Contributions

In-Kind Contributions are accounted for by reference to the In-Kind Accounting Contribution Framework, which has been approved at a number of levels – The University’s Financial Operations Department, Internal Audit and External Auditors. The Framework is provided in a number of documents (the 2009 Annual Report and the 2011 Business Plan - Revised).

2013 Financial Results

2013 Audit

The 2013 accounts have been reviewed by The University’s Departments of Financial Operations and Internal Audit. Oakton’s have conducted an external audit of the accounts and their audit statement confirming the accuracy of the both the accounts and the in-kind contributions is published as part of the Financial Supplement to this Annual Report.

Income

Income to the Initiative in the 2013 year consisted of interest earned from grant funds and direct income support from The University. As noted above, $646,000 of income was also earned by the LSCC as subscription income.

Total expenditure from both project accounts is made in accordance with The University’s approved Financial Policies and Procedures.

Contributions to VLSCI activities from individuals providing their time and expertise to Outreach and Directorate endeavours remain substantial at $235,265.

Initiative Expenditure

Expenditure from the Grant was made in accordance with the approved categories of expenditure under the Grant and The University’s policies and procedures.

Overall expenditure was 4% under budget, and not a significant variance.

Expenditure from University Funds was under-expended (43%). During the year planned expenditure on capital equipment of $1 million was set aside, electrical costs were lower than anticipated and there were savings in expenditure on associated IT equipment and software. As in 2012, this represents a good result, as these funds will need to be managed carefully.

Summary

2013 saw the continuation of major expenditure related to PCF high performance computer equipment, sustained and growing LSCC’s activities, significant Outreach and Communications activity and ongoing Directorate activity in relation to Business Plans and Sustainability Planning. The Initiative managed the finances in accordance with agreements and budgets and the overall result continues to be sound and pleasing.

VLSCI Cash Funds

Grant funds from DSDBI reside in a separate project account – that account earns interest at Reserve Bank Rate less 40 basis points. Expenditure from this account is made in accordance with the approved categories of expenditure set out in the Grant: the Peak Computing Facility (PCF), the Life Sciences Computation Centre (LSCC), the Communications, Skill & Outreach Program, and the Directorate.

Cash funding provided by The University ($12.83 million) is made up of a combination of direct funding from Melbourne Research and central Infrastructure Funding. In 2013 income was collected from subscriptions to LSCC services and this amounted to $646,000. These funds were applied to activities of the LSCC and VLSCI. The University’s funds reside in a separate project account. Expenditure from this project account consists of salaries and expenditure categories not covered by the Grant funds.

All expenditure from both project accounts is made in accordance with The University’s approved Financial Policies and Procedures.

ACCOUNT STRUCTURE

VLSCI CASH FUNDS

Grant funds from DSDBI reside in a separate project account – that account earns interest at Reserve Bank Rate less 40 basis points. Expenditure from this account is made in accordance with the approved categories of expenditure set out in the Grant: the Peak Computing Facility (PCF), the Life Sciences Computation Centre (LSCC), the Communications, Skill & Outreach Program, and the Directorate.

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All expenditure from both project accounts is made in accordance with The University’s approved Financial Policies and Procedures.

IN-KIND CONTRIBUTIONS

In-Kind Contributions are accounted for by reference to the In-Kind Accounting Contribution Framework, which has been approved at a number of levels – The University’s Financial Operations Department, Internal Audit and External Auditors. The Framework is provided in a number of documents (the 2009 Annual Report and the 2011 Business Plan - Revised).

2013 Financial Results

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Total expenditure from both project accounts is made in accordance with The University’s approved Financial Policies and Procedures.
### GRANT ACCOUNT

**STATEMENT**

Grant Account Statement of Income & Expenditure for the period - 1 January 2013 to 31 December 2013

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<thead>
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<th>CARRY FORWARD CASH BALANCE</th>
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#### INCOME

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<td>TOTAL INCOME</td>
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#### SALARY EXPENDITURE

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<td>Salary Expenditure</td>
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#### NON SALARY EXPENDITURE

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<td>Asset Expense &gt;$10,000</td>
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<tr>
<td>Audit Fee Expense</td>
<td>11,800.00</td>
</tr>
<tr>
<td>Bursaries &amp; Grants</td>
<td>500.00</td>
</tr>
<tr>
<td>Computer Software &amp; Services</td>
<td>38,083.25</td>
</tr>
<tr>
<td>Consultants Service Fees</td>
<td>233,800.63</td>
</tr>
<tr>
<td>Consumable Supplies</td>
<td>11,227.52</td>
</tr>
<tr>
<td>Entertainment &amp; FBT Costs</td>
<td>1,939.10</td>
</tr>
<tr>
<td>Expensed Assets</td>
<td>10,150.18</td>
</tr>
<tr>
<td>IBM Fitout Supply - Scheduled Payments</td>
<td>4,629,626.00</td>
</tr>
<tr>
<td>Network Installation</td>
<td>1,243.79</td>
</tr>
<tr>
<td>Printing, Photography / Reprints , Photocopying Charges</td>
<td>528.50</td>
</tr>
<tr>
<td>Scholarships</td>
<td>305,611.04</td>
</tr>
<tr>
<td>Services Expenses</td>
<td>3,039.78</td>
</tr>
<tr>
<td>Staff Training &amp; Development</td>
<td>4,212.49</td>
</tr>
<tr>
<td>Subscriptions and Memberships</td>
<td>6,377.90</td>
</tr>
<tr>
<td>Travel &amp; Conference</td>
<td>159,871.77</td>
</tr>
<tr>
<td>Other (Non-Salary) Expenditure</td>
<td>5,968,687.36</td>
</tr>
<tr>
<td>TOTAL EXPENDITURE - SALARIES, MAJOR PCF &amp; OTHER</td>
<td>7,971,731.78</td>
</tr>
<tr>
<td>TOTAL AVAILABLE (CASH)</td>
<td>14,731,742.93</td>
</tr>
</tbody>
</table>

---

### UNIVERSITY CONTRIBUTION

**ACCOUNT STATEMENT**

University Contribution Account Statement of Income & Expenditure for the period - 1 January 2013 to 31 December 2013

<table>
<thead>
<tr>
<th>CARRY FORWARD CASH BALANCE</th>
<th>3,935,893.53</th>
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</table>

#### INCOME

<table>
<thead>
<tr>
<th>University of Melbourne</th>
<th>1,000,000.00</th>
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</thead>
<tbody>
<tr>
<td>LSICC Subscriptions</td>
<td>645,439.91</td>
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<tr>
<td>TOTAL INCOME</td>
<td>1,645,439.91</td>
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</table>

#### EXPENDITURE

<table>
<thead>
<tr>
<th>Directorate</th>
<th>536,856.44</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directorage Salaries &amp; Overheads</td>
<td>230,663.98</td>
</tr>
<tr>
<td>Communications &amp; Outreach Salary Expenditure</td>
<td>1,056,424.19</td>
</tr>
<tr>
<td>TOTAL EXPENDITURE - SALARIES, MAJOR PCF &amp; OTHER</td>
<td>2,649,564.86</td>
</tr>
<tr>
<td>TOTAL AVAILABLE (CASH)</td>
<td>2,931,768.58</td>
</tr>
</tbody>
</table>

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Ms Karin Diamond  
Business Manager
GLOSSARY

Alfred …… The Alfred Hospital
Austin …… The Austin Hospital
Baker IDI …… Baker IDI Heart and Diabetes Institute
Bion21 …… Bion21 Institute
Burnet …… Burnet Institute
Curtin …… Curtin University
CERA …… Centre for Eye Research Australia
Deakin …… Deakin University
DEPI …… Department of Environment & Primary Industries Victoria
FedUni …… Federation University
Florey …… Florey Institute of Neuroscience and Mental Health
GVL …… Genomics Virtual Laboratory
IBM …… IBM Research Collaboratory for Life Sciences - Melbourne
IVEC …… Pawsey Centre
La Trobe …… La Trobe University
LSFCC …… Life Sciences Computation Centre – VLSCI
Ludwig …… Ludwig Institute for Cancer Research
Max Planck …… Max Planck Institute of Biochemistry
MASSIVE …… Multi-modal Australian ScienceS Imaging and Visualisation Environment
MBC …… Melbourne Brain Centre
MCRI …… Murdoch Children’s Research Institute
Melb Dental …… Melbourne Dental School
MHTP …… Monash Health Translation Precinct
MMRI …… Monash Institute of Medical Research
Monash …… Monash University
Museum Vic …… Museum Victoria
NCI …… National Computational Infrastructure
NCMAS …… National Computational Merit Allocation Scheme
NeCTAR …… National eResearch Collaboration Tools and Resources
NICTA …… National ICT Australia
Oxford …… Oxford University, Britain
PCF …… Peak Computing Facility - VLSCI
Peter Mac …… Peter MacCallum Cancer Centre
RAS …… Resource Allocation Scheme
RBG …… Royal Botanic Gardens
RCH …… The Royal Children’s Hospital
RMH …… Royal Melbourne Hospital
RMIT …… RMIT University
RWH …… Royal Women’s Hospital
SVH …… St Vincent’s Hospital
SVI …… St Vincent’s Institute
Swinburne …… Swinburne University of Technology
SydneyUni …… The University of Sydney
UNSW …… University of New South Wales
UoA …… The University of Adelaide
UoM …… The University of Melbourne
UoSC …… University of the Sunshine Coast
UQ …… The University of Queensland
UWA …… The University of Western Australia
V3 alliance …… V3 alliance (ex VPAC & VERSI)
VABC …… Victorian AgriBiosciences Centre
VCI …… Victorian Cancer Biobank
VIDRIL …… Victorian Infectious Diseases Reference Laboratory
VLSCI …… Victorian Life Sciences Computation Initiative
WEHI …… Walter & Eliza Hall Institute of Medical Research

PUBLISHING INFORMATION

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