



THE PAPUA NEW GUINEA  
**UNIVERSITY OF TECHNOLOGY**

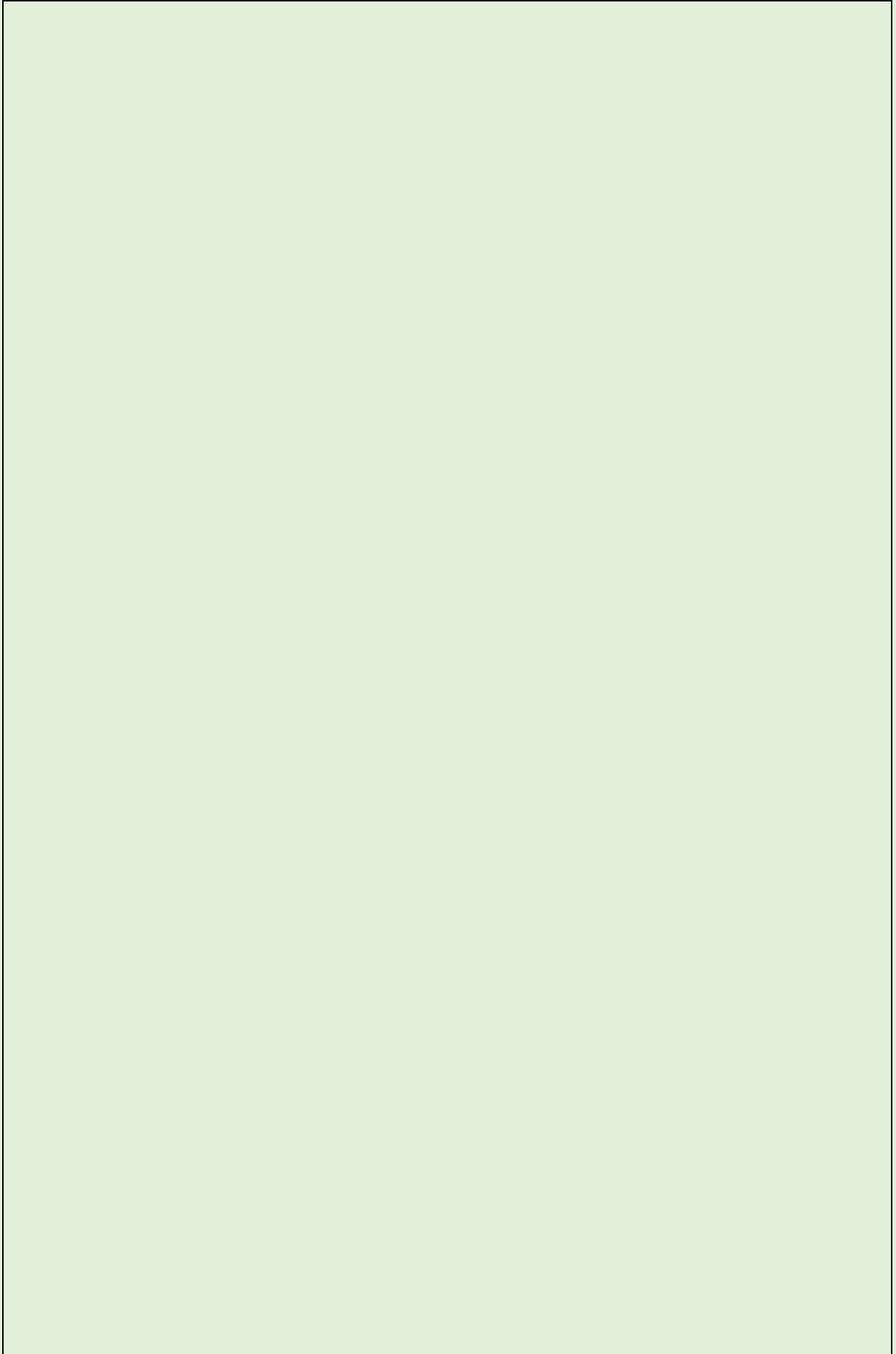
# **RESEARCH REPORT**

## **2016**

Compiled and Edited  
by

**Professor Shamsul Akanda**

Department of Agriculture



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## FOREWORD

On behalf of the Research Committee of Unitech, I am delighted to present the 2016 Research Report of the Papua New Guinea University of Technology. This is a compilation of the research activities of the thirteen academic departments and four research units of the university. I am very thankful to the Dean of Postgraduate Studies, Professor Shamsul Akanda, for compiling and editing the report.

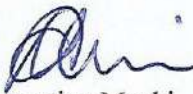
Unitech has the largest postgraduate program in the country, with more than 200 postgraduate students at the present time. The majority of the students are from Papua New Guinea but there are also some from other Pacific Islands who are here through Erasmus Mundus Program of the European Union. This year, we have one postgraduate student from Africa, Botswana, who is under the Association of Commonwealth Universities Scholarship. The presence of research students creates an atmosphere that is conducive to research. Supervision of postgraduate students and doing research go hand in hand.

The Papua New Guinean postgraduate students at Unitech are either sponsored by the university, by companies or by themselves. Whereas the government has instituted scholarship programs for undergraduate study (HECAS – Higher Education Cost Assistance Scheme - and AES – Academic Excellence Scholarship) no similar schemes are in place for postgraduate studies. We are aware that the government plans to introduce scholarships for postgraduate studies soon, and we look forward to a substantial expansion of our postgraduate programs when that happens.

There is a well-attended weekly research seminar at Unitech. For the preceding few years this was coordinated by the Dean of Postgraduate Studies, Professor Shamsul Akanda, and last year and this year it is being coordinated by another member of the Research Committee, Professor Subramaniam Gopalakrishnan. I am very grateful to both of them for their commitment to the seminars, research and to the postgraduate program as a whole.

Unitech has a Research Committee that funds research projects and staff attendance at national/international conferences. In 2016, a total of K56,281 was given out by the Research Committee for student research projects only, but no fund was used to support staff attendance at national and international conferences. Nonetheless, many requests for research funding and attendance at international conferences were turned down by the Research Committee, due to a shortage of funds. These funds need to be tripled or quadrupled. That would be a good investment.

I would like to take this opportunity to thank all heads of department, leaders of research units and members of the Research Committee for their fruitful work during the year 2016. I also thankful to the Vice Chancellor and his management team for their continued support and commitment of funds even when the university budget is under stress. Above all, I thank the Dean of Postgraduate Studies, Professor Akanda, for preparing the 2016 Unitech Research Report.



Dr Augustine Moshi  
Pro Vice Chancellor Academic and  
Chairman of the Research Committee

## **THE RESEARCH COMMITTEE OF THE ACADEMIC BOARD**

### **1. TERMS OF REFERENCE**

In order that research activities within the University may be encouraged, coordinated, funded and monitored efficiently, the Academic Board set up a Research Committee under the following terms of references:

- (a) To promote and encourage research and development;
- (b) To formulate an overall research policy and appropriate guidelines;
- (c) To allocate funds for research and development within the University;
- (d) To prepare an annual report on the research conducted by the University.

### **2. CONSTITUTION**

#### **Ex-Officio Members**

- a. Vice Chancellor
- b. Pro Vice Chancellor (Academic)

#### **Appointed Members**

- c. One person appointed by the Vice Chancellor who shall be the Chairman of the Committee
- d. Six persons appointed biennially by the Academic Board

### **MEMBERSHIP**

#### **Ex-Officio Members**

Dr Albert Schram  
Associate Professor Augustine Moshi

#### **Appointed Members**

Associate Professor Augustine Moshi (Chairman)  
Professor S. Akanda  
Dr. K. Pirapaharan  
Dr. S. Gopalakrishnan  
Dr. G. Arpa

#### **In Attendance**

Mr Peter Likius, Deputy Bursar  
Mr Gabriel Paul, Executive Officer

## **Executive Summary**

Academic year 2106 was a year of unprecedented challenge for Unitech. Unitech suffered the loss of life and property. However, Unitech completed the academic year with a high note. “UNITECH Research Committee Report” is a comprehensive compilation of ongoing and completed research from all the 13 academic departments. The Research Report 2016 contains the research priorities aligned with “Unitech 2030” and national priority areas, ongoing and completed research, publications, national and overseas conference attendance by the academic staff from the 13 academic departments. During 2016, a total of 55 research articles were published in reputed international and national journals compared to 47 in 2015. This shows the strong commitment and resilience of the faculty members to research and publications despite funding shortage and disruptive academic environment in 2016

Fifty postgraduate students representing nine academic departments, including one PhD, successfully completed their research/studies and graduated on April 21, 2017.

Research conducted by the final year undergraduate students also constitute a large proportion of research reported by the academic departments.

Due to cashflow problems, no conference fund could be approved in 2016. Despite severe cashflow problems, university allocated a total of K56,281 mostly to support the postgraduate students’ research, compared to an allocation of K176,207 for research and conference attendance in 2015. This demonstrates the Unitech’s strong commitment to PG studies and research. This funding needs to be substantially increased in the coming years as this is the worthwhile spending. Postgraduate studies are the conduits for the universities to develop research programs to be creative and solve complex problem through innovations leading to sustainable national developments. These are the shared challenges for the whole country and needs shared solution.

The report also contains 24 abstracts presented in the “Unitech Research Committee Seminar Series” – a hallmark of Unitech. This weekly seminar series that is running for the last four years brings the academics, staff and students together in a common platform to share and disseminate research findings to wider university community. This seminar series is the best forum not only to disseminate the research outcomes to wider community but also to train the young academics and postgraduate students for their presentation and communication skills.

**Number of Journal Publications for Different Academic Departments (2013-2016)**

<b>Departments</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>Total</b>
Agriculture	14	06	08	08	36
Applied Physics	0	0	0	06	06
Applied Sciences	04	07	09	02	22
Architecture and Building	01	0	0	0	01
Business Studies	01	1	05	07	14
Civil Engineering	01	0	01	03	05
Communication and Development Studies	03	10	05	02	20
Electrical and Communication Engineering	0	03	01	06	10
Forestry	02	02	03	0	07
Mathematics and Computer Science	04	02	01	0	07
Mechanical Engineering	01	03	01	1	06
Mining Engineering	03	01	01	0	05
Surveying and Land Studies	03	11	12	20	46
<b>Total</b>	<b>37</b>	<b>46</b>	<b>47</b>	<b>55</b>	<b>185</b>



# **Departmental Research Reports**

**Agriculture**

**Applied Physics**

**Applied Sciences**

**Architecture and Building**

**Business Studies**

**Civil Engineering**

**Communication and Development Studies**

**Electrical and Communication Engineering**

**Forestry**

**Mathematics and Computer Science**

**Mechanical Engineering**

**Mining Engineering**

**Surveying and Land Studies**



## **DEPARTMENT OF AGRICULTURE**

### **Head of Department: Professor Abdul Halim**

The Department of Agriculture is one of the 13 Academic Departments in Papua New Guinea University of Technology. It offers Undergraduate and Postgraduate Degrees in Agriculture, conduct agricultural research and disseminate the relevant information to the community. The undergraduate program consists of a four year study program- Bachelor of Science in Agriculture (B.Sc.Ag). The Bachelor of Agriculture and Rural Development (BARD), program is offered in distance mode in collaboration with the Department of Distance Learning. There are three robust postgraduate programs, which include Master of Science in Agriculture (MSc. Ag), Master of Philosophy (MPhil), and Doctor of Philosophy (PhD). The MSc. Ag) program is a combination of course work and research based degree program, while PhD and MPhil studies are fully research based degrees.

The Department has 15 qualified academic staff (10 with PhDs and 3 on PhD studies overseas, 1 returned and awaiting confirmation of PhD). In 2016, seven students graduated with postgraduate degrees (2 MPhil and 5 MSc). The Department of Agriculture is committed in delivering quality teaching, research, outreach activities and post-graduate studies. It has well guided activities including research thrust areas stipulated in the Department's Five Year Strategic Development Plans (2005 – 2010 and 2011 – 2015). Strategic Plan for 2016-20 has already been prepared based on the University's Vision 2030 and Mission. The curriculum is enhanced through regular and periodic review in consultation with stakeholders and industries in the public and private sectors. The Department has established strong collaborative research links with international developmental partners and stakeholders, including Australian Centre for International Agricultural Research (ACIAR) and New Zealand AID. Regular publication of the scientific journal '*Niugini Agrisaiens*' and academic staff publishing scientific papers regularly confirm the department's strong commitment in research at Unitech. Strong collaborative

research collaborations exist with PNG National Agricultural Research Institute (NARI), University of South Pacific (USP), Fiji, Charles Sturt University (CSU), Australia, National Research Institute (NRI) of Greenwich University (U.K.), South Australian Research and Development Institute (SARDI), Australia, University of Canberra, Australia and other NGOs, industries and institutions further cements our strong leadership in agricultural research. Other publications, compilation of abstracts of research done by the post-graduate students, Annual Reports, Farm Report and Strategic Plan on annual basis also strengthens the department's research capacity.

In the later part of 2016 (December), Unitech Biotechnology Centre was amalgamated to the Department of Agriculture for the administrative oversight.

The following research focus areas have been identified and much of the staff and student research are woven around these thematic areas:

## **RESEARCH FOCUS AREAS**

### **Research Focus Area – 1: Crop Sciences**

- Evaluation of promising rice varieties for Papua New Guinea
- Crop improvement and adaptation to stress environments caused by climate change
- Use of *Trichoderma* spp. as a biocontrol agent against some selected soil borne pathogens
- Study of the production technology and practices of selected crops by farmers in different agro-ecological regions of Papua New Guinea
- Study of the production technology and practices of selected vegetables by farmers in different agro-ecological regions of Papua New Guinea
- Soil N and composting in sweet potato-based farming systems
- Symbionts as potential biocontrol agent for cocoa pod borer
- Development of a maize seed system for PNG
- Gene discovery in PNG wild rice: seed and grain characteristics

- Genetic transformation of taro
- Quantification of greenhouse gases (GHG) emissions from soils under major cropping systems of Papua New Guinea

### **Research Focus Area – 2: Livestock Sciences**

- Conservation of farm animal genetic resources
- Utilization of crop wastes and agro-industrial by-products for feeding livestock and poultry
- Determining digestibility of locally available feed and fodder
- Determination of anti-nutritional factors in the fodder crops of PNG
- Development of suitable weaner piglets diet
- Smallholder Aquaculture development in PNG

### **Research Focus Area – 3: Agricultural Economics**

- Analysis of marketing costs and margins spread of sweet potato sales produced from the highlands of Papua New Guinea
- Economic impact assessment of honey bee
- Coffee integrated farming in Eastern Highlands Province
- Economic impact of climate change on coffee and cocoa production in PNG: A Ricardian Approach
- Handbook on relevant production, trade and price statistics on agricultural, livestock and poultry products of PNG
- Agriculture sectoral growth in Papua New Guinea since political independence

#### **Research Focus Area – 4: Agricultural Extension and Rural Development**

- Evaluation of on-going extension approaches in PNG and their effectiveness in rural livelihood improvement
- Problems and prospects of retaining youth in agriculture in PNG
- Identifying the present farming systems in different regions of PNG and scope for improvement
- Examining household food security in peri-urban settlements
- Livelihoods of settlers in peri-urban settlements
- Return from Investment in Higher Education, Extension and Innovations
- Entrepreneurship Development among Rural People
- Women in Agriculture for Food Security
- Diffusion of Agricultural Innovations among Rural Community

#### **Research Focus Area – 5: Post-Harvest Technology**

- Survey on current status of mechanization in PNG: impact study of mechanisation on rural livelihood and environment
- Development of post-harvest technology and post-harvest management systems for horticultural crops in PNG

#### **EXTERNALLY FUNDED RESEARCH PROJECTS/ COLLABORATIONS**

1. SARDI Project: Enhancing role of small scale feed milling in the development of the monogastric industries in Papua New Guinea (<http://aciarc.gov.au/project/ASEM/2010/053>). A four-year project amounting A\$ 798,863.00 with partners: South Australian Research and Development Institute (SARDI), NARI, CLTC Banz, Livestock Dev Corp).

2. Transformative Agriculture and Development in Papua New Guinea (TADEP): The TADEP project comprises of other ACIAR-funded projects which includes Bougainville Cocoa

(HORT/2014/099), Canarium (FST/2014/099), Sweetpotato (HORT/2014/099), Women's Business acumen (ASEM/2014/095), and PNG Cocoa (HORT/2014/096).

3. ACIAR (HORT/2015/087): Sweetpotato Crop Protection project: The Sweetpotato crop protection project is a five-year project and is focused on sweetpotato weevils in PNG. It is collaboration between Charles Sturt University, University of Southern Queensland, Unitech, NARI and FPDA.

4. ACIAR (ASEM/2014/095): Improving Opportunities for Economic Development for Women Small Holders in Rural Papua New Guinea. This is a four-year project under ACIAR funding. The collaborating institutions include University of Canberra, Pacific Adventist University, TADEP/ACIAR, NARI, FPDA, and an NGO– Baptist Union of PNG.

5. Early Learning Project, The Early Childhood Education and Learning project is collaboration between University of Canberra and the Pacific Adventist University under the ACIAR funding. Unitech's Agriculture Department is involved in producing smallholder agriculture-based modules for teaching trainee teachers for lower and upper primary school learning. This project is also tied to the TADEP project above.

## **LIST OF PUBLICATIONS**

### **Peer-reviewed Journal Articles/ Books**

Alepa, R. and Rajashekhar Rao, B.K. (2016). Land use change from rainforests to oil palm plantations and food gardens in Papua New Guinea: Effects on soil properties and S fractions. *Journal of Agriculture and Rural Development in the Tropics and Subtropics* 117 (2), 335-343.

Dotaona, R., Wilson, B. A. L., Stevens, M. M., Holloway, J. and Ash G. J. (2015). Screening of tropical isolates of *Metarhizium anisopliae* (Hypocreales: Clavicipitaceae) for virulence to the

sweetpotato weevil, *Cylas formicarius* (Coleoptera: Brentidae). *International Journal of Tropical Insect Science*, 35(4): 153-163. doi:10.1017/S1742758415000211.

Dotaona, R., Wilson B. A. L., Stevens, M. M., Holloway, J. and Ash G. J. (2017). Chronic effects and horizontal transmission of *Metarhizium anisopliae* strain of QS155 infection in the sweetpotato weevil, *Cylas formicarius* (Fab.) (Coleoptera: Brentidae). *Biological Control*, 114: 24-29. doi:10.1016/j.biocontrol.2017.07.008.

Kapia, S., Rajashekhar Rao, B.K. and Sakulas, H. (2016). Assessment of heavy metal pollution risks in the Yonki Reservoir environmental matrices affected by the gold mining activity. *Environmental Monitoring and Assessment*, 188, 586. DOI: 10.1007/s10661-016-5604-9.

Kerua, W. and Glyde, S. (2016). Beyond the cocoa farm: a new look at farmers' choices in livelihood activities and impact on productivity in selected areas of Papua New Guinea, *Rural Extension & Innovation Systems Journal* 12 (1), 1-11.

Manus, P. (2016). Economic efficiency of smallholder peanut farming: An application of data envelopment analysis to smallholder producers in Markham valley of Papua New Guinea. *South Pacific Studies* 37, 9-20.

Maino, M. and S. Akanda (2015). Suitability of four tomato varieties as hosts for Papua New Guinea isolates of root-knot nematode, *Meloidogyne incognita*. *Niugini Agrisaiens*, Vol 5: 1-9 (Not included in 2015 Report)

Michael, P. S., Fitzpatrick, R. and Reid, R. (2016). The importance of soil carbon and nitrogen in amelioration of acid sulphate soils. *Soil Use and Management* 32, 97-105.

Maino, M. and Akanda, S. (2016). Occurrence of *Meloidogyne incognita* in sweetpotato gardens in the lowland provinces of Papua New Guinea. *Niugini Agrisaiens* (Under review).

Maino, M. and Akanda, S. (2016). Screening of 64 lowland sweetpotato varieties from Papua New Guinea against root-knot nematode, *Meloidogyne incognita* in the greenhouse. *Niugini Agrisaiens* (Under review).

Bogan, B. and Manus, P. (2016). Factors influencing marketing costs and margins of smallholder sweetpotato in two major distribution centres in PNG. *Niugini Agrisaiens* (Under review).

## Unitech Research Seminar Presentation for 2016

Jayaprakash (2016). Prevalence of *Salmonella* and *Campylobacter* spp. in chicken in PNG

Esechie, H. (2016). Potential Use of Oilfield Water in Agriculture

## POSTGRADUATE STUDENTS' RESEARCH

Table 1. Research conducted by postgraduate students under the supervision of Departmental staff, 2016

Student	Research topic	Funding source	Supervisor
<b>M.Sc.Ag Program</b>			
Malcolm KABIWAGA	Assessing the extent of genetic diversity of wild rice in Papua New Guinea	GAP	Dr. T Okpul
Aloma MOTAMOTA	Morphological and molecular characterisation of <i>Colletotrichum</i> spp. causing anthracnose on <i>Dioscorea alata</i> (true yam) in PNG	GAP	Dr. M Maino
Melanie PITIKI	Isolation and identification of endemic fungal pathogen of Eaglewood	GAP	Dr. M Maino/ Dr T Okpul
Zina BIRD	Assessing the dietary patterns of households in West Taraka peri-urban settlement in Lae, Papua New Guinea	BULA	Dr. V Bue
Priscilla POLONA	Broiler production by smallholders in Eastern Highlands Province of Papua New Guinea	GAP	Dr. K Elahi
Magero NURIE	Effects of indigenous strains of <i>Metarhizium anisopliae</i> (Metschnikoff) Sorokin on sweet	GAP	Dr Dotaona



	potato weevil, <i>Cylas formicarius</i> (Coleoptera:Brentidae) and West Indian sweet potato weevil, <i>Euscepes batatae</i> (Fairmaire [Coleoptera Curculionidae])		
Peninah JACOB	Effect of feeding crushed grain sorghum and grass mixtures on digestibility, growth and feed conversion efficiency of goats in Papua New Guinea	Trukai	Prof. Danbaro
Murphy NOMI	Validation of a Nitrogen (N) dilution curve in sweet potato ( <i>Ipomea batatas</i> . L) crop	Self	Dr Rao
Naomi BATAISARISARI	Economics of taro production in Taveuni Island, Fiji.	BULA	Dr Manus
<b>M. Phil Program in Agriculture</b>			
Rokotamana VITINAQAILEVU	Cocoa pod husk composting – Quantification of N loss and effect of amendments	BULA	Dr. R. Rao
Brian TAKOBOY	Symbiotic bacteria as alternative biocontrol against Cocoa Pod Borer (CPB) <i>Canopomorpha cramerella</i>	ESPGovt	Dr. M Maino
Burie BOGAN	Factors affecting demand and marketing costs and margins of sweet potato in two major distribution centres in PNG	Trukai	Dr. P Manus
Obert LOU	Assessment of feed digestibility, feed intake, and body weight gain of goats fed <i>Leuceanae leucocephala</i> forage mixed with three common pasture species in Papua New Guinea	Unitech (LNSDC)	Prof. G Danbaro
John RIWASINO	Monitoring and evaluating the effects of agribusiness entrepreneurship in Papua New Guinea: <i>Farmer's opinion and decision about tree farming on their customary land in</i>	Self	Mr Kerua & Dr Manus

	<i>Markham Valley, Morobhe Province</i>		
Elizabeth OWA	Agricultural innovations adopted by women and its impact on household food security in selected villages in Jiwaka Province, Papua New Guinea	ACIAR	Dr Bue
William NANO	Performance and evaluation of peer education learning in animal feed production for women in selected rural areas in the Jiwaka Province of PNG	ACIAR	Mr Kerua

## FINAL YEAR UNDERGRADUATE STUDENTS' RESEARCH PROJECTS

Table 2. Research work undertaken by fourth-year BSAG students as a partial fulfilment of the Bachelor's degree program

#	Name	Supervisor	Title of the research project
1	Paul Skeeta	Prof. Akanda	Screening of Trukai rice varieties against sheath blight of rice ( <i>R. solani</i> )
2	Titus Renalie	Prof. Akanda	Effect of <i>Trichoderma harzianum</i> on the soil borne tomato disease at Unitech farm
3	Billy Kaski	Dr. Patrick	Micropropagation of <i>Moringa olifera</i> using callus culture <i>in vitro</i>
4	Anos Willie	Dr. Patrick	Production practices of Abika by farmers in Nasuwapum of Wamper LLG in Huon Gulf District of MP
5	Bruce Joe	Dr. Patrick	Effect of salinity on the growth and biomass production of the NARI released rice varieties
6	Chawan Peter	Dr. Maino	Molecular Identification of Four Major Species of Root-knot Nematode, <i>Meloidogyne</i> spp
7	Leo Leonnie	Dr. Maino	Identification of Expressed Genes of <i>Trichoderma harzianum</i> used against <i>Colletotrichum gloeosporioides</i>
8	Ricky Serah	Dr. Maino	Mycoparasitic activity of entomopathogenic bacteria
9	Eki Tracey	Dr. Okpul	Standardization of <i>in vitro</i> propagation of potato ( <i>Solanum tuberosum</i> ) microtuber
10	Fale Eddie	Dr. Okpul	Investigating induction of tetraploids in taro
11	Mark Warendo	Dr. Okpul	Standardization of plant regeneration protocol for taro
12	Tohora Brendan	Dr. Okpul	Investigating induction of mutation in taro using mutagenic agents
13	Eremuge Rita	Dr. Elahi	Economics of world oil palm industry- production, consumption and trade
14	Namu Charlene	Dr. Elahi	Economics of oil palm plantation in PNG: A study of fresh fruit bunch pricing (FFB) policy in Hoskins, West New Britain
15	Gabriel Flemin	Dr. Rao	Evaluation of respiration rate of enriched cocoa pod husk composts as a maturity index

16	Jessie Paragum	Dr. Rao	Impacts of Glyphosphate herbicide on the population of soil nematodes
17	Towo Giru	Dr. Rao	Effects of some selected chemical enrichments on the decomposition rates of cocoa pod husk
18	Jamepa Arneth	Dr. Ronnie	Effects of natural-occurring EPF on scolytid beetles, a vector of black pod disease in cocoa
19	Maiga Gerega	Dr. Ronnie	Isolation and identification of entomopathogenic fungi (EPF) in Morobe soils
20	Roy Solomon	Dr. Ronnie	Olfactory response to <i>Euscepe postfasciafus</i> to barrier plant -Lemon grass
21	June Kaminiel	Mr. Vidinamo	To assess the mechanical damage of Tomato ( <i>Solanum lycopersicum</i> )
22	Uvire Sanah	Mr. Vidinamo	Prediction of soil loss using USLE at Unitech farm
23	Ottie Givax	Mr. Vidinamo	Constraints faced by women in entrepreneurship development in Avani, Eastren Highland Province.
24	Kaso Floyd	Dr. Bue	Perceptions of highland farmers and Lae urban consumers towards the ban of certain imported vegetables
25	Korowa Jopath	Dr. Bue	Problems faced by women broccoli and tomato farmers in selling their products at the Lae Market
26	Poning Louise	Dr. Bue	Evaluating participation of women in small holder coffee production in a selected village in Bonana LLG, MP
27	Parau Tabitha	Dr. Bue	Duckweed as a major feed source in choice feeding of Tilapia fish grow-out
28	Kekele Valentine	Mr. Nano	The use of animal and plants waste (by-products) in Biogas (Methane Gas) production: A study in the laboratory conditions
29	Kunda Dini	Mr. Nano	Cocoa pod waste as a chicken and pig feeds: the use of food waste as a sustainable raw material
30	Wambie Stephanie	Mr. Nano	Assessment of sustainability practices on beef cattle farms in the Markham valley
31	Smith Joel	Prof. Danbaro	Assessment of sustainability practices on beef cattle farms in the Markham Valley (Erap).

32	Willie Peilyn	Prof. Danbaro	Environmental factors affecting milk yield of Holstein-Friesian cattle on EBC farm
33	Job Mark	Mr. Kei	Screening the susceptibility of 20 MUIB variety against sweet potato weevil
34	Baine Kewane	Mr. Kei	Using barriers as IPM for sweet potato weevil/ west Indian weevil in PNG
35	Joe Israel	Mr. Kei	
36	Philrock Inny	Mr. Kei	Assessing the infestation of Cocoa Pod Borer at UNITECH cocoa block
37	Peter Fedrick	Dr. Manus	A gross margin analysis for livestock production
36	Mesmin Jemimah	Dr. Manus	A gross margin analysis of live-stock production performances at Unitech-agriculture farm.
37	Mulungu Elly	Dr Manus	Performance of the Agriculture Farm: An Analysis of the Influence of Teaching and Research Activities on Income Generation
38	Fuapla Augusta	Dr Jayaprakash	Energy content of some commonly used feed
39	Selmatin Loretha	Dr Jayaprakash	Digestibility of pasture grass at Unitech Agriculture farm for sheep/goat

## **DEPARTMENT OF APPLIED PHYSICS**

**Head of Department: Dr. Gabriel Anduwan**

The Department of Applied Physics is relatively small in terms of building but the department served a lot of students just like other service departments. We have two courses running; the Bachelor of Science in Applied Physics with Electronics and Instrumentation and Bachelor of Science in Radiation Therapy. These two courses are completely different in terms of the course structures. On top of these courses are the service courses that the department offers to 10 out of 13 departments in this University.

The Applied Physics course with electronics and Instrumentation with more emphasis on the principles of application to Physics are imparted to students. The students are grounded with analytical skills and all the application to Physics principles. The graduates of Applied Physics students are working all over the country and few overseas. They work in any work related to Physics. Some are working in the Airline industry; education, mining industry, PNG Power and even some are doing private consultancy work. However, Radiation Therapy is a specialized field that deals with cancer treatment which is run by our department in collaboration with Angau Hospital. At the completion of the course, the students are expected to work with the Health Department.

### **1. Unitech Research Seminar Presentations**

- i) Bound States and Worldline Formalism by Dr Ravindra Thakur

### **2. Research Publications**

1. Chinh Tam Le, Daniel J. Clark, Farman Ullah, Velusamy Senthilkumar, Joon I. Jang, Yumin Sim, Maeng-Je Seong, Koo-Hyun Chung, Hyoyeol Park, and Yong Soo Kim. (2016). Nonlinear optical characteristics of monolayer MoSe<sub>2</sub>. *Ann. Phys. (Berlin)*, Wiley Online Library (United States), 551–559.

2. Han Gyeol Park, Tae Jung Kim, Hwa Seob Kim, Chang Hyun Yoo, Nilesh S. Barange, Van Long Le, Hyoung Uk Kim, Velusamy Senthilkumar, Chinh Tam Le, Yong Soo Kim, Maeng-Je Seong & Young Dong Kim (2016). Temperature Dependence of the Critical Points of Monolayer MoS<sub>2</sub> by Ellipsometry. *Applied Spectroscopy Reviews*, 7-9.
3. Nhu Thuy Ho , Huynh Ngoc Tien , Se-Jeong Jang , Velusamy Senthilkumar, Yun Chang Park , Shinuk Cho, Y.S. Kim. (2016). Enhancement of recombination process using silver and graphene quantum dot embedded Intermediate Layer for Efficient Organic Tandem Cells, Scientific Reports. *Scientific Reports*, 6: 30327. Nature Publishing group (United Kingdom).
4. Pereira, B. Felix; Philip, Bijoy John and Girish, T. E. (2016). On the nature of IMF polarity dependent asymmetries in solar wind plasma properties during the minimum of sunspot cycles 23 and 24. *Journal of Atmospheric and Solar-Terrestrial Physics*, Volume 140: 34-40. DOI: 10.1016/j.jastp.2016.01.009
5. Senthilkumar, V., Firoz Babu Kadumudi, Nhu Thuy Ho, Ji-Woong Kim, Sungkyun Park, Jong-Seong Bae, Won Mook Choi, Shinuk Cho and Yong Soo Kim (2016). NiO Nanoarrays of Few Atom Thickness on 3D Nickel Network with Enhanced Pseudocapacitive Electrode Applications. *Journal of power sources*, 363-371, 2016.
6. Ullah, F., V. Senthilkumar, S.-H. Kim, D. Y. Lee and S. Park and Y. S. Kim. (2016). Continuous Large Area Few Layers MoS<sub>2</sub> Films by Pulsed Laser Deposition and Effect of Annealing in Sulfur Environment. *Journal of Nanoscience and Nanotechnology*, American Scientific Publishers (United States), 10284-10289.

### **3. Conference Papers**

1. Tunable second harmonic generation of monolayer MoS<sub>2</sub> by Se doping.  
CT Le, DJ Clark, **V Senthilkumar**, JI Jang, H-Y Cho, YS Kim  
*American Physical Society (APS)*, March Meeting 2016.
2. Design and development of Solar Enhanced Comfort Cooling Equipment for Commercial and Industrial Buildings in Tropical and ACP (African, Caribbean and Pacific) countries.  
**O. Renagi, G. Anduwan, D. Olatona**, M. Iruna, G. Sapi, G. Kore, R. Lovo, and L. Fontenu.  
*Regional Renewable Energy Stakeholder Conference* (University of Fiji; 7<sup>th</sup> Oct 2016).



## DEPARTMENT OF APPLIED SCIENCES

**Head of Department: Dr. Janarthanan Gopalakrishnan**

### Introduction

The Department functions with two sections: Applied Chemistry and Food Technology. Food Technology courses are only offered in PNG University of Technology in the whole of the South Pacific (except Australia and New Zealand). Our department, based on the current market scenario and other developments, keeps track on the curriculum, and suitable changes and revisions to the curriculum were done in the past. The department also embarked into balancing the total credits, as much as possible, so that the students undergo a smooth teaching-learning process. The research activities of the two sections are provided below.

### Research interests: Applied Chemistry Section

No.	Name	Research interests
1	Dr. Janarthanan Gopalakrishnan	Synthetic inorganic chemistry, organophosphorus chemistry, coordination chemistry of selected N-based ligands, inorganic chemistry in traditional practices
2	Prof. Subramaniyam Gopalakrishnan	Synthetic organic chemistry, medicinal chemistry, nanotechnology, food chemistry
3	Dr. Srikanth Bathula	
4	Mr. David Timi	Organic chemistry, phytochemistry
5	Mr. Justin Narimbi	Analytical chemistry, environmental chemistry, instrumental methods for analysis
6	Mr. Jayson Wau	Organic chemistry, phytochemistry
7	Mrs. Sandy Puy	Analytical chemistry, environmental chemistry

### Research interests: Food Technology Section

No.	Name	Research interests
1	Mr. Reilly Nigo	Renewable and Clean Energy, Animal Feed Development, Thermal Processing, Food Drying studies
2	Dr. Lydia Yalambing	Food nutrition
3	Ms. Elizabeth Nasing	Antimicrobial Studies in Foods – Food Safety & Therapeutic Uses, Food microbiology – Water Safety, food safety, Antioxidants – Public Health/Food Safety, Product Development
4	Mrs. Sogoing Denano	Food safety and food security; compliance studies

5	Mr. Zeipi Toksy	Food chemistry
6	Mr. Nigel Kiaka	Industrial solid and liquid waste management
7	Mrs. Rag Gubag-Sipou	Food microbiology

### **Research Output: Peer Reviewed Journals**

1. Gopalakrishnan, J., Swarnalatha, U. and M.N.S. Rao, M. N. S. (2016). Halogenation reactions of phosphiniminocyclotrithiazenes: search for new inorganic heterocycles., *Synth. React. Inorg. Met.-Org. Nano-Met. Chem.*, 46(9), 1324-1331
2. Gopalakrishnan, J. (2016). A deep analysis on widely used condensation route for preparing aminophosphines: synthesis and spectral characterization of an aminobis (chlorophosphine),  $(NC_4H_8N)[P(i-Pr_2N)Cl]_2$ , *Synth. React. Inorg. Met.-Org. Nano-Met. Chem.*, 46(9), 1336-1343

### **Research Projects**

1. **Studies on simple and cost-effective water purification methods using plant products: studies with tuber products** [funded by PNGUoT Research Committee] - undertaken by Mr. Kaupa Philip for M.Phil. degree under Graduate Assistantship Program (Feb '15 to Dec '16). Principal supervisor: Dr. J. Gopalakrishnan. Completed and the student was awarded with M.Phil. degree during Apr 2017 graduation.
2. **Studies on Health and Medical Conditions Related to Environmental Effects of Volcano Affected Areas of East New Britain Province of Papua New Guinea** – undertaken by Ms. Kundo Hundang for Ph.D. degree under self-sponsorship (since Feb '15). Principal supervisor: Dr. J. Gopalakrishnan. Study is underway and few samples were collected from various identified zones in ENB Province and Cd analysis on progress. General survey was also carried out in various places around the volcano (Mt. Tauruvur).
3. **Biological assessment of phytosynthesized silver nanoparticles** [funded by PNGUoT Research Committee, LNSDC and the Department of Applied Sciences] – Undertaken by Mr. David Timi for Ph.D. degree. All the experimental work on the malaria component and nematode control studies were completed. The rest of the components are in progress and about to complete. The characterization of silver nanoparticles will be sent to India

during first week of July 2017. The thesis is expected to be submitted by end of 2017 / beginning of 2018.

4. **Extracting and assessment of coconut oil using mannan degrading enzymes from the crop of *Achantina fulcia*** [funded by LNSDC] – Undertaken by Mr. Zeipi Toksy for M.Phil. degree. The research funding was allotted in semester 1- 2017. The extraction of enzymes from snails is completed. The rest of the work is in progress and expecting to complete the laboratory work by the end of this year 2017.
5. **Synthesis, characterization and anti-tuberculosis activity of antimicrobial agents of selected medicinal plants** – undertaken by Mr. Tata Telawika for M.Phil. degree under self-sponsorship. Registered in 2017 and literature studies are being carried out.
6. **Renewable and Clean Energy: Biogas Development from Household and Market wastes** - Funded by the Department of Applied Sciences. Principal investigator: Mr. R. Nigo. A prototype design has been completed with safety features and gas burners have been modified and tested with promising performance. Currently gas production profiles of different animal and food wastes are being worked out. The project has some promising impacts of livelihoods of both rural and urban communities on clean energy, reduction of population and boost of agricultural activities through high grade liquid organic fertilizers through the digested sludge from the biogas.
7. **Renewable and Clean Energy: Bioethanol production from cocoa pod wastes-** The project is funded by the Department of Applied Science. Principal investigator: Mr. R. Nigo. Cocoa is the third largest agricultural export commodity in PNG which generates a lot of cocoa wastes through the pods after the bean has been removed for fermentation and drying. Preliminary research has shown that the cocoa wastes can yield up to around 20% alcohol from the mucilage which can be used as fuel for both power generation and cooking. The work currently is focusing on using the bioethanol produced to run load test using different alcohol-gasoline ratios to run petrol engine generators.

8. **NFA–Unitech – Laboratory Accreditation** – Project leader: Mr. R. Nigo. Around K3.5 million has been allocated to this project. Through the NFA funded the Department of Applied Sciences Building has been fully renovated. Several equipment worth more than K2 million has been purchased. Preliminary accreditation work is in good progress and targeting August 2017 to complete histamine test accreditation procedure for the new National Food Testing and monitoring Centre (NFTMC).
  
9. **Food Safety Courses / Training for Industries** – Coordinator: Mr. R. Nigo. This is a program running in three stages annually. Conducted by the senior Food Technology staff of the department (Mr. R. Nigo, Mrs. R.G. Sipou, Mrs. S. Denano, Ms. E. Nasing, Mr. Z. Toksy and Dr. L. Yalaming). The team has written modules and delivered training to various food Industries. The training is becoming popular in food and allied industries and government / semi-government organizations like NAQIA and Department of Health.

### Completed Projects (2016)

#### Applied Chemistry Section – research projects with final year students

No.	Student Name	Supervisor	Topic
1	ABEL Gideon	Dr. Harakuwe	Determination of the Carbon Content in Above Ground and Below Ground Components of <i>Arabica</i> coffee
2	ANDANO Mathew	Dr. Jana	Oxalate content in selected varieties of beans sold in Lae
3	APIO Anna	Mr. Wau	Studies on essential oil, Phase 2: Mathematical derivation and optimization of <i>Cymbopogon citratus</i> oil by juggling extraction <i>time</i> and <i>temperature</i>
4	BANGUI sixthus	Dr. Gopal	Phytochemical screening, studies on antimicrobial activities and efficacy of AgNps against nematodes under laboratory conditions using <i>Pittosporum</i> and <i>Smilux</i> .
5	BEBEUYO Flynn	Dr. Jana	Synthesis of acetylacetonato complexes of selected metals and attempts to convert them into metal phosphates
6	DOMINIC Peter	Dr. Gopal	Phytochemical screening, comparison of antimicrobial activities and antifungal activities between extract by boiling and homogenous method using <i>Ficus Wasa</i> and <i>Alpinia</i> .
7	HECKO Hazel	Mr. Narimbi	Formulation of an appropriate nutrient solution for hydroponic vegetable production of local variety of leafy vegetables
8	IGAG Augustine	Mr. Timi	Efficacy of phytosynthesized silver nanoparticles (AgNPs) against a fungal species of <i>Collectotrichum</i>
9	JOHN Mugu	Dr. Gopal	Phytochemical screening, studies on antimicrobial activities and efficacy of AgNps against nematodes under

			laboratory conditions using <i>Euodia</i> and <i>Mussaenda</i> .
10	KEDEA Emmanuel	Dr. Jana	Determination of anions present in the ash suspension obtained from Busiga
11	LEO Henry	Dr. Jana	Further studies on Rabaul Volcanic ash and analysis of selected constituents
12	MUGANG Manfred	Dr. Harakuwe	Studies on Phytoremediation: Spot testing for selected heavy metals in selected fern, <i>Arabica</i> coffee and <i>Robusta</i> coffee
13	MICHAEL Joyce	Mr. Narimbi	Evaluation of the heavy metal concentration of different canned fish sold in supermarkets in Lae City
14	NATHANIEL Eli	Mr. Wau	Preliminary: Chemical and microbial assessment of 'Wonderflush', a new disinfectant
15	PONGE Dasol	Dr. Gopal	Phytochemical screening, Comparison of antimicrobial activities and antifungal activities between extract and silvernanoparticles from <i>Antiaris</i> and <i>Epipremnum</i> .
16	PURINGI Kaysie	Mr. Wau	Pharmacological Studies on <i>Piper celtidiforme</i> Opiz. (PIPERACEAE). Phase 3: Optimization of separation parameters to isolate five alkaloids
17	RAGELOA Justin	Dr. Harakuwe	Environmental analysis: Country Statement on the Minamata Protocol
18	TATANG Stanis	Mr. Narimbi	Assessment of the concentration of metals(cadmium, chromium, iron & zinc) in makhsam and busu river system in morobe province.
19	WAPE Newman	Mr. Timi	Oil Content of PNG Noni: A Comparative Study
20	WINGA Donus	Mr. Wau	Studies on <i>Morinda citrifolia</i> oil; Phase 3: Comparison of <i>Morinda citrifolia</i> "noni" oil A, B & C for FFA concentration, oxidation potential and unsaturation level
21	YAUBELA Ferguson	Mr. Narimbi	Identifying and characterising acid sulphate soils at the Lae port and neighbouring development sites.

**Food Technology Section – research projects with final year students**

No.	Student	Supervisor	Project Title
1	Anna Silata	Rag Gubag Sipou	Further work on the microbiological quality of Water/Cordial sold around Lae city.
2	David Sivi	Reilly Nigo	Further studies on second generation biofuel development from cocoa pod wastes.
3	Kirsty Peng	Reilly Nigo	Further studies on operation of mini digester for biogas production using household and farm wastes as an alternative for clean energy source in food processing.
4	Bianca Daveona	Reilly Nigo	Post-harvest packaging studies for cabbages.
5	Magaret Taule	Lydia Yalambing	Food fortification studies.
6	Nehemiah Pelis	Lydia Yalambing	Assessment of the nutritional quality and adequacy of meals provided in schools in Lae.
7	Elisha Parak	Sogoing Denano	Compliance studies – Develop pre-requisite programs for Lae Biscuit Company.

8	Bobby Kessie	Reilly Nigo and Elizebeth Nasing	Further studies on food product development and safety studies on molasses: Ramu Agro Industries.
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**Unitech Research Seminar Series Presentation**

1. **Justin Narimbi.** Identifying Tilapia (*O. niloticus*) diets in fertilized pond-based aquaculture in PNG using stable isotope analysis (October 2016)

## DEPARTMENT OF ARCHITECTURE AND BUILDING

**Acting Head of Department: Mr. Daniel Wasi**

Research interest for the staff members from the Architecture and Building Department are as follows;

<b>Academic Staff</b>	<b>Research Interest</b>
Daniel Wasi <i>Principal Technical Instructor &amp; Acting HOD</i>	<ol style="list-style-type: none"> <li>1. Building Construction Waste in Papua New Guinea</li> <li>2. Motivation and Performance of Indigenous Contractors.</li> <li>3. Small National Contractors Management skill development</li> <li>4. Safety and Cultural obligation of Small National Contractors</li> <li>5. Motivation and Productivity of Small National Contractors</li> </ol>
Professor C Gonduan <i>Architecture Course Director</i>	<ol style="list-style-type: none"> <li>1. User Behavior in Institution Housing: a periodic observation and assessment of indigenous user behavior in PNGUOT housing.</li> <li>2. Environmental Stress: An assessment of the built environment wear and tear in response to user overload.</li> <li>3. Shifting Cultural Influence in Domestic Architecture Design in Indigenous Environments and Societies</li> <li>4. Bamboo Ply as alternative Building Material in Rural PNG.</li> </ol>
Dr. Andrew Sariman <i>Senior Lecturer</i>	<ol style="list-style-type: none"> <li>1. Thermal Performance of UNITECH Housing</li> <li>2. Design Faults in Existing Housing</li> <li>3. Climatic Data for Architects in Papua New Guinea</li> <li>4. Effectiveness of Shading Devices</li> <li>5. Design Studio Learning</li> <li>6. Thermal Performance Comparison Between Steel Metal and Traditional Thatched Roofs</li> <li>7. Quality of Concrete Masonry Block Manufactured from Sand Obtained from Sea Shore around Papua New Guinea</li> <li>8. Building Energy Studies</li> </ol>
Ali Bou <i>Principal Tech Instructor</i>	<ol style="list-style-type: none"> <li>1. Natural Preservation of Wooden Marine House Pile for Coastal PNG</li> <li>2. Convenient Roofing for Rural PNG</li> <li>3. Mangrove Farming: Future Sustenance for Coastal Rural PNG</li> <li>4. Convenient Flush Toilet for Coastal Rural PNG</li> </ol>
Mathew Pomoso	Lecturer currently undertaking his Masters in Management



Senior Technical Instructor	on distant mode with the University of Natural resources and Environment
Magdelyne Kuluwah Technical Instructor	With no teaching experience (Have been in the industry for more than 10 years), staff needs time to improve her delivery of lecturers and assessment of student and work, before she can undertake any research

### **Conference Attendance 2016**

No staff attended any conference in 2016, given the shorten semester and the shortage of staff, lecturers were busy in the delivery of lectures.

### **List of Publication**

There are no staff publications in 2016, due to heavy teaching load. With the death of a staff member, shortened semester and the student's unrest, this had an effect on staff producing publications.

### **Students Research**

Below are list of research undertaken by students of the Department of Architecture and Building in 2016.

<b>Student Name</b>	<b>Topic</b>
Chris Kiapin	Factors affecting effective delivery of government projects in Manus
Igob Isembo	Construction and Demolition waste management in PNG
Raphael Bogg	Affordable housing strategies for low and medium income earners in PNG
Godfred Muriki	Risk management techniques for construction projects in PNG

## **DEPARTMENT OF BUSINESS STUDIES**

**Head of Department: Professor Zhaohao Sun**

### **Introduction**

Department of Business Studies (DBS) is the largest Department of the thirteen academic departments at the UNITECH with approximately 600 undergraduate and postgraduate enrolments every year. It is a multidisciplinary Department with proven track records for producing national and Pacific regional leaders and beyond. Our alumni have led PNG's industrial and governmental sectors for decades.

The programs within the DBS make our students easier to build bridges between knowledge, skill and practice. The DBS offers undergraduate degree programs in Accounting, Applied Economics, Information Technology, and Management. It also offers postgraduate degree programs such as Master of Philosophy in Information Technology and an Executive Masters in Business Administration (EMBA) program. DBS is developing the comprehensive postgraduate programs including postgraduate diploma, masters and PhD studies in Accounting, Applied Economics, Information Technology, and Management.

The DBS has a research centre of big data analytics and intelligent systems with active international cooperation. It is building a PNG –China Centre of Business Studies and a PNG-Australia Centre of Governance and Policy Development as well as a Centre of Innovation and Entrepreneurship.

Research across the four main disciplines represented in the DBS is encouraged: Economics, Management, Information Technology, and Accounting. The following research activities were undertaken by academic staff members in the DBS during 2016 Academic year: The report shows that 1. Comparing with 2015, the number of publications has increased from 6 to 14. The quality has been also dramatically increased. At least 8 of them have been indexed by SCOPUS or ERA or ISI (SCI). The main contributors for research outcome of DBS are four academic staff and a visiting professor. However, the majority of academic staff at DBS have no record of publications, nor attending national and international academic conferences, nor delivering any research seminar

presentations in the past three years (2014-2016). Therefore, how to activate the research passion of academic staff and increase outcome of quality research taking into account SCOPUS, ERA or Clarivate (JCR) (then ISI (SCI) is still a big challenge for DBS, because the research performance of academic staff is an important index for any international or national accreditation of undergraduate and postgraduate programs.

### **UNITECH Research Committee Seminar Presentation**

Dr Wise Mainga, Mr Reuben Maino Daniel & Dr Luis Alamil: Employability Skills of Business Studies Degree Students in PNG (15-03-16)

Dr. Zhaohao Sun: Big data, Analytics and Intelligence (08-11-16).

### **International Research Seminar Presentation**

Prof. Dr. Zhaohao Sun, Invited presentation on Big Data Analytics and Intelligent Systems at Hebei University of Science and Technology (30 Dec 2016)

### **DBS Research Seminar Presentations**

Dr Zhaohao Sun: Methodology of Publishing Academically for Academia (5 April, 16)

Dr Zhaohao Sun: How to use Microsoft Word to Develop a Journal Paper-1 (10 Aug 16)

### **List of Publications in 2016**

In 2016, DBS published 7 peer-reviewed international journal articles and 1 peer-reviewed international conference proceedings papers. Another was published in 2014 and not included until now.

### **Published Journal Articles**

Adimuthu, R. (2016). The Effects of Transformational and Transactional Leadership Style on Employee Voice and Empowerment; The International Journal of Business & Management (ISSN 2321-8916) 4(12): 118-123

Gomi, G. (2014) The Keynesian marginal propensity to consume: An application with respect to Papua New Guinea's Gross Domestic Product and Budget-expenditure, 1977-2014", *South Pacific Journal of Pure and Applied Mathematics*, Volume 02 No. 3 2014, ISSN 2308-295X, On-line 2308-4774, pages 84-103 (Not reported earlier reports).

Sun, Z. Sun, L, and Strang, K. (2016). Big Data Analytics Services for Enhancing Business Intelligence, *Journal of Computer Information Systems (JCIS)*, DOI:10.1080/08874417.2016.1220239, published online in October 2016 ERA A, SCOPUS, ISI

Sun, Z. (2016). A logical approach to experience-based reasoning, *Journal of New Mathematics and Natural Computation*. 12 (4): 1–20, DOI: 10.1142/S1793005716002939. ERA, SCOPUS

Sun, Z. (2016). A Framework for Developing Management Intelligent Systems. *International Journal of Systems and Service Oriented Engineering (IJSSOE)*. 6(1) :37-53. DOI: 10.4018/IJSSOE.2016010103. DBLP, ACM

Strang, K. and Sun, Z. (2016). Meta-Analysis of Big Data Security and Privacy: Scholarly Literature Gaps. *IEEE Big Data 2016*, Washington DC, USA. pp. 4035-4037. IEEE Press. ISI, SCOPUS

Thomas, P. and James, K. (2016). The Linkages, Persistence, Asymmetry in the Volatility and the Effect of the Us Subprime Mortgage Financial Crisis, on the Spot and the Futures Rate's Returns in the Indian Stock Market. *The Applied Economics*, "A" ranked journal of Routledge - Taylor and Francis 2016, 48(8): 669-683. SCOPUS, ISI, ERA

### **Working Papers**

The following 3 working papers have been published at ResearchGate ([https://www.researchgate.net/profile/Zhaohao\\_Sun](https://www.researchgate.net/profile/Zhaohao_Sun)) with DOIs.

Sun, Z. (2016). Natural Treatment of Hypertension and Diabetes Based on Big Data Analytics. BAIS No. 16001, DOI: 10.13140/RG.2.2.22681.01123. Research Centre of big data analytics and intelligent systems (BAIS), DBS

Sun, Z. (2016). Big Data, Analytics and Intelligence. BAIS No. 16002. DOI: 10.13140/RG.2.2.34807.62880. Research Centre of big data analytics and intelligent systems (BAIS), DBS

Sun, Z. (2016). Big Data Analytics and Intelligent Systems. BAIS No. 16003. DOI: 10.13140/RG.2.2.19708.13449. Research Centre of big data analytics and intelligent systems

(BAIS), DBS

### **National and International Engagement (Outreach)**

#### **Editing Journal & Other Research Activities**

Prof. Sun, Z. and Prof. Paul Wang of Duke University have edited a Special issue on big data analytics and intelligence in Journal of New Mathematics and Natural Computation (Scopus indexed journal), which has been published.

Prof Sun has been editing two special issues on Big Data, Service and Intelligence in IJSSOE and on Big Data Driven Risk and Contingency Management in IJRCM, respectively with Dr Dickson Chiu of University of Hong Kong, and Prof Kenneth Strong of State University of New York, USA.

Prof. Sun has been servicing on the Editorial Board of Journals

- Editor of Journal of New Mathematics and Natural Computation (<http://www.worldscientific.com/worldscinet/nmnc>).
- Associate editor of Journal of Intelligent and Fuzzy Systems
- Associate editor of International Journal of Systems and Service-Oriented Engineering (IJSSOE).
- Associate editor of International Journal of Business Intelligence Research (<http://www.igi-global.com/journal/international-journal-business-intelligence-research/1168>).
- Associate editor and Strategic Advisor of International Advisory Board (IAB) at International Journal of Risk and Contingency Management (IJRCM).
- Member of the Editorial Board of International Journal of u- and e- Service, Science and Technology (<http://www.sersc.org/journals/IJUNESST/>).

### **Visiting other Universities**

Prof Sun visited Hebei University of Science and Technology and delivered a research presentation, and worked with the colleagues effectively in December 2016.

### **Organizing International Conferences**

Prof Sun as a PC member or reviewer has been engaged in organizing the following conferences:

- CONFENIS 2016, Vienna, 13-14 December 2016, <https://shop.ocg.at/en/events/confenis2016.html>
- ICE-B 2016, ICE-B 2017 (<http://www.ice-b.icete.org>)

- ITS 2016, 7th International Conference on Internet Technologies & Society 2016, 6 - 8 December 2016, Melbourne, Australia, (<http://www.its-conf.org/>)
- 2016 IEEE International Conference on Systems, Man, and Cybernetics (SMC 2016)
- I3E 2016 IFIP Conference on e-Business, e-Services and e-Society, September 13 - 15, 2016 Wales, UK (<http://www.swansea.ac.uk/som/i3e2016/>)

## **DEPARTMENT OF CIVIL ENGINEERING**

**Acting Head of Department: Mr Chris Kobal**

Research interests for the staff members from the Civil Engineering Department are as follows:

**Chris A Kobal**, *Principal Technical Instructor and Acting Head of Department.*

### **Research Interests:**

1. **Coconut Timber** – as a structural material. Coconut timber is currently not included in the Timber Structures Design Code list of timber species available for use as a structural material for structural designers. The aim is to carry out tests on timber specimens.

Tests have been carried out on Bending/Flexural specimens and tension/Tensile specimens. The results are still to be analysed and reported.

2. **Solid Waste Management** – Domestic and Industrial Solid Waste. This has been expanded to include Recycling as an option for the Lae City, and Mining Waste treatment.

A two-year fulltime Master of Science (MSc) program has been approved by the Academic Board for implementation in 2017.

Solid waste is an ever-growing challenge and educating our Engineers and Scientists on the best practice for this is of paramount importance and urgency. This knowledge can then be passed onto the rest of the communities concerned

3. **Storm water**

Surface runoff from rain is disposed off through a series of drains to final storage in sinks, either in the ocean or in designated temporary storage.

- Lae experiences a high annual rainfall and most of the rain water goes to waste.

- Lae uses underground water for its water supply. The surface storm water can be redirected to replenish aquifers which will eventually and inevitably run dry as the demand for water increases with an ever expanding city.
- Surface runoff may also carry with it dangerous diseases (apart from other usual debris) and if unchecked can pose a health risk to the communities along its path. The water and debris needs to be treated and/or removed prior to release into storage – by (sand) filters?

**Dr Mirzi Betasolo**, *Senior Lecturer*

**Research Interest and Priorities**

**1. PAVEMENT & TRAFFIC**

**1.A GHG Monitoring in Lae City (Proposal made, need funding)**

GHG is a major pollutant air quality, as the 4-lane drive from Nadzab to Lae is in its realization, the increase of public and private vehicle will increase, thus will affect the quality of air that the population of Lae depends in the future.

**I.B INVESTIGATION OF EXISTING DRAINAGE SYSTEM IN LAE**

Lae city has the highest annual rainfall in Papua New Guinea hence the road networks in the city faces continuous deterioration. The Independence drive-way for example the drainage system is functioning well but after few years, the system cannot manage the flow of water causing the pavement and it supports to deteriorate.

The study will consider the flooding possibility of Lae city and what to do about it.

I.C Safe & Resilient City

I.D Urban Transport

I.E Sustainable Urban Land Use Planning

**2. WATER & WASTE WATER ENGINEERING - (WATER RESOURCES)**

**2.A DEVELOPMENT IMPACT ON GROUNDWATER RESOURCES IN LAE**



The development process of groundwater resources in Lae has led to a continuous depletion of its groundwater resources and contamination due to improper waste disposal. The unplanned, excessive pumping of groundwater in some areas caused a sharp decrease in groundwater storage and the lowering of the aquifer's potentiometric levels at that area while other areas are excessively untapped. Development activities will be hindered if the effects of these activities on the groundwater reservoir are not realized. In order to sustain the aquifer usefulness in the development process, the reservoir's natural balance must be re-established. Therefore, the need for multi-objective planning aiming at integrating Lae's full water resources capacity and water demands is of paramount importance.

The project will involve the investigation of pollution of reservoir, availability of reservoir, analysis of the sustainability and distribution of existing system.

- a. **Groundwater resources- on Going**
- b. Turbulent flow impact in rivers (proposed)

## **2.B PURIFICATION METHOD TO POLLUTED WATER SYSTEM**

Unitech sewage pond is the center of this investigation and to find out a method to purify the polluted water system that the sewage system produce. The Unitech sewage system exists very long and the system has not been upgraded since its development, thus the investigation is being sought.

## **2.C RAINWATER HARVESTING**

### **Rainwater Harvesting –on going**

## **2.D Designing Water Utility Reform**

## **3. MATERIAL & STRUCTURAL ENGINEERING**

### **3.A Structural Design and Performance of Reinforced RVA Structure**

Volcanic Ash has adverse geologic effect, however utilizing it for concrete structure was found to be meaningful. A structural design and performance investigation is necessary to validate its full utilization.

The project will involve in the investigation of the ash properties, mix design, its' possible use in the concrete structure as additive or can be used as concrete blocks and the

performance to varied environmental condition. The investigation will include reinforcing it for better structural performance.

- **RVA (Rabaul Volcanic Ash) Cement and fine aggregate –on going (need fund to prototype project)**
- **Fiber reinforced RVA concrete (for funding)**
- **Structural Design and Performance of Reinforced RVA Structure (on going, need funds)**
- **Axiomatic & Robust Design on structural RVA (on-going)**

### **3.B Utilization of waste wood planks**

The workshop of the Civil Engineering Department and the industry centers for timber utilization produces tons of waste wood planks. The utilization by laminating different planks of different species and using different adhesives, determination of spread rates, pressures and press times is being considered in the study. (In partnership with ACIAR)

#### **3.B.1 Utilization of waste wood straw**

The workshop of the Civil Engineering Department and the industry centers for timber utilization produces tons of waste wood straw. The utilization by laminating those straw to form boards by using different adhesives, pressures and press times is being considered in this study. (In partnership with ACIAR)

#### **3.B.2 PNG native forest sawn timber wood waste and residues-quantities, types and opportunities**

The workshop of the Civil Engineering Department and the industry centers for timber utilization produces tons of wood waste, and residues. The investigation aims to quantify, identify types of forest sawn timber and opportunities of engineered materials from those pressing issues. (In partnership with ACIAR)

#### **3.B.3 Review of wood durability and wood treatment**

PNG is mostly using wood products in the building construction industry. In this regard, review of wood species specification in particular address to design capability of structural timber member and the method of treatments made to those timbers is considered in this study. (In partnership with ACIAR)

### **3.C Utilization of plastic bottles, plastic waste materials as a building material**

The modern living produces tons of waste materials such as PET bottles, utilization of those for building construction is studied, thus reducing the production of waste thrown to second seven or the dumpsite of Lae, PNG.

### **3.D Utilization of local resources –**

- **Utilization of Areca (Betelnut) Husk for FRC- on going (need fund)**
- Timber technology –
- **structural strength of local timber (on-going)**
- Asphalt mix flexibility for the tropics (proposed)
- Recycling (on-going)

## **4. Energy Research & Climate Change**

### **4.A Energy Efficiency Design on Public Buildings (Unitech) on going need funding**

The study aims to improve efficiency of public buildings by modernizing or designing the public buildings that will conserve it energy use to minimize energy consumption. The project will help provide lightings and ventilation even during frequent blackout and high humidity of 73% in Lae, PNG.

### **4.B Waste to Energy (on-going)**

*Title of Project: Unitech Resource & Energy Recovery System (URERS) Facility: A Proposal*

## **5. Solid Waste Management**

- **Greening Civil - A campaign to mitigate Climate Change (on going)**
- **Lae City Second Seventh Landfill Rehabilitation (on going)**
- **Effects of chemical leakage from Lae dumpsites (on going)**
- **New Lae Dumpsites (on going)**

## 5. Engineering Education

- **Framework on Paradigm Shift Learning in Engineering Courses- ongoing**
- **Virtual Research Environment- on going**
- **LMS in Blended Learning for Engineering classes at Unitech- on going**

### 2016 List of Publications – Dr. Betasolo

#### **Presentations on Conferences**

with “-” (For Journal Publication: Global Journal of Civil Engineering & Proceeding at SSRN before the end of this year)

Ambraga, M., Fincham, R., Betasolo, M. (2016). **A comparative Evaluation of the Structural Performance of Papua New Guinea river gravel using the repeat load tri-axial (RLT) test performance based test.** Global Virtual Conference in Civil Engineering (GVCCE) 2016. 21-25 November 2016 Lae PNG. <http://gvcce2016.weebly.com/accepted-papers.html>

Betasolo, M., Lageo, A., Kasai, W., Kipit, W., Kathoa R and Kana, S. (2016). **Polypropylene Fiber Reinforced Autoclaved Concrete.** Global Virtual Conference in Civil Engineering (GVCCE). 21-25 November 2016 Lae PNG. <http://gvcce2016.weebly.com/accepted-papers.html>

Betasolo, M., Dromenge. A. (2016) **Strengthening Rabaul Volcanic Ash (RVA) Cement Properties.** Global Virtual Conference in Civil Engineering (GVCCE) 2016. 21-25 November 2016 Lae PNG. <http://gvcce2016.weebly.com/accepted-papers.html>

Betasolo, M., Patrick, N., Sampa, G., Foike, J. (2016) **Increase strength on RVA cement paste by Autoclave curing.** Global Virtual Conference in Civil Engineering (GVCCE) 2016. 21-25 November 2016 Lae PNG. <http://gvcce2016.weebly.com/accepted-papers.html>

Betasolo, M. (2016). **International Networking of Tertiary Educators- an online learning: The case of Ivanovo State University and the Papua New Guinea University of Technology.** Global Virtual Conference in Civil Engineering (GVCCE) 2016. 21-25 November 2016 Lae PNG. <http://gvcce2016.weebly.com/accepted-papers.html>

Betasolo, M. (2016) **Challenges & Future Direction in Teaching & Learning Engineering Courses.** Global Virtual Conference in Civil Engineering (GVCCE) 2016. 21-25 November 2016 Lae PNG. <http://gvcce2016.weebly.com/accepted-papers.html>

Betasolo, M., Sudani, K. (2016). **Assessment of Drainage System along Independence Drive of Lae City Papua New Guinea.** Global Virtual Conference in Civil Engineering (GVCCE) 2016. 21-25 November 2016 Lae PNG. <http://gvcce2016.weebly.com/accepted-papers.html>

Pikire, W., Betasolo, M. (2016) **Strength Characterization of Bolted Joints with spacers**. Global Virtual Conference in Civil Engineering (GVCCE) 2016. 21-25 November 2016 Lae PNG. <http://gvcce2016.weebly.com/accepted-papers.html>

Smith, C., Betasolo, M. (2016) **Proposed Policy for Sustainable Rainwater Harvesting (SRSH) in Papua New Guinea**. Global Virtual Conference in Civil Engineering (GVCCE) 2016. 21-25 November 2016 Lae PNG. <http://gvcce2016.weebly.com/accepted-papers.html> (For Journal Publication: Global Journal of Civil Engineering & Proceeding at SSRN)

#### **Published Documents:**

Betasolo, ML. (2016). **Culture-educational paradigm shift learning methodologies derived from axiomatic design principle**. Procedia CIRP. PROCIR4263, PII: S2212-8271(16)30924-6, DOI:10.1016/j.procir.2016.08.035 (listed in SCOPUS) [www.sciencedirect.com/science/article/pii/S2212827116309246](http://www.sciencedirect.com/science/article/pii/S2212827116309246)

Betasolo, ML., & Smith, C. (2016). **Axiomatic design process in developing a model prototype rainwater harvesting infrastructure**. J Procedia CIRP. PROCIR4276, PII: S2212827116309374, DOI:10.1016/j.procir.2016.09.004 (listed in SCOPUS) <http://www.sciencedirect.com/science/article/pii/S2212827116309374>

Betasolo, ML, & Nilova, S. (2016). **Personal endeavored professional development (PEPD) framework: an online-based professional development**. Tambovsky State University named after G.R. Derzhavin <http://www.tsutmb.ru/nauka/internet-konferencii/2016/lich-i-prof-razvitie-ped/8/betosolo.pdf>

#### **Conference Attended**

- **GVCCE 2016**  
21-25 November 2016  
Department of Civil Engineering, PNGUOT  
**Organizer/Presenter**
- **The 10<sup>th</sup> International Conference on Axiomatic Design**  
21-23 September 2016, X'ian China  
**Presenter:**
  - a) Culture-educational paradigm shift learning methodologies derived from axiomatic design principle
  - b) Axiomatic design process in developing a model prototype rainwater harvesting infrastructure

**Mr. Jedge Kasadimi**, *Technical Instructor (I)*

## **Research Interest**

1. **Urban/Region Development(Intercity)** – with Lae City being planned for expansion in the coming years, there is a Master Plan currently done by JICA. There is a need to come up with smaller detail plans to fit into this master plan, not within the city alone but nearby villages as well. I see there is much to do in terms of critical planning of how service providing systems/mechanisms can enhance the delivery of quality basic services and goods. Not only that but also to make these infrastructural developments sustainable and must sync with the entire province and or districts overall future development plan.
  - Currently a Project is ongoing into an area besides the university as a model area of study, this will be its 2nd year of rolling
  - Below are areas I intend to further my research into

**Proposed Road Management System, Computer Model** – A computer science graduate, Mr. Francis Kikile and I have come to agree to work on this research as is able to produce a model utilising infrastructure's design criterions however the design and data collections would have to be collected for by me in which I have planned to split into 2 general cases;

### **Case 1 – Lae's road network and infrastructures**

- i. Case study of the Lae City's Future Planning Strategies in line with the master Plan ( Collaboration with lae City Council)
- ii. Initiate a research and project for sustainable designing/planning of efficient delivery of macroeconomic activities utilising data accessed by the other Departments within the University, Lae City Council, DoW Lae, PNG Water, Lae, PNG Power Ltd, and relevant stakeholders.

**Case 2 – Provincial road network** - Will produce something bigger observing what has been done in case 1 (i) and (ii).

Preliminary research has already been done in terms of the programming part, only to make the research formal and to collect and feed data into the trial system. Also, I deem my interest shall be refined more in due course, based on resources and avenues available to me. the LCC has agreed to assist and have given copies of certain information already.

**3 Case study of designing a road built as a bridge with slabs on beams and on posts/abutments/columns for only a certain type of car.** Below are few reasons considered;

- a. Reduce the road and material cost
  - b. This suspended Road bridge is designed for 1 specific truck/car only and pedestrian to use
  - c. Reduce the traditional method machineries of road construction
  - d. Link areas so remote to the nearest road that will link to the main highway/intercity routes
  - e. Reduce the overall expense of labour and work of the actual construction works for standard gravel and or sealed roads.
4. Case study of **behavior of surface runoff** of small catchments within the Unitech students' lodges. Will identify area, origin and destination, time, frequency of rain, discharge, and infrastructure design criterion. This research interest will align with Mr. Kobal's research interest #3 and supplementing data to my student research of Uni block development plan, that is in progress currently.
5. **Unitech graduation/multi-purpose hall** - Research and Designing of a traditional style structure utilising modern day technology and materials. , fast to erect, spacious, open to any indoor activities, etc...

Just examples of natural structures

1. Turtle's shell
2. Umbrella/coconut

## **DEPARTMENT OF COMMUNICATION AND DEVELOPMENT STUDIES**

### **Head of Department: Dr Garry Sali**

As concerns *teaching activities*, the Department offers a 4-year professional program and has two sections: A Communication for Development (C4D) Studies and a service-course sequence in English for Academic Purposes (EAP) for students across all disciplines of the University; and, a professional program Communication for Development degree program to train liaison and community development and public relations officers for resource development companies, government departments and non-government organizations. It also presently administers the Postgraduate Certificate Course in Student-Centred Teaching for the further specialized training of academic staff at PNGUoT.

In 2009, the Department began offering a Masters in Communication Studies (MCS) program. This program has both a course work and a dissertation component, where the students write a research paper on an appropriate topic in the final semester of their second year. In addition, a Masters of Arts in Organizational Leadership is offered in Cooperation with Development Associates International (DAI), The Christian Leadership Training College of Papua New Guinea (CLTC), and the Pioneers of Australia. Furthermore, a growing PhD program is underway, with one graduate to date and another enrolled.

As concerns *research activities*, the Department of Communication and Development Studies at the Papua New Guinea University of Technology is a department that blends three broad academic strands (Language and Communication Studies, Sociology, and Communication for Development). Through its individual members of staff, research is conducted in under general umbrellas (Linguistics and Culture, English for Academic Purposes/EAP, English for Special Purposes/ESP, Sociology, and Communication for Development). General and sub-topics include:



In Linguistics and Culture, focus is given to PNG national languages, comparative linguistics, and the interface between society and language across time. In EAP or ESP, research topics include: classroom research, EAP/ESP methodology, course design, material design, genre analysis, rights analysis, critical EAP/ESP, reading and writing, testing and evaluation, computer-mediated language learning, EAP/ESP research, and socio-linguistic influences on the teaching and learning of EAP/ESP.

In the general area of Sociology, research foci include fieldwork, health, corrections, communication theory and practice, media studies, critical-cultural studies, and comparative higher education studies. Another thread is concerned with the problems of youth in society, especially on topics such as integration, sex education, and social behavior.

In the Communication for Development (C4D) area, the sub-topics of research interest include: communication in education, communication and gender, communication in resource management, conflict resolution, negotiation skills, partnership building, communicating development in such sectoral contexts as economic industries, healthcare, agriculture, and so forth. democracy and human rights, and HIV/AIDS.

Both empirical (quantitative) or qualitative approaches to relevant topics are employed by our academics, with trans-disciplinary innovations (such as action research) encouraged. The Department publishes a peer-reviewed organ, the *JCDS: Journal of Communication and Development Studies* in cooperation with the UNESCO Chair of Quality Management of Higher Education and Lifelong Learning of "Lucian Blaga" University of Sibiu, Romania.

The Department has the following academic staff. Their positions and research areas of interest are noted below, along with their research activities undertaken for the year.

**Name of the Faculty/Position/Research Interest**

<b>Name of the Faculty</b>	<b>Position</b>	<b>Research Interest</b>
<b>Dr Eric Gilder</b>	Professor	Higher education policy, scientific communication, technology and society, communication theory and practices across intercultural contexts, radio-TV history and legal aspects of broadcasting and the socio-psychological aspects of the communication process.
<b>Dr Golam S. Khan</b>	Professor	International migration, urbanization, health sociology, political economy, research methodology (qualitative) and family dynamics.
<b>Dr Garry Sali</b>	Associate Professor and Head of Department	Sociology of crime and deviance, prison systems, crime and development, and law and order problems in PNG.
<b>Dr Rachael Aisoli-Orake</b>	Senior Lecturer	English as a Second Language writing, Education/English curriculum and pedagogy, English for Academic Purposes, Cross-Cultural communication, development and responsibility and participatory research.
<b>Dr Apoi Yaraepa</b>	Senior Lecturer	Language documentation, discourse analysis, language education, production of learning materials for language at all levels (Elementary, Primary, Secondary and tertiary institutions), cross-cultural communication strategies, curriculum research, design, implementation and

		evaluation, English language development in PNG schools.
<b>Mary Kunenda Aisi</b>	Lecturer	Development communication, gender and leadership, and mass media.
<b>Imelda Ambelye</b> (on study leave 2015-2016)	Lecturer	Enrolled in PhD Program at James Cook University (JCU-SASS), Australia. Research Topic: “Environmental education and natural resource management in Papua New Guinea” (Simon Foale, Supervisor).
<b>Francis Essacu</b>	Lecturer	Education for sustainable development and communicating sustainable development.
<b>Joshua Frank Kuri</b>	Lecturer	Language development and practices via bilingual education; practices and effects of communication across developing societies.
<b>Sheryl S. Makara</b>	Lecturer	Emotional intelligence and leadership, critical thinking, communication in crime and sociology with relations to development, community development and participation.
<b>Wilma Molus</b>	Lecturer	Sociology of children, sociology of deviance and crime.
<b>Michael Winuan</b>	Lecturer	Enrolled in PhD Program. Research Topic: “Means by which agricultural messages are communicated to farmers: A case study of OPIC and small-holder oil palm out-growers at Buvussi and Sarakolok subdivisions in West New Britain Province” (Eric Gilder and Garry Sali, Supervisors).
<b>Rhonda Lakele Eva-Gwale</b>	Principal Technical Instructor	Information management, traditional knowledge, changing societies and gender issues.

		(Enrolled in Masters in Organizational Leadership (MAOL) Program)
<b>Ngawae Mitio</b>	Technical Instructor	Local community affairs/local governance.

## **Ongoing International Partnership Research Projects**

Molus, W. (2016). The Japanese Comfort Women and Sexual Slavery during the China and Pacific Wars Research Partnership: Department of Communication and Development Studies, PNG University of Technology and School of Global, Urban & Social Studies, Royal Melbourne Institute of Technology Australia.

Yarapea, A. (Coor.). Papua New Guinea languages documentation project – Partners: PNG University of Technology and USA Livingtongues Institute of Endangered Languages.

## **Publications:**

Essacu, F. (2016). A case study to establish insights into reasons and nature of conflicts in resource based development projects in Papua New Guinea. *Journals of International Understanding*, September 2017 (Vol. 43): 5-24, Japan.

Yarapea, A. (2016). Grammaticalization in Kewapi language of Papua New Guinea. *Journal of Language and Linguistics in Oceania* 8:56-63 (published by the Japanese Association of Linguistics in Oceania).

## **Presentations:**

Gilder, E. (2016). Where/who am I? The self-construing of an expatriate academic acting across global boundaries of function, role, and places. SRHE International Conference on Research into Higher Education, on the theme “Exploring Freedom and Control in global higher education”, Celtic Manor, Newport in South Wales, United Kingdom 7-9 December.

Gilder, E. & Eastman, S. (2016). USA elections: as America trump(ets) the world gets tinnitus. Institute of Political Science and International Relations, “Ion I. C. Brătianu” of the Romanian Academy, Bucharest, 11 July.

UNITECH Coordinator & Participant: Papua New Guinea languages documentation project – Partners: PNG University of Technology and USA Livingtongues Institute of Endangered Languages.

**PhD Thesis Accepted:**

Essacu, F. (2016). *Community level leadership and Development outcomes in rural Papua New Guinea: Evidences from three case study regions*. Unpublished PhD Thesis, Australian National University, Canberra, Australia.

**Doctor of Philosophy (in Communication Studies):**

Kehatsin, J.S. (2016). *Unlocking Conflicts in the Public Universities in Papua New Guinea*. Principal Supervisor: Dr Garry Sali.

**Masters in Communication Studies Graduates (Dissertation Titles):**

Kottson, R. (2016). *Using Effective Communication to address Learning Barriers at the UPNG Distance Learning Institutions: A case study of UPNG Open Colleges (Morobe, Kainantu and Mt. Hagen)*. Principal Supervisor: Dr Apoi Yaraepa.

Pilailo, W. (2016). *The Challenge of Preventing Violence against Women in Lae City: Communicating an Integrated Approach of engaging Men as Partners in the Prevention of Gender based Violence*. Principal Supervisor: Dr Garry Sali.

Sangundi, A. (2016). *A case study in Identifying factors that force Boys into the Streets of Lae City: A platform towards Developing an appropriate communication strategy in assisting Children in being responsible*. Principal Supervisor: Dr Rachel Aisoli-Orake.

**DEPARTMENT OF ELECTRICAL AND COMMUNICATION  
ENGINEERING**

**Head of Department: Dr Peter Kiss**

**Introduction**

Electrical and Communications, arguably, is the most interdisciplinary of all technical subjects at a University. It is found in almost every single discipline whether it is word processing and data mining, computer technology based surgery, detection of hostile face in a crowd through image processing, monitoring the soil property and fauna of a farmland/forest through multisensory network or in satellite monitoring of ocean, land use and abuse. Electrical and communication technology is used in the advanced systems of deep space technology. It may be used in a remote village to assist the villagers, nurses and doctors to identify disease from symptoms reported or logged in (using English or Pidgin) and the medicines to be prescribed from an intelligent off-line computer that rapidly mines and plays the role of the medical doctor in diagnosis and prescription. Connect a blood pressure measuring electronic device and a temperature measuring sensor to the computer, it becomes an “on line” computer in a village which can sometimes even do better than a medical doctor and a nurse for certain diseases if at the basic research level, the partnership between the medical doctor and engineer has produced a very intelligent diagnosing system. Energy Systems Analysis where an electrical engineer works together with those in natural, applied and social sciences can enable the government not only to effectively deploy energy resources, including renewable energy, but also to effectively plan and make policies regarding power generation and distribution and energy saving.

Since University of Technology is the premier University of Papua New Guinea in Technology, especially in the engineering disciplines, it is indeed pertinent that the research plan should aim at projecting and developing it as a leading institute in the Oceania, producing undergraduates that are competent to be top class engineers and leaders, able to position themselves as advisors and wealth generators for the community. Moreover, it is pertinent that that the University should generate new knowledge and new technology that is relevant to the local and national needs, including that which will take away dependence on hiring expertise from abroad but

make Papua New Guinean engineers and researchers as able to provide the needed technical and research expertise to attract foreign industries to invest in Papua New Guinea and produce a local job market and economic benefit to the nation. To be second class or lower in undergraduate and postgraduate education and research is to be perpetually dependent on expatriate expertise in engineering and research, with the local graduates and researchers being dependents and a burden until the national wealth is exhausted. Hence as a leading department in engineering our vision is set on producing undergraduates and postgraduates trained in state of the art technology and research techniques and findings that will make us as a department able to compete with the best of Universities in the Oceania, and, we hope one day, globally.

Teaching, Learning and Research and Innovation of a fast advancing engineering science and technology are the tasks that face the Electrical and Communication Engineering Department. Moreover, with the rapid decrease in the price of computer technology and electronic, electromagnetic sensors there are now more problems open to solutions by electrical and communication engineers within reasonable costs, an ability to manage large amount of data (large computer memory available in small chips) and at rapid speeds (faster microprocessor and communication speeds through light speed wireless and optical fibre systems).

An additional three priorities could be added when the Phase 2 (2017-2019) of the research plan is ready at the end of the first three years. One of the priorities for Phase 2 will be Sustainability where we project that about 70% of the full academic carder will be filled with national members of staff, of which a minimum of 80 % will have PhDs) and the rest with competitive expatriate members of staff expert in one of the ten specializations and able to work together giving significant research leadership in the global scenario.

Our basic commitments, in keeping with these priorities are:

1. A department that is fully integrated with Papua New Guinea industry and community, changing society and creating wealth.
2. Depth of quality and multidisciplinary in learning and applications through class room, laboratory and research programs which have measurable outcomes.
3. Research and Innovation work that is beneficial to the local community and contributes to knowledge and experience to international challenges in science and technology and their functions in society.

## **Vision**

Cutting edge teaching and research programs that are based on experimental based courses and high impact research Amongst the top 20 electrical communication /computer engineering-discipline departments in the electrical and communication engineering discipline in the Oceania at the end of next three years. Internationally recognized research and technical leader for Papua New Guinea, at the end of the three years, in two of the three major research clusters

## **Academic Priorities and Basic Commitments**

The major **academic priorities** for **phase one (2014-2016)** of the research plan was the following:

1. Integrate Research with Teaching and Learning
2. Local and national: connecting with the community
3. Recruitment of the best talents nationally and internationally – and retaining them.

## **Research within the Department in 2016**

	<b>Researcher's Name</b>	<b>Research Title</b>
1	Mr. Joshua Yuanko	Design of Smart Energy Control System for Palm Oil Production Plant Using FUZZY-PID
2	Mr. Lolong Karipinne Bonner	VSAT: Application in Student Learning/Development of Modulation Technique to Enhance Speed
3	Mr. Samy Aiau	Renewable Energy Sources for Morobe Province and future National Smart Grid for PNG
4	Mr. Joseph Fisher	Design and Protection of Aircraft against Severe Electric Storms: with special reference to increasing use of Carbon Composite Material in aircraft body
5	Dr. K. Pirapaharan Mr. H. Kunsei	Array antennas and signal processing for Underground Mine Telecommunication Systems
6	Dr. P. Kiss	The quality of power supply in PNG



**Description of the works:**

**1. Design of Smart Energy Control System for Palm Oil Production Plant Using FUZZY-PID**

This research ventures into an investigation on the art of modern control engineering and its applications that can be suitably utilized to establishing Smart Energy Control System in the Palm Oil Processing Industry in Papua New Guinea to improve efficiency of energy utilization in the production plants. While basing this research in the application of Control System, the Fuzzy Logic Control System (FLC) and Proportional plus Integral plus Derivative Controllers are the classes of control system that will be used to determine the design of an Ideal Energy Controller.

Since Fuzzy Logic Control System covers the application of classical control system and can define parameters of control system properly in situations where the application of later methods become ambiguous and ill defined, FLCS introduces a new strength that can be harnessed in the designs of better controllers. Knowledge of Classical methods of Analysing control system is very important in formulation of mathematical modelling in control systems and helps one to predict system behavior. By using fuzzy control system both closed loop system as well as other control subsystems that are ill defined by classical methods can be approximated with fuzzy logic reasoning methods based on expert experience and knowledge of the system. Since this involves impartation of expert's knowledge from human to Intelligent Controller, the Fuzzy Controller is closer in spirit to a human expert.

Three Dimensional Electric and flowcharts development, plant control system interaction design, plant data collection and mathematical (Qualitative and Quantitative) analysis, mathematical model formulation and Simulations. The mathematical model was constructed in MatLab and in Simulink simulation environments to determine the stability and ideal design parameters of the Smart Energy Controller with respect to applications of FLCS and PID.

**2. Renewable Energy Sources for Morobe Province and future National Smart Grid for PNG.**

In this work a study of renewable energy (RE) sources available in PNG with a focus on the Morobe Province is carried out, while mapping for Wind energy and Solar energy potential in the whole of Papua New Guinea is done. Following the identification and calculations of significant RE resources in certain areas, the work will design and optimize the connection of the RE sources not only to local town/village residences, but also to the main Ramu power grid, which is largely driven by hydroelectric power and increasingly by diesel generators.

### **3. Array Antennas and Signal processing for Underground Mine Telecommunication Systems.**

It is recognized that wireless communications in the underground mines will have advantages over the wired (e.g. using leaky wave cables) telecommunication systems currently used in underground mines including for the location and communication with miners trapped by tunnel collapse or explosions.

However, the underground mine presents a formidably harsh environment for space waves radiated by antennas. In this work a new design for array antennas is sought, with appropriate measurements of underground signal propagation measurements done to design against interference due to multiple reflections from the cave surfaces as well tunnel bends and junctions. Initial work has made progress in the design of an array antenna that is simple in structure but will generate a single beam with significant reduction in additional beams which lead to waste of battery power as well as multipath signals emanating from the unwanted side lobes. This will also cut down on the need for reflectors which are commonly used in above ground wireless telecommunication systems.

### **4. Design and Protection of Aircraft against Severe Electric Storms: With Special Reference to Increasing Use of Carbon Composite Material in Aircraft Body**

To make aircraft lighter and faster, both commercial aircraft (reduction in fuel) and military aircraft (allowing for faster manoeuvres when combating enemy aircraft) increasingly use carbon composite material. These have less withstand power to lightning strikes, less shielding effectiveness for internal electronic system and demand a different geometrical structure to reduce the effects of severe electric storms. Moreover, with climate change and increase of earth surface and atmospheric temperatures, the thunder storms are expected to increase in severity calling for different strategy to handle future threats to land, sea and air borne systems

and devices. The research work has successfully modelled and simulated realistic scenarios of aircraft-lightning electrodynamics to generate and analyse transient currents on aircraft surfaces which are almost impossible to measure when direct hits occur, as recent work on this at the Netherlands National Laboratory has shown (aircraft are deliberately flown into thunder storms).

## **Publications in 2016**

### **Journal**

1. Aiau, Sammy S., Moses Kavi, K. Pirapaharan, Paul R. P. Hoole, Martin Anyi and Samuel, R. H. Hoole. (2016). "PNG's Energy Sector and Estimation of Renewable Energy Resources in Morobe Province, Papua New Guinea: Solar and Wind Power for New Umi Township," *Journal of Telecommunication, Electronic and Computer Engineering*, vol.8, no.12, pp. 26-30.
2. Fisher, Joseph, Paul Hoole, K. Pirapaharan and Samuel Hoole. (2016). "Pre-Lightning Strikes and Aircraft Electrostatics," *Journal of MATEC web of conferences*.
3. Kiss, Peter. (2016). "The Power System of Papua New Guinea", *Elektrotechnika*, vol. 5-6, pp. 8-11, ISSN 0367 0708 (paper in Hungarian)
4. Kiss, Peter. (2016). "The Quality of the Power Supply in Papua New Guinea", *Elektrotechnika*, vol. 7-8, pp. 5-8, ISSN 0367 0708 (paper in Hungarian)
5. Pirapaharan, K., H. Kunsei, K.S. Senthilkumar, Paul R. P. Hoole, and Samuel R. H. Hoole. (2016). "A Robust, 3-Element Triangular, Reflector-less, Single Beam Adaptive Array Antenna for Cognitive Radio Network: Inter-element Distance Dependent Beam," *Journal of Telecommunication, Electronic and Computer Engineering*, vol.8, no.12, pp79-82.
6. Senthilkumar, K.S., K. Pirapaharan, and P.R.P. Hoole. (2016). "Single Perceptron Model for Smart Beamforming in Array Antennas," *International Journal of Electrical and Computer Engineering (IJECE)*, vol.6, no.5, pp.2300-2309.

### **Conference Papers**

1. Fisher, Joseph, Paul Hoole, K. Pirapaharan and Samuel Hoole. (2016). "Parameters of Cloud to Cloud and Intra-cloud Lightning Strikes to CFC and Metallic Aircraft Structures," in *Proceedings of International Symposium on Fundamentals of Electrical Engineering 2016 (ISFEE2016)*, Bucharest, Romania, June 30-July 2, 2016.
2. Kavi, M., Y. Mishra and V. D. Vilathgamuwa. (2016). "A Decomposed Alternating Sequence Morphological Algorithm for the Detection and Identification of Power

System Disturbances, IET Conf. on Development in Power System Protection, Edinburgh, Scotland, Feb 2016.

3. Kavi, M., Y. Mishra and V.D. Vilathgamuwa. (2016). “Detection and Identification of High Impedance Faults in Single Wire Earth Return Networks” IEEE Australian University Power Engineering Conference, AUPEC 2016, University of Queensland, Bris, Australia, Sept, 2016.
4. Kunsei, H., K. Bialkowski and A. Abbosh. (2016). “Channel Modeling of Reconfigurable Antennas for Underground Communications,” in Australian Microwave Symposium, Adelaide, Australia.
5. Kunsei, H., Md Shahidul Alam, K. Bialkowski and A. Abbosh. (2016). “Planar Reconfigurable Antenna for Underground Mine Communication” in Australian Microwave Symposium, Adelaide, Australia.
6. Pirapaharan, K., H. Kunsei, K. S. Senthilkumar, P.R.P. Hoole and S. R. H. Hoole. (2016). “A Single Beam Smart Antenna for Wireless Communication in Highly Reflective and Narrow Environment,” in *Proceedings of International Symposium on Fundamentals of Electrical Engineering 2016 (ISFEE2016)*, Bucharest, Romania, June 30-July 2, 2016.
7. Senthilkumar, K. S., K. Pirapaharan, G. A. Lakshmanan, P. R. P. Hoole and S. R. H. Hoole. (2016). “Accuracy of Perceptron Based Beamforming for Embedded Smart and MIMO Antennas,” in *Proceedings of International Symposium on Fundamentals of Electrical Engineering 2016 (ISFEE2016)*, Bucharest, Romania, June 30-July 2, 2016.

### List of Research Students

<b>Researcher's Name</b>	<b>Supervisors</b>	<b>Program</b>	<b>Research Title</b>	<b>Remarks</b>
Mr. Joshua Yuanko	Dr. K. Pirapaharan	MPhil	Design of Smart Energy Control System for Palm Oil Production Plant Using FUZZY-PID	Completed in 2016
Mr. Lolong Karipinne Bonner	Prof. P.R.P. Hoole Dr. K. Pirapaharan	MPhil	VSAT: Application in Student Learning/Development of Modulation Technique to Enhance Speed	Started in Year 2016, work in progress
Mr. Samy Aiau	Dr. K. Pirapaharan Prof. P.R.P. Hoole	PhD	Renewable Energy Sources for Morobe Province and future National Smart Grid for PNG	Registered in Year 2015, work in progress
Mr. Joseph Fisher	Prof. P.R.P. Hoole Dr. K. Pirapaharan	PhD	Design and Protection of Aircraft against Severe Electric Storms: with special	Registered in Year 2015, expected to

			reference to increasing use of Carbon Composite Material in aircraft body	submit the thesis in 2017
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## **DEPARTMENT OF FORESTRY**

**Head of Department: Dr Larry Orsak**

UNITECH's Forestry Department is the only academic institution in the South Pacific island region to confer undergraduate and postgraduate degrees in Forestry.

Education is the university's principal mission and the Forestry Department aims to provide high quality academic and administrative support services not only for undergraduates, but with increasing focus on the training of postgraduate students. Our postgraduate program continues and further develops research skills they began learning through Year 3 courses (especially 'Experimental Design'), and culminating in Year 4 (final year research project).

Our overall educational challenge in forestry is to produce professionals, both men and women, with the necessary technical skills. Foremost amongst these is the ability to solve problems. It is to develop this problem-solving capacity that our department's research activities fundamentally fit into our education mission. To achieve this goal requires that the faculty themselves are not only well versed in research but apply that knowledge through active research projects and programs. This five-year plan is our first departmental articulation of the strategies and mechanisms by which we hope to enhance our department's research activity component. The document also points out current, significant constraints in attaining our objectives that must be overcome at the university level.

### **Forest/Forestry Research Themes**

The Forestry Department has long recognized the multi-faceted value of Papua New Guinea's forests, and over the years has woven this into its academic and research program.

Sustainable forestry in PNG requires a cross-disciplinary approach, which today means blending aspects of the economy, social features, environment services and climate change.

The Department structures its Research Development Plan and Postgraduate Study Program around a number of specific research themes:

- ✓ Ecosystem and Environmental Services

- ✓ Forest Biology, Ecology & Biodiversity
- ✓ Forest (health) Protection
- ✓ Wildlife Management, Community-Driven Forest Conservation.
- ✓ Role of Forests in Climate Change
- ✓ Silviculture, Including Reforestation and Plantation Management
- ✓ Agro-forestry/ Social and Community Forestry and Multiple land-use
- ✓ Wood Science and Technology; Timber Production/Utilisation
- ✓ Forest Engineering
- ✓ Forest Economics and Forest Product Marketing
- ✓ Appropriate Technology
- ✓ Remote Sensing and GIS
- ✓ Biomass Energy

Table 1 Summary: Academics Staff at Forestry Department (Taraka) & BUC 2016

<b>Name</b>	<b>Position</b>	<b>Research Interest</b>
Dr Larry Orsak	HOD & Associate Professor	Forest Entomology and biodiversity assessments; Soil effects and tree stresses and growth; tree crop horticulture
Dr Osia Gideon	Professor	<ul style="list-style-type: none"> <li>- Plant systematic (specialist in the families Rubiaceae, Portulacaceae, Costaceae, Zingiberaceae &amp; Arecaceae)</li> <li>- Plant diversity and Conservation</li> <li>- New Guinea Biogeography</li> <li>- History of New Guinea Botany (exploration and biographies of botanists)</li> <li>- Sustainable use of biodiversity (traditional and contemporary uses)</li> <li>- Forest Policy for Sustainable Development</li> </ul>
Dr. Mex Peki	Senior Lecturer	Forest inventory including measurements and estimation of timber volume, biomass and carbon in plants (above ground). Sustainable Forest Management and Planning
Mr. Peter Edwin	Lecturer 2	Wood science and technology; forest management (Currently PhD study University of Melbourne)
Mr. Rapo Pokon	Lecturer 2	Plant biology, pest and disease

Mr. Haron Jeremiah	DHOD & Lecturer 1	Forest Economics and marketing
Mr. Eko Maiguo <sup>1</sup>	Lecturer 2	Silviculture and Forest Management (Study leave PhD University of Melbourne)
Mr. Louis Veisami <sup>1</sup>	Technical Instructor 2 & A/Principal	Forest Mensuration and Inventory
Mr. Benson Gusamo <sup>1</sup>	Lecturer 2	Wood Science & Technology, Forest Products, Non-timber Forest Products, Bio-energy
Mr. Bazakie Baput <sup>1</sup>	Lecturer 1	Community Forestry, Agro forestry and Forest Ecology
Mr. Olo Gebia <sup>1</sup>	Lecturer 1	Forest ecology and plant biology; Forest biodiversity
Mr. Diaiti Zure	Lecturer 1	Natural forest Silviculture; Forest Genetics; Soil-plant-microbial interactions and nutrient dynamics under changing environmental conditions; Ecological and molecular responses of plants and trees (crops) to climate change; and Evolution, phylogenetic and diversity of secondary medicinal plant metabolites (Currently study leave; PhD in Taiwan)
Mr. Tombo Warra <sup>1</sup>	Technical Instructor 1	Plant Ecophysiology and Conservation Ecology
Mr. Russell Tarutia <sup>1</sup>	Technical Instructor 1	Forest Surveying and GIS
Mr. John Beko <sup>1</sup>	Technical Instructor 1	Silviculture and Plant Propagation
Miss Pricilla Menin <sup>1</sup>	Technical Instructor 1	Community Forestry, Communities response on forest plantation and projects
Mr. Leonard Hansutan <sup>1</sup>	Technical Instructor 1	Phytoremediation - plant/soil and toxic chemical relationship
Mr. Samson Aguadi <sup>1</sup>	Technical Officer	Forest Enumeration through Imagery, Forest App Development and Forest Harvesting Operation Planning.
Mr. Koniel Alis <sup>1</sup>	Technical Instructor 1	Timber Utilization and Bio-energy

Note: <sup>1</sup>Faculty members based at Bulolo University College (BUC)



## **On-Going Research Programs in the Department (2016)**

The Forestry Department has a number of on-going research activities, which are segregated according to general theme and briefly described below, noting the principal investigators involved:

- **Ecosystem and Environmental Services**
- **Forest Biology, Ecology & Biodiversity**
  1. Effects of altitude on soil seed bank community along an altitudinal gradient in Morobe Province, Papua New Guinea (Olo Gebia).
  2. A review of genus *Ixora* in Papuaia region with an exploration of sources of species richness including flower-dependent niche partitioning (Heveakore and Orsak)
  3. Analysis of Moth Data from Morobe Province (Larry Orsak)
  4. Comparison of understory composition and regeneration in Lae Botanic Garden versus natural forest (Larry Orsak)
- **Forest (health) Protection**
  1. Soil, plant stress and pest/disease vulnerability in plantation in *Araucaria* species (Larry Orsak)
  2. Termite Control Using *Tithonia* sp (Asteraceae) leaves on *Araucaria cunninghamii* at Oomsis forest plantation (Larry Orsak)
  3. Soil profile differences between poor growth and healthy *Araucaria* within a small area of *Bulolo Plantation* (Larry Orsak)
  4. Relationship of stress and termite damage in plantation *Araucaria* (Larry Orsak)
- **Wildlife Management, Community-Driven Forest Conservation**
- **Role of Forests in Climate Change and Carbon Trade**
  1. Comparing options for earnings in merchantable standing volume and biomass in Busama forest: Log export and managing forests for carbon trade (Samuel Namba and Mex Peki)
  2. Estimation of biomass and carbon stock in Oomsis and Ngalakumbung forest area of Morobe Province (Mavis Jimbudo and Mex Peki)

3. Variation of Carbon (C) content in Different Age group of *Araucaria cunninghamii* in Bulolo Plantation, Morobe Province, Papua New Guinea (Helen Baki and Mex Peki)

- **Silviculture, including Reforestation and Plantation Management**

1. Clonal Propagation for Eaglewood (John Beko)
2. Investigating seed propagation and agar wood formation of Papua New Guinea Eagle wood (*Gyrinops ledermannii*): Seed germination and fungi efficacy
3. Variation in soil moisture, pH and texture in cultivated eaglewood (*Gyrinop* sp) sites
4. The potential effect of different hormone concentrations on the root initiation and development from stem cuttings of *Santalum macgregorii*
5. The Use of *Acacia mangium* in the rehabilitation of mined out site at Hidden Valley in Papua New Guinea

- **Agro-forestry/ Social and Community Forestry and Multiple land-use**

1. Motives for grassland burning and the consequent threat status in Markham Valley (Haron Jeremiah)

- **Wood Science and Technology; Timber Production/Utilisation** (M. Hossain, Peter Edwin and Benson Gusamo)

1. Physical Wood Strength of *Anisoptera thurifera* for Constructional use in Papua New Guinea
2. Wood strength testing to use in the design of house and bridge structures
3. Strength Dynamics of *Araucaria cunninghamii* (Hoop) from Bulolo Forest Plantation
4. Conducting natural durability test using soil bed trials by lesser known timber species: *Macaranga aleuritoides* and *Trema orientalis*

- **Forest Engineering (M. Hossain)**

1. The productivity Study of Skidding Operation at Bulolo Pine Forest Plantation
2. Study on Soil Compaction on Skid Trail and Landings due to Harvesting Activities in Bulolo Forest Plantation

- **Forest Economics and Forest Product Marketing**

1. Role of Policy in Export Trade of Round logs In PNG, Guyana and Gabon (Haron Jeremiah)

- **Appropriate Technology**

1. Mini-Pro Solar Kiln Timber Dryer – Drying of hardwood timbers using solar energy (low power consumption) technology (Peter Edwin)

- **Remote Sensing and GIS**

1. Land use and land cover detection using medium and high resolution data by remote sensing techniques in the Markham valley of Morobe Province, PNG (Russell Tarutia)
2. Comparison of biodiversity hotspot areas and logging concessions in PNG using GIS
3. Creating a map with Information on PNG soil type, vegetation & rainfall erosivity using GIS

- **Biomass Energy**

Postgraduate Research Projects (2016)

Table 2 Postgraduate Student Research Reports (2016)

Name of the Candidate	PG Code	Thesis/ Research Title	Name of the Supervisor
Dambis Kaip	MPhil/1	Forest policy now and for the future	Dr. Mex Peki
Gewa Gamoga	MPhil/1	Measuring Forest Land Use Change in Papua New Guinea between 2000 -2015	Dr. Mex Peki
Constin Bigol	MPhil/1	The Role of Indigenous Knowledge in Forest Management: Implication for the Multi-purpose National Forest Inventory in Papua New Guinea	Dr. Mex Peki
Steven Komut	MPhil/1	Physical, Mechanical and Wood Working Properties of <i>Trema orientalis</i> (L) Blume in Papua New Guinea	Dr. Mex Peki
Bruno Kuroh	MPhil/1	Estimating above ground biomass and carbon in selected forest types in PNG	Dr. Mex Peki
Gibson Sasonika	MPhil/1	Patterns of Fern Species Richness and Beta Diversity in Highlands Ecosystems of Papua New Guinea	Prof. Osia Gideon
Miller Kawanamo	MPhil/1	Tree species diversity and forest structure in different vegetation types and disturbance levels	Prof. Osia Gideon
Enock Kaledimimo	PhD	Modern and traditional resource ecology of culturally and socially important tree species in PNG	Prof. Osia Gideon
Haydrian Morte	MPhil/2	Effect of Labor Cost to Informal Sawn Timber Production Using Portable Mills along Bukawa and Bulolo roads, Morobe Province, Papua New Guinea	Mr. Haron Jeremiah
Bulisa Iova	MPhil/1	The effect of habitat types on bird communities in different elevations throughout Papua New Guinea. Exploration of Beta-diversity, Alpha-diversity and abundance	Dr Larry Orsak
Redley S. Opasa	MPhil/1	Fruit fly community observation and assessment in PNG forests for forest health analysis	Dr Larry Orsak
Jacob Yombai	MPhil/1	Diversity and community composition of ants (Hymenoptera: Formicidae) in the forest of Papua New Guinea	Dr Larry Orsak

Clifford Single	MSc/2	Exploring root causes of <i>Piper anduncum</i> competitive ability with an investigation of possible mitigative control measures in the Bulolo <i>Araucaria</i> plantations (Morobe Province, PNG).	Dr Larry Orsak
Kerenga William	PGD	Treatment of <i>Casuarina</i> spp for durable bush material houses	Mr. Peter Edwin/Mr. Benson Gusamo
Steven Keki Anakime	MPhil/1	Strength Dynamics of <i>Araucaria cunninghamii</i> (Hoop) from Bulolo Forest Plantation	Professor M. Hossain

### Undergraduate Research Projects (2016)

**Table 3 Final Year Student Research Reports (2016)**

Name of the Student	Thesis/ Research Title	Name of the Supervisor
Helen Baki	Variation of Carbon (C) content in Different Age group of <i>Araucaria cunninghamii</i> [Hoop Pine] in Bulolo Plantation, Morobe Province, Papua New Guinea	Dr. Mex Peki
Mekino Malo	Review of Sawn Timber Grading Rules/Standards Used by Producers and Manufacturers of Wood Products in Morobe Province	Dr. Mex Peki
Elijah Hwasiura	Identifying Simple Participatory Forest Inventory Techniques in Morobe Province	Dr. Mex Peki
Aaron Freal	Preliminary Investigation into Physical and Mechanical Properties of Plantation-grown <i>Pinus caribaea</i> , Morobe Province, Papua New Guinea	Mr. Benson Gusamo
Moses Tambili	Developing a Business Model for Small-Scale Sawmilling for Tree Farmers based on Bulolo University College Portable Sawmill Operation	Mr. Benson Gusamo
Luke Tata	Investigating Anti-sapstain and Insecticidal Activity of Neem and Tobacco Extracts on Freshly Sawn <i>Pinus caribaea</i> Boards	Mr. Benson Gusamo
Joash Paul	A Preliminary Study into the Impacts of Logging on Watershed Management in Bulolo	Mr. Benson Gusamo (co-

	Forest Plantation, Morobe Province, PNG.	supervisor)
Henry Kaomara	Comparing Ant Diversity in Different Lowland Forest Ecosystem	Mr. Rapo Pokon
Stephanie Kawat	Comparing the Effectiveness of chili, tomato leaf, & garlic-onion-pepper organic pesticides on Plant Defoliating Caterpillars.	Mr. Rapo Pokon
Anna Oiza	Inventory & Identification of foliage eating Caterpillars and their Potential Parasites/Parasitoid as bio-control agent to pest outbreak	Mr. Rapo Pokon
Maxwell Mulekena	Effect of slope and altitude on tree growth and economic returns of Araucaria plantation at Bulolo, Morobe Province	Mr. Haron Jeremiah
Reskut Dora	Factors affecting primary wood producers' market preference in Morobe Province	Mr. Haron Jeremiah
Shen Sui	Rapid increase in nectria canker threatens population of <i>Anisoptera thurifera</i> in Oomsis rainforest	A/Professor Larry Orsak
Delmaj Iveke	The effects of moisture content on wood cutter heads machine	Mr. Eko Maiguo
Napa Yanderave	The effect on the biomechanical property (density) of mangrove root system, Huon Gulf coast, PNG	Mr. Eko Maiguo
Patrick Dobunaba	Comparison of moth diversity in a primary forest area and the Lae botanical gardens	A/Professor Larry Orsak
Paul Rova	Native tree species assessment in Lae botanical and other low land tropical forest sites	A/Professor Larry Orsak
Rensley Wokoto	Floral dimorphism an sex expression in native dioecions <i>Mussaneda scretchleyi</i> of PNG	Professor Osia Gideon

### **ONGOING RESEARCH COLLABORATION WITH EXTERNAL PARTNERS**

Apart from internally funded research programs, Forestry Department has been blessed with number of opportunities to conduct collaborative research with external partners over the last five years. The formal projects that contain research components include:

**1. Improving the Papua New Guinea balsa value chain to enhance smallholder livelihoods (FST 2009/16) ( include the duration of the project)[ACIAR PROJECT]**

- Kotlarewski, N.J, Ozarska, B and Gusamo, K.B (2015). Thermal conductivity of PNG Balsa wood measured using the needle probe procedure, Bioresources, 9(4), 5784 - 5793. (This paper was not reported in 2016 report) under this project

**2. Technical support to the Papua New Guinea Forest Authority to implement a multi-purpose National Forest Inventory (GCP/PNG/006/EC) (March 2013 to February 2016) extended [EU FAO PROJECT]**

- Research activities under this collaboration is mainly by way of sponsoring of the postgraduate students in our department see table 2 [ Candidate with \* (astrix) after their name]
  - List of research equipment submitted for funding for NFI research activities
  - Attended workshop organised by this project: In Soil research (Leroy Moripi); Tree Identification (Charles Feriwok and Olo Gebia); Forest Inventory Methodology (Dr. Mex Peki).

**3. Enhancing Value Added Wood Processing in Papua New Guinea (FST/2012/092) (July 2014 to January 2018. [ACIAR BPROJECT]**

**Current staff from DOF Unitech involved in this Project**

1. Dr. Mex Peki – Team Leader Unitech Partner & Project Objective 2 Leader
2. Professor M. Hossain - Researcher
3. Mr. Benson Gusamo – Researcher
4. Mr. Haron Jeremiah – Researcher
5. Mr. Peter Edwin – Researcher (on PhD studies at Melbourne University under this project)
6. Mr. Ono Pendis – Research Officer (ACIAR funded position)

**Background**

A strong focus has been placed on strengthening research capacity of PNG researchers involved in the project through increasing their skills in developing methodologies for research activities, sampling techniques, operating scientific equipment and conducting tests on wood properties and processing characteristics.

Project teams were formed for each objective, consisting of PNG and Australian members according to skills and expertise required to achieve various activities and tasks. Detailed Action Plans for the objective milestones were developed by each team.

Objective 1 of the project involves testing of wood properties and processing characteristics of lesser known PNG species from secondary and plantations forests. ‘State-of-the-art’ testing equipment, not available anywhere else in PNG, has been purchased which will enable researchers and the University students to learn and undertake experiments on wood properties and processing characteristics of wood. Twenty six species have been selected for testing during the project. The testing program has been developed with the aim to complete wood properties testing for twelve species before the Mid-Term Review of the project which was held in February 2017.

Within Objective 2, which aims to identify, pilot and evaluate interventions for enhanced value-added processing systems, a program has been developed towards involving landowners and small wood processing companies in wood value-adding processes. A total of 19 timber industry setups were visited and their current practices and capabilities assessed. Various models for the establishment of Central Processing Unit (CPU) are being investigated. The CPU concept aligns with the government strategy to encourage downstream processing, ensure that PNG small sawmillers and landowners are able to sell their sawn timber which can be further processed and to build capacity in training of landowners to effectively and sustainably use natural resources to sustain income flows in the future in their community. A business plan for the proposed CPU structure and operational procedures will be developed in the next few months.

The focus of the Objective 3 has been on establishing the forest products and economic outcomes from the production and use of logs harvested in PNG under the diversity of production enterprises operating across PNG. Templates have been developed for data collection on all approved log producing activities by legal identity together with approved time periods and volumes.

There are many problems and challenges faced by the project and these issues have resulted in delays in meeting deadlines in several areas. It was agreed at the Project Annual Review



that revision of the project timelines was required. The project team leaders have submitted the plan of revised milestones and their deadlines to RPM for consideration.

A significant achievement has been a John Allwright scholarship provided to Mr. Peter Edwin of the Unitech to undertake a PhD study at the University of Melbourne. The proposed topic of his PhD thesis is “Modelling the energy efficiency of downstream processing of forest industries through the Life Cycle Analysis processes in the Papua New Guinea”.

**Seminars and Workshops attended by the UNITECH Team:**

1. An inception workshop was held on 17 February 2016 to launch a new ACIAR project in PNG, FST/2014/065 “Development of durable engineered wood products in PNG and Australia”. The workshop was attended by Benjamin Vali and Peter Edwin and presentation on the “Value-Adding” (FST/2012/092) project was made by Mr. Vali to ensure that the research objectives and activities of the two projects are well understood by all the projects’ partners.
2. A seminar was held on 24 February 2016 at Unitech entitled “Proposed Central Processing Unit (CPU) models for trials at Timber & Forestry Training College (TFTC)”. Mr. Haron Jeremiah presented CPU models which were adopted from the current small scale saw millers’ mode of operation along the wood/timber production and processing supply chain. Research areas arising from testing of these models were discussed. Comments and discussions from this seminar will be taken into consideration in the final design of the models.
3. Land Owner Groups and Central Processing Unit (CPU) Workshop was held on 27 April 2016 at FRI, Lae, with the aim to identify landowner groups and wood processing companies interested in participating in CPU (The workshop was attended by 35 people: 14 project members, 20 landowners and wood processors and one media representative (PNG National newspaper).

4. The Project Annual Review workshop was held on 23 May 2016 in Lae with the aim to review the project's progress to date. The workshop was attended by 32 project participants. The reasons for delays in achieving various project activities and tasks have been discussed. Problems causing the delays have been identified and possible solutions discussed and agreed to. The discussion was followed up by team meetings held on 24-26 May 2016 when a detailed testing program was developed to ensure that the tasks are completed by the Project Mid-Term Review which will be held in February 2017.

**Research reports publish under this project in 2016 by faculty members:**

- Asok, F., **Ono, P.** and E. Galore. 2016. Assessment of wood manufacturing capabilities in PNG. GS Model Ltd, Keravat. 13 pp.
- Asok, F., **Ono, P.** and Galore, E. 2016. Assessment of wood manufacturing capabilities in PNG. A E S Timbers Ltd, Takurbar, Kokopo. 12 pp.
- Iru, R., **Peki, M., Jeremiah, H.** and F. Asok. 2016. Assessment of wood manufacturing capabilities in PNG. Craftsman Ltd – Nga Group of Companies. 11pp.
- Jeremiah, H.** 2016. Assessment of wood processing companies. Hamea Timbers. 15 pp.
- Jeremiah, H.,** Asok, F., **Edwin, P.,** Iru, R., Marika, D. and E. Galore. 2016. Assessment of wood processing companies. Yara Timbers Ltd. 10 pp.
- Jeremiah, H.,** Asok, F., Edwin, P., Iru, R., Marika, D. and E. Galore. 2016. Assessment of wood processing companies. Santi Forestry PNG Ltd. 16 pp.
- Jeremiah, H.,** Asok, F., **Edwin, P.,** Iru, R., Marika, D. and E. Galore. 2016. Assessment of Wood processing companies. PNG Tropical Wood Products. 17pp.
- Jeremiah, H.,** Asok, F., **Edwin, P.,** Iru, R., Marika, D. and E. Galore. 2016. Assessment of wood processing companies. Local Timber Supplies. 18 pp
- Jeremiah, H., Peki, M.,** Asok, F. and R. Iru. 2016. Assessment of wood processing companies. Masurina Timbers Ltd. 14 pp.
- Jeremiah, H., Peki, M.,** Asok, F. and R. Iru. 2016. Assessment of wood manufacturing capabilities in PNG. South Pacific Timber Products Industries. 10 pp.
- Malo, M and Peki, M.** 2016. Review of sawn timber grading rules/standards used by producers and manufacturers of wood products in Morobe Province (UniTech student project report). 16 pp.

**Peki, M., Jeremiah, H.,** Asok, F. and R. Iru. Assessment of wood processing companies. Sarco Timber Yard Ltd. 24 pp.

**Ono, P and Peki, M.** 2016. Landowner involvement in the project – Innovative approaches in carving making. 15 pp.

Ozarska, B., Asok, F., **Jeremiah, H.** and A. Jenkihau. 2016. Assessment of wood manufacturing capabilities in PNG: Pryde Furniture Pty Ltd. 10pp.

### **List of Publications**

See under projects above

### **Seminar /Workshop and Conference Attended**

- Most of the seminar and workshop attendance were specifically under ACIAR PROJECT by staff involved (see above)

### **Unitech Research Seminar Series**

#### **Plant exploitation and domestication in PNG**

**Professor Osia Gideon**

**15th November 2016**

#### **Abstract**

New Guinea is one of the most biologically diverse islands on earth. The island occupies less than 1% of the world's land area, and yet it is home to about 6 – 8% of the world's species, and with extraordinarily high levels of endemism. New Guinea contains the third largest tract of rainforest in the world. This diverse and peculiar biota somewhat reflects its geological history and physiographic diversity. New Guinea as one of the world's centres of plant diversity, with about 15,000 to 25,000 species of vascular plants and as high 70% species endemism. With such a rich plant life, it is no coincidence that this landmass has a long history of agriculture and plant domestication. For a long time Papua New Guinea was considered as a passive recipient of domesticated plants and animals from Southeast Asia and beyond. However, recent archaeological evidence indicates that PNG is one of the few places on earth where agricultural practices have developed independently. Papua New Guineans were definitely exploiting plants such as taro (*Colocasia esculenta*), bananas (*Musa* spp.), sugarcane (*Saccharum officinarum*), etc. for at least 10,000 years. Only a few regions are

geographically suited to become the homelands of full agricultural systems, and New Guinea is definitely one of them.

The presentation will discuss the exploitation and domestication of plants by Papua New Guinea societies to meet basic human needs. Most plants were exploited for food, as starch, fruits and nuts. A number of food plants are considered to have been first domesticated in New Guinea, and these include *Pandanus* spp. (*P. brosimos*, *P. julianettii*, *P. ewen*, and *P. conoideus*), *Canarium* spp., *Terminalia* spp., sago (*Metroxylon sagu*), sugarcane (*Saccharum officinarum*), bananas (*Musa* spp.), etc.

## **Forestry Department In-House Seminar (2016)**

### **Proposed Central Processing Unit (CPU) models for trials at Timber & Forestry Training College (TFTC)**

**Haron Jeremiah**

Dated 24<sup>th</sup> February 2016

#### **Abstract:**

ACIAR project FST 2012/092 is a collaboration project between Australia and PNG to research potential of PNG wood processing industries in value adding PNG wood products. One of the projects main objectives is to study the viability and feasibility of establishing central processing units (CPU) for small scale saw-millers in PNG. Such a concept attempts to address current challenges facing small-scale saw millers such as promotion of sustainable harvesting practices, meeting technical processing standards and quality, increasing recovery rates through value adding and consistency in meeting domestic and regional standardized and specialized market demand for various wood products and their related mixes.

The models presented in this presentation are adopted from the current small scale saw millers mode of operation along the wood/timber production and processing supply chain. Resource sustainability, economical and equity balance (viability) and adoptability of processing technologies for these models will be assessed along the primary production to value-added supply chain. Research areas arising from testing of these models will also be discussed in this presentation for interested researchers in the project. Comments and

discussions from this presentation will be considered in the final design of the models to be submitted to ACIAR project team leaders and TFTC for approval and trials.

### **Supporting YUS Rangers to Strengthen Local Ownership of Conservation Efforts in Papua New Guinea**

Daniel Solomon Okena  
Tree Kangaroo Conservation Programme, Lae.  
Dated: 1 October 2015

#### **Abstract:**

The Tree Kangaroo Conservation Program (TKCP) focuses efforts in the YUS Conservation Area on the Huon Peninsula, in Morobe Province, Papua New Guinea. Many Huon Peninsula species are found nowhere else on earth, including the endangered Matschie's tree kangaroo, TKCP's flagship species. Ensuring the survival of the species is of both local and global importance. TKCP's community-based strategy helps provide benefits and improve the standard of living for the more than 12,000 people in 50 villages throughout the YUS landscape. The sustainability of the protected area depends upon the commitment of the local landowners. Local people must be the drivers of any sustainable conservation effort, and communities must be involved in the monitoring of biodiversity to ensure the long-term success of protected areas.

The goal was to create a skilled group of local Ranger officers to undertake this work. Each month, Rangers spend seven days patrolling segments of the designated protected areas near their villages to record the presence or absence of several community-identified priority animal species key to achieving conservation outcomes, and to check for potential violations of the mutually-agreed bylaws governing the YUS CA. In addition to patrols, the Rangers raise awareness within their communities to enhance the understanding of YUS CA boundaries and rules, as well as sharing information and feedback regarding conservation efforts. YUS Rangers also collaborate with the village court system to report bylaw infractions within the conservation area to local magistrates and peace officers. Preliminary observations during the Ranger patrols indicate increased sightings of previously-scarce wildlife and I will discuss the overall impact of the YUS Rangers.

**Testing a hypothetical hybrid, *Alpinia xilanensis*, and its putative parents, *A. japonica* and *A. pricei* using Inter-Simple Sequence Repeats (ISSR) markers**

Diaiti Zure

PNG University of Technology

M.Sc. International Master Program of Agriculture, Laboratory of Tree Genomics & Molecular Biology, Forestry Department, National Chung Hsing University, Taiwan (ROC)

**Abstract**

Studies based on morphological and eco-geographical evidences hypothesized that *Alpinia xilanensis* is a natural hybrid between *A. japonica* and *A. pricei*. The hybrid has characteristics variable but wholly in the range of its putative parents with exception to its other qualitative characters, which differs from the parents but discerns the intermediate state of hybrid. However, the direction of hybridization in the hybrid and its putative parent is unknown. We further tested this hypothesis using Inter-Simple Sequence Repeats (ISSR) molecular marker. ISSR having the advantage of combining Simple Sequence Markers (SSR) and Amplified Fragmented Length Polymorphism (AFLP) with available species-specific primers of putative parents; genomic DNA of the taxa were tested. The study revealed similar DNA band patterns, close genetic and phylogenetic relationships between *A. xilanensis* and *A. japonica* than to *A. pricei*. Introgression was unlikely due to hybrid is infertile and cannot backcross with its parent. We assume the possibility that the taxon was probably misidentified or the hybrid is an offspring of another *Alpinia* species. Further studies were recommended into the hybrid and its putative parents using reproductive traits (we used leaf morphological traits) and other molecular markers.

Keywords:

*Alpinia*, hybridization, Inter-Simple Sequence Repeats (ISSR), species-specific markers

## **CONSTRAINTS**

World-competitive research today occurs only when certain, mandatory infrastructure is present. Because forestry relies so much on field work, reliable personal transport (4-wheel drive vehicle) is our foremost constraint. While lab space and overall research funding are general issues at UNITECH, high quality research is often possible in forestry at surprisingly low cost and our lab space is good compared to other departments.

Less mentioned but probably most fundamental to achieving world-competitive research, however, is access to relevant primary literature. This is woefully inadequate at UNITECH: we rely on antiquated interlibrary loan hardcopies which themselves are limited, plus a few free access journal networks provided by non-profit institutions that do not access many forestry journals. In contrast, researchers overseas enjoy electronic access via an appropriate level of subscription to the Web of Science that would include a spectrum of high calibre Forestry and related journals.

Expatriate faculty, and certain senior national faculty suffer less from this deficiency if they have library connections (via overseas schools they attended, overseas advisors they studied under, etc.), or can pull in literature during overseas annual leaves (i.e. Expatriates). Faculty lacking such connections are at a disadvantage within the Forestry Department and more generally in the university. Currently it is the national faculty who have not recently gone on overseas study leave who suffer disproportionately; it is essential that this inequality be recognized and addressed through much-improved university-wide access to primary literature.

## **DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE**

**A/Head of Department: Mr Benson Mirou**

### **Introduction**

The Mathematics and Computer Science department offers a four year degree in Computer Science and also teaches Mathematics and Computing courses to other 12 academic departments. The department comprises of 14 full-time academic staff that specializes in fields of mathematics and/or computer science.

The department has continue to change its computer science curriculum to adapt the new technology and changes in the IT industry. The current first and second year are on new curriculum while the third and fourth year on the old curriculum. By the 2018 the old curriculum would be phased out completely. The department is also embarking on involving more industrial input into the design and delivery of the content of the new curriculum.

### **List of published papers**

1. Remus, Dieter; Ursul, Mihail (2017). Van der Waerden rings. *Topology Appl.* 229: 148--175. [MR3688668](#)
2. Ursul, Mihail (2017). Torsion-complete and algebraically compact groups with compact endomorphism rings. *Comm. Algebra* **45**: 11, 4817--4832. [MR3670353](#)
3. Ursul, Mihail, V. Bovdi and M. Salim. (2017). Completely simple endomorphism rings. "Applied General Topology"(Submitted for publication).
4. Lenz L Nerit, Finite State Automata Representation of Protocol Symbols from Network Traces, School of Engineering and Computer Science, Victoria University of Wellington, New Zealand (February, 2016).

## **2 List of seminar presentations**

### **1. Professor, Dr. Mihail Ursul**



Department of Mathematics & Computer Science, University of Technology, Lae,  
PNG, Topological endomorphism rings,

A talk given at the Department of Mathematics of UAEU University, AlAin,  
May 2017, 30 minutes.

2. Dr Lakao Fitina ran a series of seminar on the Mathematics of Computer Security which will continue into 2017.

### **3. Current list of research**

#### **Dr Lokao Fitina**

- a. A topological view of hypergraphs and their connectivity
- b. Decomposing a finite topological space with a view to creating a secret sharing scheme
- c. Secret sharing schemes based on abstract groups - are these viable?

#### **Professor Mihail Ursul**

- a. Jointly with Dieter Remus, Germany), Refinements of compact ring topologies.

#### **Mr Raymond Kuna**

Raymond Kuna, The Hartman-Mycielski functor in the class of topological rings

## DEPARTMENT OF MECHANICAL ENGINEERING

**Head of Department: Dr Albert Ude**

### **Introduction**

The Department of Mechanical Engineering considers engineering research to be very important as it leads to an expansion of knowledge and discoveries of new products and services. It is through research that leads to breakthroughs in engineering and technology. Research and experimental development comprises creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications.

Engineering research is the systematic investigation and study of materials and sources to establish facts and reach new conclusions, so it shapes people's understanding of the world around them. Research involves testing hypotheses and predictions using testable data and a full battery of scientific and engineering tools and methods.

### **Focused Research Areas**

The department has decided to concentrate and focus on the following areas of research in mechanical engineering:

- i. Design and Manufacturing*
- ii. Energy and Environment*
- iii. Materials Characterization*
- iv. Engineering Education and Management*

The department encourages faculty to conduct their research concentrating and focusing in the above areas.

## **Research Seminars**

Departmental staff and postgraduate students are encouraged to present seminars regularly and as often as possible. The research coordinator is encouraged to schedule regular research seminars basing on the above areas of research interest.

## **Faculty Research Interests**

The following Table provides research areas of interest for the current faculty members:

<b>Academic Staff Members</b>	<b>Research Areas</b>
Professor John Pumwa, PhD	Tribology (Friction, Wear and Lubrication), Failure Analysis, Energy, Biodiesel, Vehicle Emission Effect on the Environment, Engineering Education.
Professor Nicholas Lambrache, PhD	3-D modeling of weak parts and subsystems, Finite Element, Simulation on stresses – including dynamic stresses and fatigue, Fatigue experiments on computer controlled devices, Statistical interpretation based on accumulated data from the mine site, Material Science interactive research on minerals affecting strength of metal alloys in mining equipment.
Kamala K. Muduli, PhD	Supply Chain Management, Sustainable Development, Operations Management, Health Care, Waste Management.
Syed Wahid, PhD	Research in the Broader Area of Energy, Renewable/Sustainable Energy, Environment and Pollution, Heat Exchanger's, Behavior/Control of Heat Flow at the Interface of Materials, Tribology, MEMS in Energy Exchange Applications.
Ghulam M. Arshed, PhD	Numerical Analysis, Fluid Dynamics
Pankaj Charan Jena, PhD	Design and Analysis of Composite Materials, Smart/Advanced Materials, Vibrations, Robotics, Artificial

	Intelligence, UAV, Solar Energy Applications in Mechanical Engineering.
Mr. Jack Khallahle	Two Phase Flow in Horizontal gas/liquid pipeline flow for on shore application and the revalidation of flow parameters for stratified flow in horizontal pipeline
Mr. Samuel Dunstan	On Study leave
Mr. Steve Ales Korokan	On Study leave
Mr. Brian N'Drelan	Renewable energy – use of solar to provide power, efficiency management of renewable energy, Statistical analysis of Failure of mining equipment – study of the properties of the mineral being mined and the effects on life expectancy of equipment components, Safety Analysis of Causes of Accidents leading to analysis of design and even management of existing practices – looking at ethical implications.

### **Undergraduate Research Projects**

The following are final year Mechanical Engineering Students projects in 2017 as part of their partial fulfillment of their degree:

	<b>Project Title</b>	<b>Names of Students</b>	<b>Supervisor</b>
1	Biodiesel production from waste cooking oil from student mess	Willie Kapi	Prof. John Pumwa
2	Environmental effects of vehicle Exhaust	Scotmell Kolo, Jay Komep)	Prof. John Pumwa
3	The design of screw press for the extraction of oil from peanut seeds with a processing capacity of 50kg/hr.	Norman Wampe, Samantha Vodo)	Prof. John Pumwa
4	Analyse Air condition system at Haus Europa and recommend maintenance improvement.	Nathan Goma, Christina Leo	Mr. Brian N'Drelan
5	Bio-gas from municipal solid waste	Alexandar Opop, Gibson Kemben	Dr Syed Wahid
6	Small boat hull design	Samuel Maihua, Stacy Keno, Ishmael Kelly, Moses Tagai	Prof. Nicholas Lambrache
7	Jig Design for grinding and polishing metallographic samples.	Laven Nande	Prof. Nicholas Lambrache

8	Contact Mechanics and Fatigue simulation of critical mining equipment components.	Tooh Benard, Victor Haen	Prof. Nicholas Lambrache
9	Designing of a Geothermal power plant	Kelvin Laa, Jimmy Joseph, Jeferry Venevel	Brian N'Drelan
10	Quantum Energy (Free Energy) Generator Design	Chuck Asphil, Jay Komep	Dr Ghulam Arshed
11	Design & selection of a drive system for a 30 metre long by-pass conveyor from Sag Mill for a Jaw Crusher – Material Iron Ore.	Johnson John, Stanley Simon	Mr. Jack Khallahle
12	Design of two phase flow horizontal pipeline System	Deborah Aru	Mr. Jack Khallahle
13	Design of a 200 kW Turbine and its drive system for a Mini hydro electric scheme.	Fred A Lakera, Jonathan Seken	Mr. Jack Khallahle
14	Feasibility study for micro-hydro power for rural application	Bob Olik	Mr. Jack Khallahle
15	Heat exchanger for student lab use or solar power	Numa Koim, Nathan Tiki, George Kende	A/Prof Kamalakanta Muduli /Dr Syed Wahid
16	Design of Well Water Desalination Plant	Ezra Tomi, Christopher Vela	Mr. Karo Komuna
17	Design of a Mini-hydro power scheme – feasibility study	Noel Uvovo, Peter Kee	Mr. Karo Komuna/ ATCDI

### **Postgraduate Students Research**

The following projects are being conducted by our Postgraduate Students:

<b>Item</b>	<b>Research Projects</b>	<b>Status</b>	<b>PG student</b>
1	Mechanical Component Failure In Inventory Management	Continuing	Brian N'Drelan (PhD)
2	Feasibility Study of Mini Hydro Power Plant for Six Villages in Eastern Highlands Province	Continuing	Joram Seth (MTech)
3	Studying the possibility of interfacing the Ultrasonic Digital Flaw Detector to a PC/Laptop to carry out UT testing, interpretation of test results.	Continuing	Thomas Peter (MTech)
4	PDI Optimization in Automatic Control of Vessel Fluid Level	Continuing	Roboam Pabuar (MTech)
5	Corrosion Rates in Atmospheric and Seawater Environment of Lae Port on Selected Metallic Alloys	Completed (2017)	Stephanie Konts (MTech)

6	Evaluation of current livestock and aquaculture small-scale feed mill equipment used in PNG and development of strategies for best practice under various operating requirements	(Incomplete)	Jimaimah Nathaniel (MTech)
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**List of Publications**

1. Khan, Ovais U., Arshed, G.M. (2017) *"High Resolution Numerical Schemes and Supersonic Flow over a Backward-Facing Step"*, 55th AIAA Aerospace Sciences Meeting, AIAA Science and Technology Forum and Exposition, Grapevine, Texas, USA.
2. N"Drean, B. (2017) *"Sustainability of a Company's Operation or Process Through Reliability Centred Maintenance"*, 2017 IEPNG National Conference Innovation and Sustainability, IEPNG, Port Moresby, PNG, 18 April 2017 - 19 April 2017
3. Pumwa, J. (2017) *"Mathematics as a Means of National Development"*, 2017 IEPNG National Conference Innovation and Sustainability, IEPNG, Port Moresby, PNG, April 18, 2017.
4. Pumwa, J. (2017) *"Waste Cooking Oil as a Fuel Source for Diesel Engines"*, The Proceedings of the Sardinia Symposium, Waste Management – 2018, Wessex institute of Technology, Southhaston, UK, October 2 – 6, 2017.
5. Wahid, Syed S M S (2017) *"Automatic Brake Wear- A Review"*, Journal, Environmental Science and Pollution Research, Accepted for Publication, 2017.
6. Wahid, S. M. S. (2017) *"Waste to Energy-Review of Waste Management Activities and Challenges, Papua New Guinea"*. Proceedings of Sustainability, Technology and Education 2017, Sydney, 11-13 Dec 2017.
7. Wahid, S. (2017) *"Speak Out For Engineers (SOFE)"*, IMechE News Bulletin, No. 179
8. Wahid, S. M. S., Madhusudana, C. V. (2015) *Correlations for Roughness, Slope and Peak Height for Bead Blasted Surfaces*, Proceedings of Malaysian International Conference.
9. Wahid, S M S., Madhusudana, C. V. (2016) *"Correlations for Roughness, Slope and Peak Height for Bead Blasted Surfaces"*, Journal, Tribology-Materials, Surfaces & Interfaces, Vol. 10, No.2, PP89-93, 2016.

## **DEPARTMENT OF MINING ENGINEERING**

**Head of Department: Dr. Gabriel Arpa**

The Mining Engineering departments offer two degrees- bachelor of Engineering in Mining Engineering and Mineral Processing Engineering. There are 13 academic staff, 4 Technical staff, 2 Administrative staff and two auxiliary staff. One of the 13 academic staff are currently on study leave pursuing PhD studies in Australia and 3 academic staff are currently pursuing Masters in Philosophy studies in the Department. The current staffs of the department are pursuing research activities in their areas of expertise as outlined below.

### **DR. GABRIEL ARPA, SENIOR LECTURER**

#### **Research Priority Areas**

- Feasibility study of Kassam Pass Underground Tunnel Construction., Lae Papua New Guinea.
- Site Blasting specification for Hidden Valley open pit mine using blast vibration monitoring. Morobe Mining. Lae Papua New Guinea.
- A comparative study on ventilation efficiency in dead space in both laboratory model and underground mine condition. Lae, Papua New Guinea.
- Modelling of the Deep Sea Tailing Placement System and Practice in Papua New Guinea.
- Sedimentation Studies of the Watut and Markahm River system and their effect on the environment and Lae Wharf system. Lae Papua New Guinea.
- Mineral Economic studies of mines in PNG after Extension of Mine Life
- Geomechanics Studies of Wafi-Golpu Underground Mining (Block Caving)
- Mechanics of Phytoremediation – Environmental Engineering

#### **Paper submitted to Journal of Marine Science Research and Development**

#### **Modelling the Extent of Diffusion and Dispersion of Deep Sea Mine Tailings Placement – Papua New Guinea Case**

Gabriel Arpa<sup>1</sup>, Kyuro Sasaki<sup>2</sup>

<sup>1</sup> Mining Engineering Department PNG University of Technology, PMB, Lae Morobe, Papua New Guinea. Phone: +675 4734671, Fax:+675 4734666. Email: [gabriel.arpa@pnguot.ac.pg](mailto:gabriel.arpa@pnguot.ac.pg)

<sup>2</sup> Department of Earth Resources Engineering, Kyushu University. Japan

## **Abstract**

Mining of minerals has been part of modern human history dating back to the earliest human civilization era. The global demand for precious and non-precious metal will continue to increase proportional to the global population growth. Minerals are mined using different mining methods both on-shore and off-shore and recently venturing into deep sea mining. More than 98% of the massive tonnages mined are discarded as waste and are either stored on site in engineered tailing dam, discharged into river system, stored in natural lake or direct discharged into sea as deep sea submarine tailing placement system. The balance between demand and economic needs versus environmental damage is an ongoing global challenge. Papua New Guinea is a developing country with 70% export earnings from mineral exports mining gold, copper, silver, nickel and cobalt. This paper presents the results of preliminary modelling of deep sea tailings discharge from two mines.

Key Words:

Mining, Tailing waste, Deep Sea Tailings, Diffusion, Dispersion

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## **KASSAM PASS ROAD SLOPE STABILITY EVALUATION**

*Gabriel Arpa, Benson Lauke*

*Mining Engineering Department, PNG University of Technology*

## **INTRODUCTION**

Slope failure is one of the very common problems that is catastrophic and affects both the natural and manmade surroundings and environment in many countries around the world today. Slope failures can occur naturally and also can be instigated by human actions and activities as well.

The potential of major catastrophic events of slope failure, both in terms of human safety as well as economy loss underlines the importance of efficient and reliable designs.

## **Problem Statement**

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In this research project, we studied the existing problem of slope failures at Kassam-Pass area which is located at the border of Eastern Highlands and Morobe Province of Papua New Guinea. The problem of slope failure there is an existing problem that costs millions of kina ever since the road was constructed and the problem is still ongoing. This ignites a need for further research and identify the real causes of the problem and provide effective approach to control and solve the problem.

### **Purpose & Rational of the study**

This study is to investigate the factors that contribute towards slope failures at Kassam-Pass. We should know that proper road networking systems play an important role to the development of the nation and also contribute effectively towards the wellbeing of the people. Therefore the main purpose of this project is to conduct researches and provide possible solutions to the problem at Kassam-Pass for Papua New Guinea National interest.

### **Discussion & Evaluation of results from Face Mapping & Lab Tests**

From the site investigation, face mapping and data collection it was seen that the rock materials present at the slope of the location where the major slope failure are incompetent. From the face mapping, we observed that the slope face has a lot of discontinuities and joints. Not only that but the two main rock units or types present in the area were identified as andesite. One highly altered and another is the fresh unit but it is highly jointed as well. Based on visual observation we concluded that the slope is prone to failure based on its present condition.

Finally, after collecting all the relevant information and data from site investigation and lab tests like RMR-basic value and joint set orientations against the slope face, the Slope Mass Rating of the cut-back slope at Kassam Pass where the major slope failure occurred was done. The Slope Mass Rating (SMR) value obtained is **7.65** and this value is in the *SMR range of 0-20* which represents the slope stability class of Completely Unstable (refer back to Table 8). Therefore, from the rating we can see that the newly cut back slope at Kassam-Pass is completely unstable meaning high vulnerability to slope failure.

### **Discussion & Evaluation of results from Site Investigation**

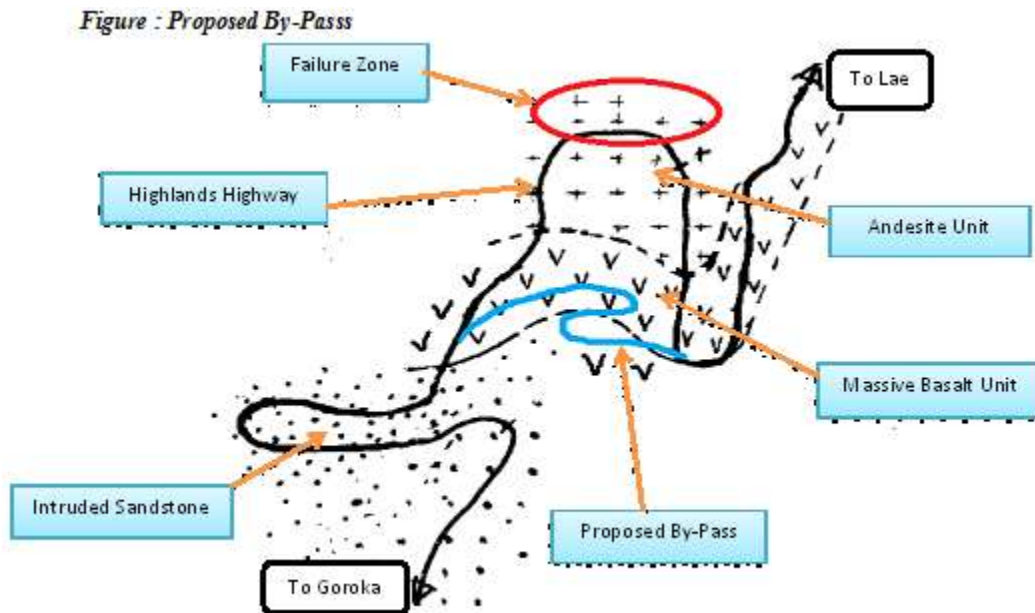
All the results obtained indicate that the major failure simply occurred because the rock material is very weak and incompetent. The rock mass is highly altered and disintegrated with multiple discontinuities or joint sets.

The cut back slope is highly vulnerable to planar, wedge or combination of both failure types based on the assessments done. The major failure that occurred at Kassam-Pass was a massive combination failure of both Plane and Wedge failure type.

## RECOMMENDATION

### *Long term:*

Failure occurred on the weak rock mass (unit). As long as that material is there, the problem will still remain. Therefore, the only way we can avoid this problem is to re-locate that part of the high-way to another fresh geology bypassing the problem region as per figure below.



### *Short term:*

- A well-planned surface water controlling system design must be made to carefully control all the surface water run offs. As a preventive measure, the water must be controlled by the provision of adequate drains on both the inside (uphill side) and outside of the road. Particular care should be taken to provide adequate drainage outlets which will not allow

haphazard release of the collected water back into the wet areas. Outlet drains should be directed towards natural waterway and the run off contained within these limits. This will help control and mitigate the state of current condition.

- All the heavy boulders and excess weights added on top of the crown of the existing failure zone must be removed as soon as possible and no more load should be added again. This has to be monitored and prevented to happen because adding more weight on to the crown of the existing slope failure poses a great risk to instigate another failure to occur.
- The steepness of the slope of the fresh cut back must be lessened or reduced because the rock is highly Altered and jointed with multiple discontinuities. Having steeper slopes on such type of weak materials is highly vulnerable to failure and so it's highly advisable to lessen the slope face down to prevent another failure.
- Recommend massive rock bolts if a competent unit is beneath or adjacent to the disintegrated unit for bolting. Otherwise rock bolt will not be that effective because the Andesite is highly altered and jointed with multiple discontinuities.

## **CONCLUSION**

Kassam-Pass is the transitional point where goods and services transit from low land to high lands. Not only that but, people also use this route to travel from coastal areas to High Lands and vice versa and this highlights the significance of the existing problem of Kassam-Pass. From the research done on the subject, we come up with some recommendations that are very important to take into consideration to mitigate and control the existing problem.

The recommendations proposed above are considered to effective for the current situation and issue at Kassam-Pass. Therefore, the specific authorities who are solely responsible and in charge to address this current issue should do more in-depth investigation in to this subject matter of concern and come up with better solutions for the problem. Especially the government of the day must take this seriously because this matter poses great risk to the lives and wellbeing of the citizen as well as the economy of the country.

Failing to take this matter seriously will result in loss of lives in the near future and also the government will continue to spend millions of Kina on the same problem every year in and out

trying to fix it. If better attention is given to the issue, I believe that the problem at Kassam-Pass will be solved once and for all for the betterment of the Nation as a whole.

**Mr. Manau Saki**

## **Metallurgical Characterization of Crater Mountain Gold Ore**

### **1.0 Introduction**

The Mt. Crater Gold project site is located in the Eastern Highlands Province of Papua New Guinea. The gold deposit is near the eastern end of the New Guinea Orogen geological province, which is hosts to number of other Au-Cu deposits including world's largest Grasberg Cu-Au mine in Indonesia, Ok Tedi Cu-Au mine, Porgera Gold Mine, Hidden Valley Gold Mine as well as other prospective deposits like Frieda River Copper, Yandera Copper-Molybdenum and Wafi-Golpu Copper-Gold.

The Mt. Crater Gold project has three major gold mineralization prospects namely; Nevera, Awanita and Nimi. The current focus is on the Nevera prospect which comprises three distinctive ore zones (see Figure 1).

- (i) Mixing zone – large low sulphidation, low grade carbonate-base metal sulphide-gold deposit.
- (ii) High-grade zone (HGZ) – a high sulphidation and high grade epithermal quartz-pyrite gold.
- (iii) Porphyry Au-Cu zone at depth below 800m

Currently, the strategy is to develop the High Grade Zone (HGZ) as an area of small scale mining of gold, which is vital to finance the ongoing drilling and exploration programs of the Mixing zone and other identified potential sites.



Figure: 1 – Nevera Prospect

## 1.1 Problem Statement

No detail metallurgical assessment were conducted on the Mt Crater gold ore, the High Grade Zone (HGZ) to ascertain the forms in which gold occurs in the ores, gold size distribution across wide range as well as the association characteristics of gold, such information is crucial to determine the suitable recovery processes.

In the High Grade Zone (HGZ) small scale mining activities were carried out by locals in 2005 – 2012 which resulted in 15,000 ozs of gold being recovered. The HGZ is identified by geologist as the high sulphidation with high grade epithermal quartz – pyrite gold.

The questions this research attempts to answer are; in what form is the gold? Is it mainly associated with pyrite or quartz or in combination of both? In what size range does the gold mainly occur?

## 2.0 Objective

The objective of this research is to conduct a series of detailed metallurgical testwork on the High Grade Zone and provide this valuable information to the Crater Gold Mining company to assist them in strategizing their development and mining activities of the HGZ. This information will help in optimizing their pilot plant processing operations.

## 2.1 Overall Objective for Crater Gold Mine

The metallurgical test program will consist of detailed mineralogical and metallurgical characterization of the HGZ ore.

## 2.2 Specific Objectives

- (i) To perform mineralogical analyses to identify the gold-bearing phases and other associated mineral phases in milled product samples and ores.
- (ii) To determine the distribution of gold across size ranges and establish the liberation size.
- (iv) If the gold is fine a further Cyclosizing analysis be carried out to ascertain the level of gold fineness.

## 3.0 Process Description – Pilot Plant

At present Crater Gold employs a pilot-scale like processing plant with a mill through-put of 1.88 tph. The feed for the pilot-scale plant comes from the mine adit.

The ore is processed by grinding it with the hammer mill and the ground materials from the mill is fed to concentrators for gold recovery. The tails from the concentrator is fed to the shaking table with the shaking table tails finally discharged into a tailings pond. The concentrate collected from the concentrator and shaking table were taken to the gold room where it was further treated by feeding it onto a small Gemini shaking table and concentrate was finally dished with a gold pan, later dried and weighted.

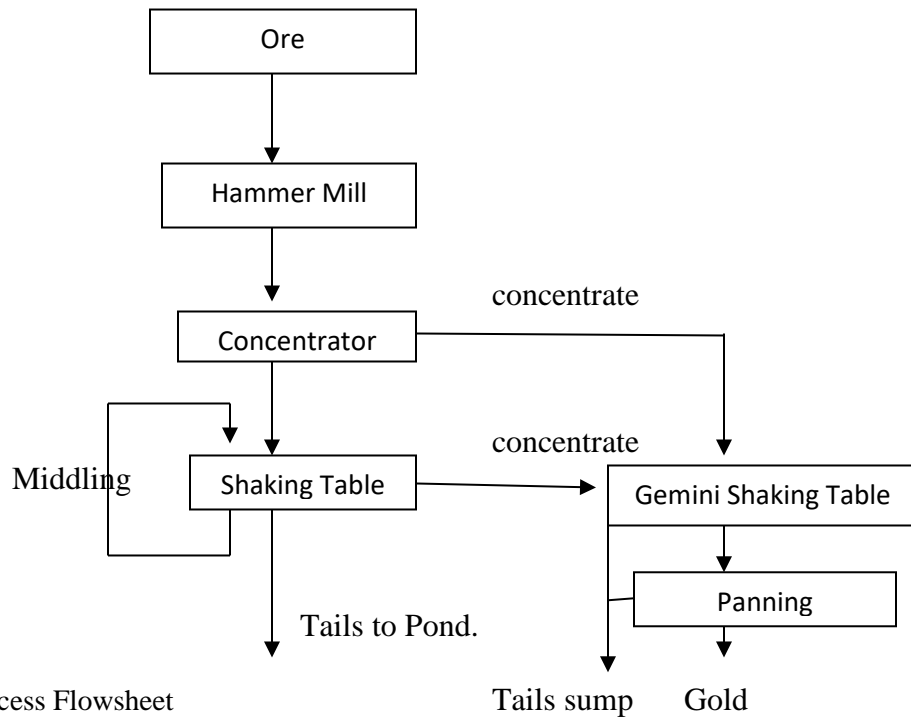


Figure: 2 – Process Flowsheet

#### 4.0 Ore Sample

The samples were delivered to the Mining Engineering Department at PNG University of Technology Lae with each sample being marked as;

- (i) Shaking Table Concentrate (Sample -1)
- (ii) Shaking Table Middling (Sample – 2)
- (iii) Shaking Table Tail (Sample – 3)

These samples were received with specific instruction from Crater Gold Mine to carry out sizing analysis using these specific sizes of 1.18mm, 850 $\mu$ m, 300 $\mu$ m, 106 $\mu$ m and chemical assays for certain elements such as gold (Au), Silver (Ag), Iron (Fe) and sulphur (S).

Due to the urgent request by Crater Gold Mine work started immediately on these samples.

The three samples were prepared by drying and split into smaller representative sample for sizing analysis and chemical assay as requested.

The samples from the sizing analysis carried out on the three Shaking Table Products have been prepared into mould and polished to be inspected under the optical (reflected light) microscope with camera mounted for photomicrograph.

## **5.0 Results and Conclusions**

Sizing analysis performed on the three sample streams, from Shaking Table, a calculated feed data was established and from this data it was determined that most gold is distributed in the +106 micron fraction with 58%, followed by 19.9% in -106 microns with 19.3% in +300 microns, other sized fractions were insignificant. Referring to the process flowsheet (Fig 2) the coarse gold is already being removed by the concentrator and the shaking table deals with the fine gold stuff.

The overall recovery of gold in the shaking table operation is 69% which is good; normally you would expect a gravity equipment recovery efficiency to be in the range of 65% to 75%.

It was also found that the loss of gold occurred mainly in the +300 micron size range to the middlings, with only 44% was recovered to the concentrate and the rest were lost to middling.

From the Mineralogical examination, the Microscopic Optical estimation technique was used to estimated ore or mineral content in the microscopic view.

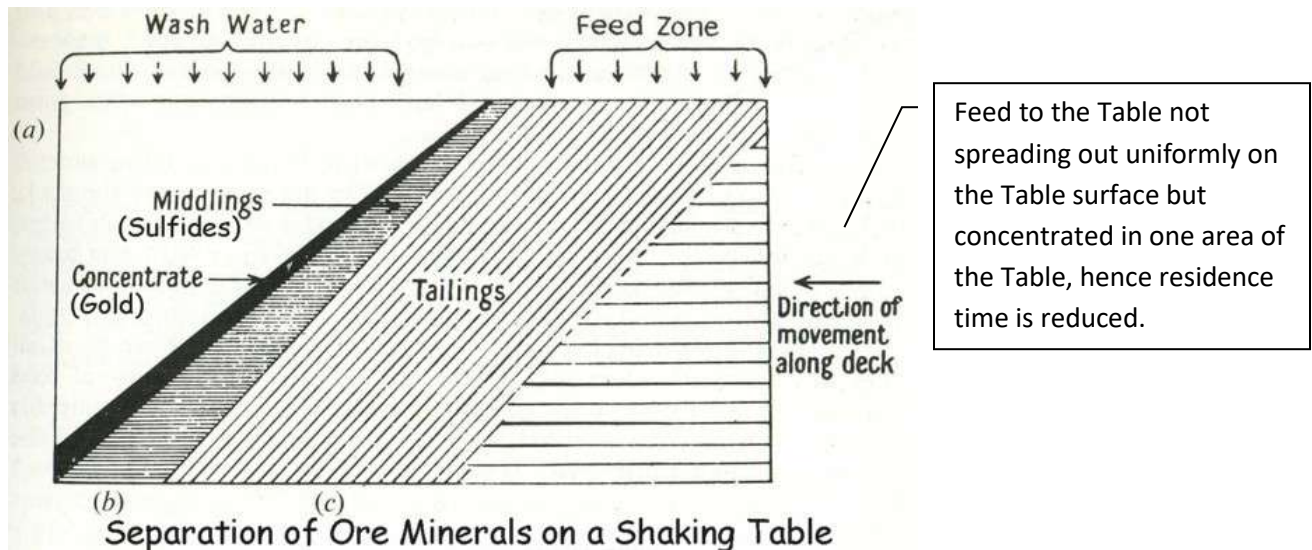
From the mineralogy study, it shows that gold recovered to the concentrate are all associated with sulphide or pyrite and gold lost to tailing are associated with quartz or oxidized gangue mainly limonite.



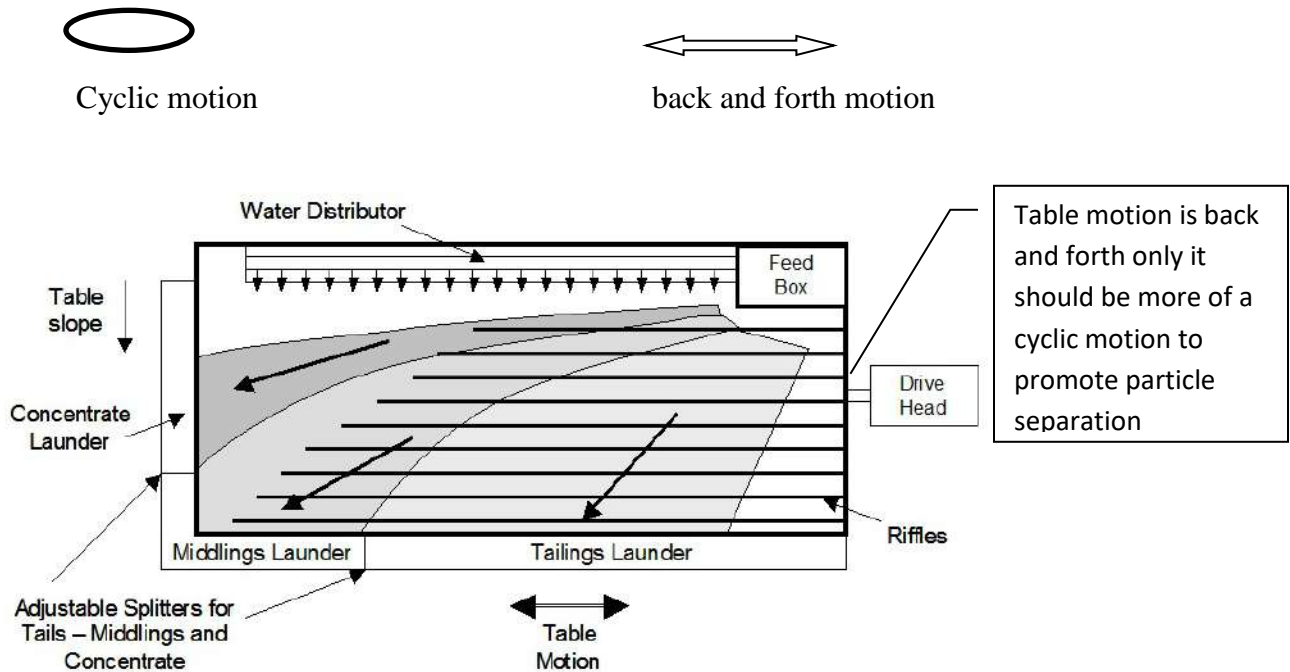
## 6.0 Recommendation

Shaking Table Middling sizing analysis shows that the 300 micron size fraction contained 59.5% sulphur which constitute the sulphide minerals and we know from the concentrate that the sulphide is hosting the gold so if we concentrate on the 300 $\mu$ m size range and recover at least another 4 or 5% of the sulphide minerals (pyrite) we can increase the overall recovery by another 4 – 5% to reach the anticipated recovery of 74 or 75%.

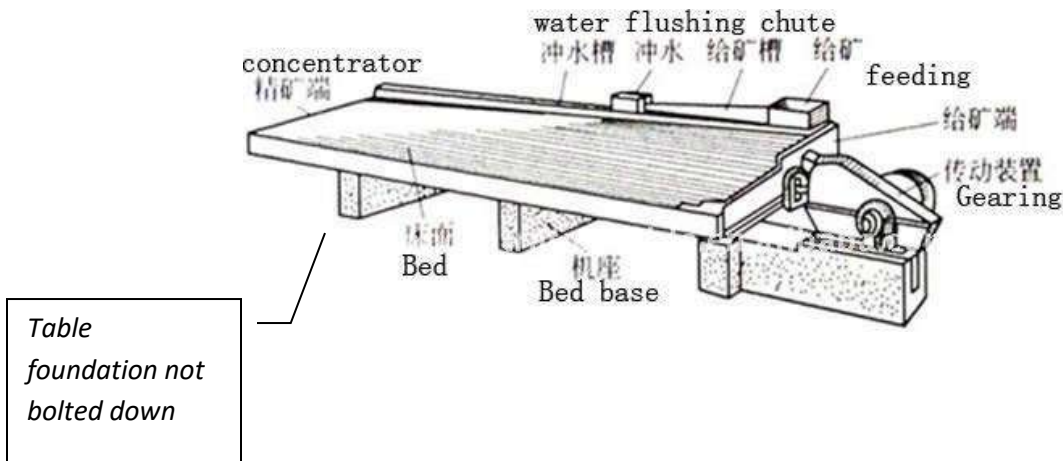
During the plant site visit it was discovered that the Shaking Table was not operating efficiently which resulted in loss of gold to the middlings and tails. The feeding arrangement of the ore to the Shaking Table were not uniformly spread across the table surface as a result the table was operating at 50% availability reducing the residence time each particle spend on the table before being discharged.



Another problem sighted was the motion of the shaking table was not correct were it should have revolved around in a cyclic motion instead it move in a straight-line motion of back and forth.



The third problem was the table foundation was not bolted down which created a lot of vibration to the table.



### 7.0 Further Research Work

New Samples taken from the Feed to the Pilot Plant operation, the ore to the feed was extracted from Level 3 in the underground mining area.

With this sample, a detailed mineralogical and metallurgical characterization of the HGZ ore to ascertain the level of gold content in the ore prior to being process by the pilot plant.

The specific objective of the research will focus on investigating;

1. The percentage of gold in the coarse fraction above +300 microns and the percentage of fine gold in the minus 300 micron size range.
2. The percentage of gold associated with sulphide minerals compared with percentage of gold associated with quartz and limonite
3. Whether the gold associated with sulphide is free milling or locked with sulphide.
4. Whether the gold associated with the quartz and limonite is free milling or locked in this matrix.

**MS. MARY KAMA, SENIOR TECHNICAL INSTRUCTOR**

**Research priority Areas**

- Calcination and Quality tests on Elimbari lime stone from Chuave in Simbu Province.
- Isothermal carbothermic reduction of iron oxide and production of sponge iron from 4 different material from Ok Tedi magnetite Skarn Ore (MPhil Research Project).
- Further research activities to extract iron from tails from other existing Mines in PNG.
- Further research to increase grade of sponge iron produced from pyrite concentrates- mini steel industries.
- Calcination & quality testing for Manus & Finshafen lime stone deposits

**Abstracts of Publications made**

**1.) Reaction kinetics of iron oxides in the tails of floated Ok Tedi magnetite skarn ore**

<sup>1</sup>M. Kama and <sup>2</sup>K. Gena

**Abstract**

The Magnetite skarn ore (MSO) is one of the many sulfide ores that are mined by Ok Tedi Mining Limited (OTML). Copper minerals are floated and collected as copper concentrates whilst pyrite, iron oxides and other gangue minerals form the tails. Hence, economic grade and quantity of iron are lost in the tailings as sulfides and oxides. Therefore, the objective of this paper is to investigate the iron ore reaction kinetics (IORK) of the iron oxides so that sponge iron can be produced for mini steel plants in Papua New Guinea.

About 1 kg of MSO sample was used for the flotation test work. Several flotation tails samples were reduced by coconut charcoal carbón at various temperatures and times. Control and fluxed samples were compared.

The EDAX analyses of:-

- (i) unfloated Ok Tedi MSO tails showed; 50.1 % Fe, 31.7 % O, 6.2 % C, 4.5 % Si, 2.4 % Ca, 1.9 % S, 1.9 % Mg, 0.7 % Al, 0.4 % Mn, 0.2 % K and 0.1 % P.
- (ii) fluxed sample reduced at 1000 °C in 60 minutes showed; 42.2 % Fe, 23.3 % C, 21.5 % O, 5.0 % Ca, 3.1 % S, 2.5 % Si, 0.9 % Mg, 0.6 % K, 0.4 % Al, 0.3 % Mn, 0.3 % Cu and 0.1 % P.
- (iii) control sample reduced at 1000 °C in 60 minutes showed; 50.2 % C, 27.9 % Fe, 13.0 % O, 3.0 % S, 2.2 % Si, 1.7 % Ca, 0.8 % Mg, 0.4 % K, 0.3 % Mn, 0.3 % Al, 0.2 % Cu and 0.1 % P.

The results suggested that the reduction of fluxed samples produced higher grade of metallic iron at 1000 °C. However, the results also showed that the CO<sub>2</sub> was unstable at this temperature and beyond 60 minutes. Therefore, reduction temperature and time need to be kept below 1000 °C and 60 minutes, respectively for better results.

<sup>1</sup>Lecturer in Mineral Processing Engineering, Department of Mining Engineering, Papua New Guinea University of Technology, PMB Lae, Morobe Province, Papua New Guinea.  
Corresponding Author Email: [mkama@mining.unitech.ac.pg](mailto:mkama@mining.unitech.ac.pg)

<sup>2</sup> Associate Professor in Geology, Department of Mining Engineering, Papua New Guinea University of Technology, PMB Lae, Morobe Province, Papua New Guinea.

**2.) Reaction kinetics of iron oxides in the Ok Tedi pyrite concentrates**  
*(Paper Accepted for Publication at Minerals Engineering Institute 2016)*

<sup>1</sup>M. Kama, <sup>2</sup>N. Kama, <sup>3</sup>P. Leki,

**Abstract**

Large quantities of iron in the form of pyrite were discarded as tailings from the Ok Tedi copper mine in Papua New Guinea, thus causing environmental problems through acid drainage around the Ok Menga riverine area. A pyrite plant was built to concentrate the pyrites and stored under water table at Bige dam. This investigation was conducted to establish the reaction kinetics of extracting the iron in the pyrite concentrates to produce sponge iron for commercial purposes.

Roasting processes were carried out in a muffle furnace at varying temperatures and times. Particle sizes of the samples ranges between 106  $\mu\text{m}$  and 150  $\mu\text{m}$ . Coconut charcoal was used as the reducing agent and calcium oxide as the fluxing agent.

The reaction kinetics was marginally higher at temperatures above 800 °C. Although, oxygen was not completely removed, the iron content was upgraded to 72 % due to the removal of sulfur.

**Key words:** pyrite, concentrates, sponge iron, kinetics, tailings.

<sup>1</sup>Lecturer in Mineral Processing, Mining Engineering Department, PNG University of Technology, Papua New Guinea. Corresponding Author Email: [mkama@mining.unitech.ac.pg](mailto:mkama@mining.unitech.ac.pg)

<sup>2</sup>Graduate Metallurgist, Ok Tedi Mining Ltd, Western Province, PNG.

<sup>3</sup>Plant Metallurgist, Barrick Pogera, Enga Province, PNG.

**3) Reaction Kinetics of iron oxides in Ok Tedi Magnetite Skarn Ore**  
(*Paper published in the International Mineral Processing Congress IMPC 2016*)

Mary Kama and Kaul Gena

Department of Mining Engineering, Papua New Guinea University of Technology, PMB Lae, Morobe Province, Papua New Guinea.

**Abstract**

The objective of the paper is to investigate the iron ore reaction kinetics (IORK) of a naturally occurring Ok Tedi magnetite skarn ore (MSO) by isothermal carbothermic reduction using coconut charcoal, lime flux and sugar cane juice as a binder.

Magnetite skarn ore is one of the copper bearing ore types mined from the Ok Tedi Copper Mine. The copper minerals are floated to concentrate the copper while the iron oxides and iron sulphides are discarded as tailings. Content of iron in the tailings are of substantial quantity and grade that it can be extracted and use as a source for sponge iron for mini steel plants in Papua New Guinea. The SEM-EDAX analyses of the Ok Tedi magnetite skarn ore indicated 10.1 % C, 30% O, 0.6% Mg, 1.1% Si, 21.1% S, 0.8 % Ca and 36.2 % Fe. Most of the iron in the Ok Tedi MSO occurs as pyrites and in oxide form.

Ok Tedi MSO samples of various size fractions, -106+53  $\mu\text{m}$ , -250+106  $\mu\text{m}$  and -425+250  $\mu\text{m}$  were reduced by coconut charcoal carbon at temperatures 800 °C, 900 °C and 1000 °C for reduction times of 10 to 90 minutes. The SEM-EDAX analyses of the reduced products of -250+106  $\mu\text{m}$  particle size indicated 30-40 % Fe at 800 °C, 40-50% Fe at 900 °C and 50-60 % Fe at 1000 °C. An increase in oxygen and decrease in sulphur compositions was observed. The XRD results indicated high iron in the form of hematite, magnetite, wustite and metallic iron in the reduced products at reducing temperatures of 900 °C and 1000 °C.

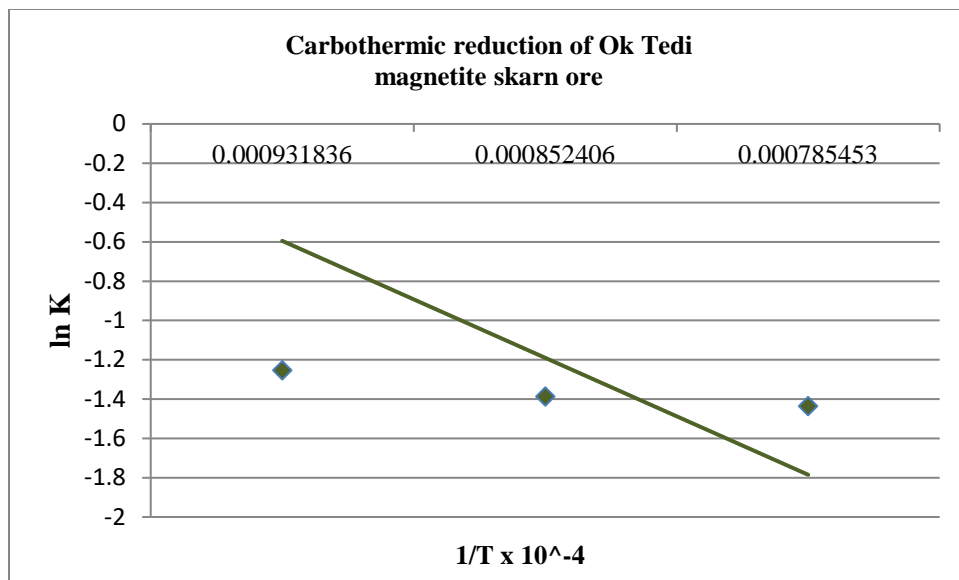


Figure 1 Arrhenius plot for Ok Tedi MSO pellets (-425 + 53  $\mu\text{m}$ ) reduced by coconut charcoal carbon for reaction:  $\text{FeO} + \text{CO} = \text{Fe} + \text{CO}_2$

Results of isothermal carbothermic reduction of Ok Tedi MSO showed that the reaction kinetics increases with increasing temperature and time. Figure 1 show that the reduction energy required to reduce the wustite to produce sponge iron is higher since the transfer of heat and reduction rates depend on the carbon gasification. Fluxing did not affect the reduction of the iron oxides significantly. Only a slight increase in kinetics was observed with reduced particle size. Besides, the reaction rate constant (k) did not vary much within the temperatures investigated, according to the kinetic model in Figure 2.

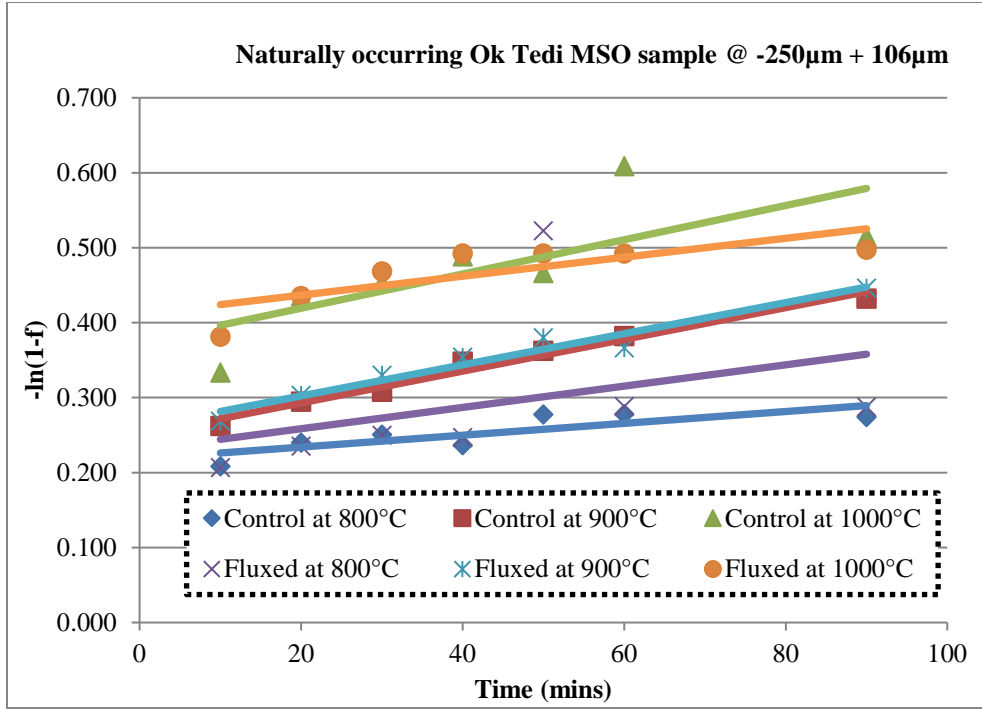


Figure 2 - Kinetic model plots of  $-\ln(1-f)$  versus reduction times for reduced naturally occurring Ok Tedi MSO of particle size  $-250+106 \mu\text{m}$ .

Reduction of iron oxides in the Ok Tedi MSO increases with increasing reduction time. Thus, prolonged time of reduction at  $900^\circ\text{C}$  would most likely produce high grade iron. However, close monitoring of temperature and reduction time are essential. Reduction rate increases with increase in both temperature and time of reduction but limited to re-oxidation. Hence, the overall rate of reduction appears to be controlled by  $\text{C}/\text{CO}_2$  reaction or carbon gasification reaction. Therefore, the IORK of Ok Tedi MSO is limited to further investigations within reducing temperature of  $900^\circ\text{C}$ . In conclusion, this study has found that it is possible to produce high grade iron from the Ok Tedi MSO.

Keywords: oxidation, magnetite, flux, skarn, ore, carbon, pyrite, reduction, sponge iron, reaction kinetics and roasting.

[https://www.google.com.pg/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&cad=rja&uact=8&ved=0ahUKEwjDhOrGg7\\_LAhUJopQKHevEBpcQFggmMAI&url=https%3A%2F%2Fsecurity.gibsongroup.ca%2Fimpc%2Fabstracts%2Fimpcabs664.docx&usg=AFQjCNHTR-5XBGVtkeLUJzYuZ9wPOO\\_p0g](https://www.google.com.pg/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&cad=rja&uact=8&ved=0ahUKEwjDhOrGg7_LAhUJopQKHevEBpcQFggmMAI&url=https%3A%2F%2Fsecurity.gibsongroup.ca%2Fimpc%2Fabstracts%2Fimpcabs664.docx&usg=AFQjCNHTR-5XBGVtkeLUJzYuZ9wPOO_p0g)



## **DEPARTMENT OF SURVEYING AND LAND STUDIES**

**Head of Department: Professor Dilip Kumar Pal**

### **A. Priority Research Areas of the Department**

The department's research activities revolve around the pivot 'Land and allied resources' optimum utilization, management and valuation; Climate studies, Disaster Risk Reduction and Disaster Risk Management. The department is primarily involved in the process of developing human resources adept in the holistic management of land resources and to eke out best value out of them in a sustainable manner through coordinated research activities. It is also actively involved in finding solution to Disasters Risks and Disaster Management, Disaster linked to climate change, tectonic activities. The human resources developed in the department have a wide exposure to the state of the art technology e.g. recent developments in the field of Remote Sensing, Geographic Information Systems, Photogrammetry, Global Positioning System / GNSS, use of latest Total Stations and allied implements of the digital era.

The department is also involved in a number of research programs including densification of Benchmark points for PNG using latest GPS / GNSS technology, GIS, remote sensing, and cartographic communication through development of thematic maps for PNG, property valuation and land management research programs as well as student projects.

Some specific areas are given below:

- 1) Climate change studies
- 2) Land suitability for Rice cultivation in PNG using Remote Sensing and GIS
- 3) Forest Biomass monitoring using Remote Sensing and GIS
- 4) Forests and Societal management
- 5) Inventorying Environmental Resources
- 6) Disaster Risk Reduction / Disaster Risk Management (DRR & DRM)
- 7) Urban sprawl detection
- 8) Groundwater mapping
- 9) Land use planning and management
- 10) Land Administration studies
- 11) Migration studies
- 12) Asset valuation studies
- 13) Cadastral Data Modeling
- 14) Management of incorporated land groups (ILG)
- 15) GNSS Survey and Vertical Adjustment of Madang Network
- 16) GIS In Customary Land Tenure Investigation
- 17) RS & GIS in Urban and Regional Planning
- 18) Mining and Its Impacts on Property Market
- 19) Residential Property Management
- 20) Public Educational Facility Management
- 21) Property Development Process in Papua New Guinea
- 22) Low Income Housing in PNG: Challenges and Opportunities
- 23) AHI land mobilization policy
- 24) Impacts on customary land owners under Plantation Redistribution Scheme

- 25) Impacts & effects of special agriculture and business lease (SABL) on customary land owners
- 26) Causes and effects of urban land values
- 27) Road Alignment (Horizontal/Vertical)
- 28) Drainage Design
- 29) Subdivision Design
- 30) Control Surveys using GPS/GNSS
- 31) Local Geoid study using GPS heighting on heightened MSL Benchmarks
- 32) GPS/GNSS to Cadastral Surveying in PNG
- 33) Infrastructure Development Surveys
- 34) Geodetic Control Surveying using GPS/GNSS
- 35) ILG (Integrated Land Groups) Customary Land Registration, etc.

## **B. List of Scientific Paper Publications in Peer Reviewed Journals**

### **International**

1. Akike, S. and Samanta, S. (2016). Land Use/Land Cover and Forest Canopy Density Monitoring of Wafi-Golpu Project Area, Papua New Guinea. *Journal of Geoscience and Environment Protection*, 4, 1-14. doi. 10.4236/gep.2016.48001
2. Bhunia, G. S. Shit, P. K. and Pal, D. K. (2016). Channel dynamics associated with land use/cover change in Ganges river, India, 1989–2010; *Spatial Information Research*, 24 (4), 437-449
3. Das, R. K., Samanta, S., Jana, S. K., and Rosa, R. (Forthcoming 2016). Polynomial Interpolation Methods In Development of Local Geoid Model, *The Egyptian Journal Remote Sensing and Space Sciences*, Elsevier Publication, ISSN 1110-9823 submitted.
4. Jana, S.K., Sekac, T. and Pal D. K., (2016). Integrating Remote Sensing and GIS for Investigating Malaria Risk areas in Morobe Province-Papua New Guinea, *International Journal of Current Research*, ISSN 0975-833X Vol. -8, Issue 8
5. Karigawa L., Babarinde, J. A. and Holis, S. S. (2016): Sustainability of Land Groups in Papua New Guinea. *Land Journal*; 2016, Vol. 5, No. 14, 23-Feb; Multidisciplinary Digital Publishing Institute (MDPI- Online), Switzerland.
6. Manisa, M., Das, R.K., Segobye, M. et al. (2016). Developing local geoid model to assess accuracy of orthometric heights from GPS-based ellipsoidal heights in Botswana, *Spatial Information Research*, Springer Publication, Volume 24, Issue 5, pp 607–616, doi:10.1007/s41324-016-0057-3, [http://link.springer.com/article/10.1007/s41324-016-0057-3?wt\\_mc=alerts.TOCjournals](http://link.springer.com/article/10.1007/s41324-016-0057-3?wt_mc=alerts.TOCjournals)
7. Michael, A. E. and Samanta, S. (2016). Landslide vulnerability mapping (LVM) using weighted linear combination (WLC) model through remote sensing and GIS techniques, *J Modeling Earth Systems and Environment*, Springer, 2(2), 1-15. doi. 10.1007/s40808-016-0141-7

8. Rosa, R., Jana, S. K., Das, R. K. and Pal, D.K. (2016). Evaluation of Orthometric Heights from GPS Survey Using a Geoid Model– A Case Study for Madang, Papua New Guinea, *International Journal of Advancements in Research & Technology*, ISSN (online): 2278-7763, Volume 5, Issue 5, May-2016
9. Samanta, S., Koloa, C., Pal, D.K., Palsamanta, B. (2016). Flood Risk Analysis in Lower Part of Markham River Based on Multi-Criteria Decision Approach (MCDA). *Hydrology*, 3(3), 29. [doi:10.3390/hydrology3030029](https://doi.org/10.3390/hydrology3030029)
10. Samanta, S., Koloa, C., Pal, D. K., and Palsamanta, B. (2016). Estimation of potential soil erosion rate using RUSLE and E30 model, *J Modeling Earth Systems and Environment*, Springer, 2(3), 1-11. [doi. 10.1007/s40808-016-0206-7](https://doi.org/10.1007/s40808-016-0206-7)
11. Samanta, S., and Pal. D. K., (2016), Change Detection of Land Use and Land Cover over a Period of 20 Years in Papua New Guinea, *Natural Science*, 8 (3), 138-151. doi. 10.4236/ns.2016.83017
12. Samanta, S., Pal, D.K., Aiau, S.S. and Palsamanta, B. (2016). Geospatial Modeling of Solar Radiation to Explore Solar Energy Potential in Papua New Guinea. *Spatial Information Research*. Springer, 24(5), 531-544, [doi. 10.1007/s41324-016-0050-x](https://doi.org/10.1007/s41324-016-0050-x)
13. Samanta, S., and Paul S. K. (2016). Geospatial analysis of shoreline and land use/land cover changes through remote sensing and GIS techniques, *J Modeling Earth Systems and Environment*, Springer, 2(3), 1-8. doi. 10.1007/s40808-016-0180-0
14. Sekac, T., Jana, S. K., Pal, I. and Pal, D.K. (2016). Earthquake Hazard Assessment in the Momase Region of Papua New Guinea, *International Spatial Information research*, Springer publication, ISSN: 2366-3286 (print version) ISSN: 2366-3294 (electronic version) <http://link.springer.com/article/10.1007%2Fs41324-016-0058-2>
15. Sekac, T., Jana, S. K., Pal, I. and Pal D. K. (2016). GIS Based Multi-Criteria Evaluation in Earthquake Hazard Micro-Zonation-A Case study of Madang and Morobe Province, Papua New Guinea, *International Journal of advanced Engineering Research and Science*, <https://dx.doi.org/10.22161/ijaers.3.8.2> ISSN 2349-6495 (P) 2456-1908 (O) Vol. -3, Issue 8 Page 95-104
16. Sekac, T., Jana, S. K., Pal, I. and Pal, D. K. (2016). A GIS Based Approach into Delineating Liquefaction Susceptible Zones Through Assessment of Site-Soil-Geology-A Case Study of Madang and Morobe Province in Papua New Guinea (PNG), *International Journal of Innovative Research in Science, Engineering and Technology*, ISSN (Online): 2319-8753 Vol. 5, Issue 5, May 2016

## National

17. Babarinde, J. A., Holis, S. S., and Adu-Mcwie, R. (2016). Bridging the Gap between Physical (Environmental) Planning Legislation and City Liveability in Papua New Guinea: Reality or Fantasy? *Melanesian Journal of Geomatics and Property Studies*, ISSN (Online): 2414-2557 Vol. 2

18. Motoro, P., Babarinde, J. A. and Holis, S. S. (2016). Perpetuation of informality in the face of rising demand for standard housing in Port Moresby, Papua New Guinea; *Melanesian Journal of Geomatics and Property Studies*, ISSN (Online): 2414-2557 Vol. 2.
19. Seniela, J., Babarinde, J. A. and Holis, S. S. (2016). An assessment of public housing components in Port Moresby and Lae cities using Principal Component Analysis (PCA); *Melanesian Journal of Geomatics and Property Studies*, ISSN (Online): 2414-2557 Vol. 2.
20. Sekac, T., Jana, S.K. (2016): Space borne Technology into assess & Monitoring Busu River Bank Erosion -Lae, Papua New Guinea, *Melanesian Journal of Geomatics and Property Studies*, ISSN (Online): 2414-2557 Vol. 2.
21. Wesley, T., Jana, S. K. and Kari, L. (2016). Preliminary Site Selection for Small-Scale Hydropower Potentials, in Bulolo, Morobe Province, Papua New Guinea: GIS & RS Approach, *Melanesian Journal of Geomatics and Property Studies*, ISSN (Online): 2414-2557 Vol. 2, Issue 1, 22.

### **C. List of Conference Proceedings Publication**

1. Babarinde, J. A. (2016). Application of a Holistic Land Development Model for City Sustainability: A Flux of Messy Situations Extending the Frontiers of Planning Theory, 52nd ISOCARP Congress, Durban, South Africa (Conference Track 4 Paper), 12-16 September, 2016 pp. 1-17.  
[http://isocarp.org/app/uploads/2016/09/ISOCARP2016\\_CongressProceedings-4-6.pdf](http://isocarp.org/app/uploads/2016/09/ISOCARP2016_CongressProceedings-4-6.pdf)
2. Jana, S.K., Sekac, T. and Pal, D. K. (Upcoming): Exploring Vulnerable areas for Malaria in Morobe Province of Papua New Guinea - Remote Sensing and GIS as Potential Tools, Geospatial World forum, 23-25 Jan, 2017 | Hyderabad, India. . (Paper was accepted for oral Presentation)
3. Pal, D K. (2016). Science of Climate Change, PNGUT Team visit to Anna University, Centre for Climate Change and Adaptation Research, Chennai, India on 25/01/2016.
4. Pal, D K. (2016). Climate Change –Enigmatic Triggers, International Conference of Regional Science Association India on Urbanisation and Regional Sustainability 28th -30th January, 2016, Regional Science Association India, at Centre for Research in Nanoscience and Nanotechnology, University of Calcutta, Technology Campus, Salt Lake City, India.
5. Pal, D. K., Pal, S. and Schram, A. (2016). Climate Change - International Response; Proc. 8th International Congress of Environmental Research, Journal of Environmental Research and Development, pp 191 Issue: SS/I/210, July'2016.
6. Samanta, S. (2016). Modelling of Climate attributes through Remote Sensing and GIS Techniques, PNGUT Team visit to Anna University, Centre for Climate Change and Adaptation Research, Chennai, India on 25/01/2016.

7. Sekac, T., Jana, S. K., Pal, I. and Pal, D. K. (Upcoming): **GIS and Remote Sensing Approach in Earthquake Hazard Assessment and Monitoring: A Case Study in the Momase Region of Papua New Guinea**, Conference Proceedings of the ICESE 2017 : 19th International Conference on Earthquake and Structural Engineering to be held in London, United Kingdom during February, 16-17, 2017. (Paper was accepted for oral Presentation)

#### **D. Book Chapters in Professional Edited Books:**

1. Babarinde, J. A. (2015/6), **Contribution on Papua New Guinea**, in: Ryser, J. and Franchini, T. (eds), International Manual of Planning Practice, International Society of City and Regional Planners, The Hague: The Netherlands, pp 228. Released in 2016

[http://www.worldcat.org/title/international-manual-of-planning-practice-impp/oclc/949266247&referer=brief\\_results](http://www.worldcat.org/title/international-manual-of-planning-practice-impp/oclc/949266247&referer=brief_results)

2. Babarinde, J. A., 2016 edition, “**Land Economics**,” In: Agbola, Tunde (Ed.), Readings in Urban & Regional Planning in Nigeria, MacMillan, Ibadan: Nigeria (2014 edition now under review).

#### **E. List of Unitech Seminar Presentations**

Rabindra Kumar Das (2016). **Development of a Local Geoid Model.**

UNITECH Research Committee Seminar – 24/2016. Presentation made at the weekly Unitech Staff/Students Academic Seminar, Rose Kekedo Foyer, Unitech Campus, Lae, Tuesday, November, 29.

## Research Conducted by PG Students

The following group of PG students completed their research/studies in 2016 and graduated in 21<sup>st</sup> April 2017

Name of the Student	Department	Program	Thesis Title	Supervisor (s)
Brian TAKOBOY	<b>AGRICULTURE</b>	MPhil	Symbiotic Bacteria of Entomopathogenic Nematode as Biopesticide against Cocoa Pod Borer, <i>Conopomorpha cramerella</i> (Snellen)	Dr M. Maino
Burie BOGAN		MPhil	Factors Influencing Smallholder Sweet Potato Marketing Costs, Margins & Efficiency in Two Major Distribution Centers in Papua New Guinea	Dr P Manus
Malcolm KABIWAGA		MSc	Investigating Wild Swamp Rice ( <i>Lersia hexandra</i> ) Diversity in Papua New Guinea	Dr T Okpul
Aloma MOTAMOTA		MSc	Study of <i>Colletotrichum</i> spp. Causing Anthracnose Disease on Yam ( <i>Dioscorea alata</i> )	Dr M Maino
Melanie PITIKI		MSc	Isolation, identification and Evaluation of Prevalent Fungal Endophytes for Agarwood Induction in Eaglewood Tree Species of Papua New Guinea	Dr M Maino and Dr T Okpul
Zina BIRD		MSc	Dietary Patterns of Households in West Taraka Peri-urban Settlement in Lae, Morobe Province, Papua New Guinea	Dr V Bue
Priscilla POLONA		MSc	Broiler Production by Smallholders in Eastern Highlands Province of Papua New Guinea	Dr K Elahi
Philip KAUPA		<b>APPLIED SCIENCES</b>	MPhil	Removal of Heavy Metals Species from Water Using Peels of Tuber and Root Products as Simple and Cost-Effective Purification Method

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Carl Anthony SMITH	<b>CIVIL ENGINEERING</b>	MPhil	Sustainable Rainwater Harvesting System (SRHS) - In Lae City - A Model for Papua New Guinea	Dr M Betasolo
Justin Severin KEHATSIN	<b>COMMUNICATION AND DEVELOPMENT STUDIES</b>	PhD	Unlocking Conflicts in Public Universities in Papua New Guinea	Dr G Sali and Prof E Gilder
Willie PILAILO		Master of Communication Studies (MCS)	The Challenge of Preventing Violence against Women in Lae City: Communicating an Integrated Approach of Engaging Men as Partners in Prevention of Gender Based Violence	Dr G Sali and Dr A Yaraepa
Richard Paul KOTTSON		MCS	Using Effective Communication to Address Learning Barriers at UPNG Distant Learning Institutions: A Case Study of UPNG Open College (Morrobe, Kainanto, and Mt hagen)	Dr A Yaraepa and Prof E Gilder
Andrian SANGUNDI		MCS	A Case Study in Identifying Factors That Force Boys into the Streets of Lae City: A Platform Towards Developing an Appropriate Communication Strategy in Assisting Children Being Responsible.	Dr R Orake and Dr A Yaraepa
Joshua YUANKO	<b>ELECTRICAL AND COMMUNICATIONS ENGINEERING</b>	MPhil	Model of a Smart Energy Control System for Palm Oil Processing Plant Using Hybrid Fuzzy-PID Controllers	Prof K Pirapaharan
Cassidy KAUSIK	<b>FORESTRY</b>	PGD	Factors Affecting Food Plant Utilization of <i>Omithoptera goliath</i> (Goliath Birdwing) in Gumi Village, Morobe Province, Papua New Guinea	Dr L Orsak
Stephanie KONTIS	<b>MECHANICAL ENGINEERING</b>	M Tech	Effects of Marine Corrosion at Old Loading Structure of Lae Port	Prof N Lambrache



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Justiniano Salvador GUTERRES	<b>SURVEYING AND LAND STUDIES</b>	M Tech	Static Torsional Stress Simulation and Experimental Evaluation on Mechanical Components	Prof N Lambrache
Victor Sao HOASIRAO		M Tech	Design Optimization on Alluvial Gold Suction Dredges	Prof N Lambrache
Tingneyuc SEKAC		MPhil (Geomatics)	GIS and Remote Sensing Approach in Earthquake Hazard Assessment and Monitoring in the Momase Region of Papua New Guinea	Dr SK Jana and Dr I Pal
Wesley TAPULU		MPhil (Geomatics)	Preliminary Site Selections for Small- Scale Hydro Power Developments Using Integrated Remote Sensing and GIS Technology in Bulolo, Morobe Province, Papua New Guinea	Dr SK Jana and Mr L Kari
James SENIELA		MPhil (Property Studies)	An Evaluation Of The Current Affordable/Public Housing Initiatives for Resolving Housing Crisis in Papua New Guinea - A Case Study of Port Moresby and Lae Cities.	Prof J Babarinde and Mr S Holis
Paulus MOTORO		MPhil (Property Studies)	A Comparative Analysis of Residential Property Markets in Informal settlements and Formal Residential Areas of Port Moresby and Lae.	Prof J Babarinde and Mr S Holis
Josiah JOSEPH		MSc (RS & GIS)	Developing a Dwelling-Level GIS Database for Planning and Management of Census Data Collection. Study Area: Gerehu Suburban, National Capital District an Rigo Central Rural LLG, Central Province.	Mr S Gupta
John WANI		MSc (RS & GIS)	Use of Remote Sensing & GIS for Mapping Crime and Crime Hotspots in Port Moresby form 2014 - 2015	Mr L Kari



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Nicholas KORADA		MSc (RS & GIS)	Delineating Drought-Risk Areas Using Remote Sensing and Geographic Information Systems - Case Study of Western Highlands Province, Papua New Guinea	Dr SK Jana
Oala LUDA		MSc (RS & GIS)	Measuring Terrestrial Carbon Based on Land Cover Change Assessment from 1995 to 2015 Using GIS & Remote Sensing Techniques - A Case Study in a Logging Concession	Dr S Samanta and Dr H Abe
Nebare POI		MSc (RS & GIS)	Remote Sensing & GIS Base Spatial Data Infrastructure for Rural Development Planning at Micro Level- A Geospatial Analysis – (A Case Study of Gumine District in Simbu Province, PNG)	Mr L Kari and Mr J Suat
Joel KUA		MSc (RS & GIS)	A Geospatial Web Based Application for Education Management	Mr L Kari
Paulus BAK		MSc (RS & GIS)	Mapping of Rural Road Network Using Remote Sensing and Geographical Information System - Case study, Nebilyer Rural District, Western Highlands Province, Papua New Guinea	Prof RK Das
Alban F. RUEPANA		MSc (RS & GIS)	Spectral Signatures of the Kaindi Metamorphic of and Morobe Granodiorite of Hidden Valley Gold Mine, Morobe Province, Papua New Guinea	Dr S Samanta

**PNG UNIVERSITY OF TECHNOLOGY**  
**ALLOCATION OF RESEARCH FUND- 2016**

Item	Applicant	Department	Title of Research	Amount (K)	Research Committee Meeting #
1	Dr Janathanan Gopalakrishnan	Applied Science	Cytotoxic studies on the ash suspension that claimed to cure cancer in Papua New Guinea	1, 556.00	<b>RC# 110 08/03/2016</b>
2	Prof. N. Lambrache J. S. Guterrres (M.Tech/2)	Mechanical Engineering	Finite Element Method Stress Simulation and Experimental Evaluation on Mechanical Components under Static Loads	4, 000.00	<b>RC# 110 08/03/2016</b>
3	Prof. N. Lambrache V. S. Hoasirao (M.Tech/2)	Mechanical Engineering	Small Alluvial Gold Mining Technology and Equipment for PNG	2,723.00	<b>RC# 110 08/03/2016</b>
4	Prof. G. Danbaro Obert Lou (MPhil/2)	Agriculture	Assessment of Live Weight Gains, Digestibility and Feed Intake of Goats fed <i>Leucaena leucocephala</i> forage mixed with three common pasture species in Papua New Guinea	5, 500.00	<b>RC # 111 02/06/2016</b>
5	Dr Larry Orsak Single Clifford (MSc/2)	Forestry	Root causes of <i>Piper aduncum</i> Invasiveness in the Bulolo Forest Plantations, With an investigation of Possible Mitigations	5, 750.00	<b>RC # 111 02/06/2016</b>
6	Dr. Ronnie Dotaona Nurrie Magero (MSc/1)	Agriculture	Management of Sweet Potato weevils with Entomopathogenic fungi	4, 000.00	<b>RC # 112 16/08/2016</b>
7	Dr. S. Gopalakrishnan David Timi (PhD)	Applied Science	(Accompanied student to provide training on Malaria with departing Professor from DWU) Costs covers Travel, PDM & Accommodation for Student's Supervisor.	5, 052.60	<b>RC # 112 16/08/2016</b>
8	Dr Sujoy Kumar Jana Catherine I. Rupa (MPhil/1)	Surveying & Land Studies	Application of PGIS and Remote Sensing Technology to Identify Places of Crime & Using Crime Prevention Through Environmental Design: A study of the Papua New Guinea University of Technology, Lae	1, 723.62	<b>RC # 112 16/08/2016</b>
9	Dr. Peter Manus Naomi Batisarisari (MSc/1)	Agriculture	Determinant of Rural Migration and Marketing Cost and Margins of Selected Taro Producer Groups in Fiji	4, 915.00	<b>RC # 113 06/10/2016</b>
10	Dr Mex Peki	Forestry	Wood Processing, Physical and Mechanical Properties of <i>Trema</i>	3, 988.00	<b>RC # 113 06/10/2016</b>

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	Steven W. Komut (MPhil/1)		<i>Orientalis</i> in Papua New Guinea (PNG Trema)		
11	Dr Dapsy Alatona  Marianus Fatima Ude MSc/ 2	Applied Physics	Determination of The Spectroscopic Signatures of Some Common Gems of the Asia Pacific Region; A Case Study of Selected East Timor and Papua New Guinea Gems (AUD 7000/00)	17,073.00	

**Total Research fund approved in 2016 Academic Year**

**K56, 281.22**

# **RESEARCH COMMITTEE SEMINAR SERIES**

## **ABSTRACTS**

## **Exploration on Indian Scholarships and Advantages- A Mission Report**

**Dr Subramaniam Gopalakrishnan**

Associate Professor

Department of Applied Sciences

[subramaniyam.gopalakrishnan@pnguot.ac.pg](mailto:subramaniyam.gopalakrishnan@pnguot.ac.pg)

The UNITECH Management and Vice Chancellor Dr. Albert Schram are making efforts to facilitate staff and students to pursue higher education qualifications via the Globalization Policy of India. Since 2014, this policy came to play a vital role in assisting students to obtain scholarships through bodies, such as the Indian Council for Cultural Relations (ICCR), and the Indian Council for Agricultural Relations (ICAR). Indian universities, such as the Tamil Nadu Agricultural University (TNAU), Sardar Patel University (SPU), Indian Institute of Technology (IIT), Anand Agricultural University and Indra Gandhi National Open University (IGNOU) have shown their interest to work with UNITECH under this initiative. As a result of our efforts (fostered by the kind support of Trukai Industries Ltd, the largest rice importer in PNG), MoUs have, to date, been signed with ICCR , SPU, and Anna University to establish this elaborated international relationship with Indian Universities and Organizations. The opportunities for taking Masters degrees and undertaking research projects by UNITECH students and staff are open for all academic departments. The outcomes of our Vice Chancellor's mission to India with myself will be presented in this Research Committee Seminar session. All HoDs, staff and research scholars are thus kindly requested to attend this exploration on fully funded Indian Scholarships and research facilitation available for UNITECH staff and researchers.

## **Adaptation and Resilience: Farmers' Responses to Environmental Shocks in Rural PNG**

**George N. Curry and Gina Koczberski**

(with Joachim Lummani, Esley Peter, Robert Nailina & Kathleen Natera)

### **Abstract**

Human adaptation and adaptation capacity are recognised as fundamental components of resilience and vulnerability assessment. There is an extensive literature that shows the rural poor, who are heavily dependent on their natural resource base to sustain their livelihoods, are particularly vulnerable to climate and environmental change. Yet few studies have explored the socio-cultural context of adaptation decision-making and a household's adaptive capacity. This presentation examines the devastating impact of an invasive pest, Cocoa Pod Borer (*Conopomorpha cramerella*) on the livelihoods of smallholder cocoa farmers in East New Britain Province (ENBP), Papua New Guinea where cocoa production has collapsed and the cocoa sector across PNG is now under threat. Cocoa was the largest source of income in ENBP and grown by over 70% of households in the province. The presentation draws on field data and is in two parts. The first part outlines the range of livelihood responses and trade-offs made by smallholders as they sought ways to cope with and adapt to the new and unfamiliar conditions created by this devastating pest. The second part of the presentation looks at why the impact of the CPB has been so great and discusses the capacity of farming households to adapt, in the short- to medium-term to sudden environmental shocks. This section will examine the interconnections between household responses, the local socio-cultural and economic context of smallholder commodity crop production and the wider institutional environment in which household choices and decisions are made. We will conclude by drawing out the implications of our study for understanding why some households are more able than other households to cope with and adapt to sudden disruptions of their livelihoods caused by environmental disturbances.

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G. Curry: Curtin University, Australia

G. Koczberski: Curtin University, Australia

J. Lummani, PhD student, Curtin University, Australia

E. Peters: Papua New Guinea Cocoa and Coconut Institute, East New Britain, PNG

R. Nailina: Papua New Guinea Cocoa and Coconut Institute, East New Britain, PNG

K. Natera: Papua New Guinea Cocoa and Coconut Institute, East New Britain, PNG

## **New Trends in Mechatronics**

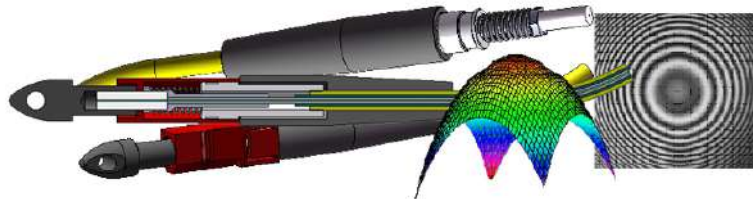
**Nicholas Lambrache<sup>1</sup>**

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### **Abstract**

The advent of integrated circuits, microprocessors and powerful computing capabilities made the borders between mechanical engineering, optics and electronics very fluid. Due to an increasing demand from industry, new educational requests, new design tools and new laboratory capabilities are imposing new trends in mechatronics.

The authors are commenting on some of the new trends in this field of applied science from the point of view of mechanical engineering. The paper is discussing characteristic examples of design, development and implementation of mechatronics devices developed by the authors in Europe and North America. Included examples focus on 3D CAE,



mathematical modeling, advanced materials and simulation regarding the way the exemplified systems were developed and designed.

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<sup>1</sup> Research done with **Mihail Ursul, Lidia Olaru**

**Nicholas Lambrache** holds a Doctor degree in Mechatronics from University of Bucharest. Dr Lambrache has enhanced expertise in Mechatronics, Optoelectronics and Materials Science acquired in post-doctoral studies in Switzerland and Canada and from his involvement as senior scientist and senior design engineer with Huber Suhner Switzerland, JDS Uniphase United States, L-3 Communications United States, Alef Photonics Canada and Perkin Elmer United States. Dr. Lambrache is a member of American Institute of Physics, Optical Society of America, International Society of Optical Engineering and is currently professor at University of Technology. As corresponding author, he can be contacted at [nicholas.lambrache@alefphotonics.com](mailto:nicholas.lambrache@alefphotonics.com).

- **Mihail Ursul** holds a Doctor Habilitatus degree in Mathematics from Institute of Mathematics of Academy of Sciences of Russia. Dr. Ursul has enhanced expertise in advanced mathematics. He was invited lecturer at Hanover University, Germany, Linz University, Austria, and Raleigh University, North Carolina, United States, and is reviewer for Zentralblatt fur Mathematik, Germany and American Mathematical Society, United States. Dr. Ursul is currently professor at University of Technology.

- **Lidia Olaru** holds a Master of Science degree in Mechatronics from University of Bucharest and enhanced her education in project management at McGill University in Montreal. Mrs. Olaru has considerable expertise in mechatronics design, project management and database development acquired in Romania, Canada, France and Germany. She is currently performing as software development manager at Jesta in Montreal, Canada.



## Scalar Bound States Using the Worldline Formalism

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### Abstract

In our study the worldline formalism of Prof. Robert P. Feynman has been used to sum up all ladders and cross-ladders in the  $\varphi^2\chi$  theory with zero mass of the  $\chi$  particle. The (euclidean) Lagrangian for this theory is  $L = \frac{1}{2} (\partial_\mu \varphi)^2 + \frac{1}{2} m^2 \varphi^2 + \frac{1}{2} (\partial_\mu \chi)^2 + \frac{1}{2} \mu^2 \chi^2 + \frac{\lambda}{2!} \varphi^2 \chi$ . We derive an integral representations for three classes of amplitudes in scalar field theory: (i) the scalar propagator exchanging  $N$  momenta with a scalar background field (ii) the ``half-ladder`` with  $N$  rungs in  $x$ - space (iii) the four-point ladder with  $N$  rungs in  $x$ -space as well as in (off-shell) momentum space. In each case we give a compact expression combining the  $N!$  Feynman diagrams contributing to the amplitude. As our main application, we reconsider the well-known case of two massive scalars interacting through the exchange of a massless scalar. Applying asymptotic estimates and a saddle point approximation to the  $N$  – rung ladders plus crossed ladder diagrams, we derive a semi-analytic approximation formula for the lowest bound state mass in this model.

The approach, used to calculate the lowest bound state mass in our study is totally new and much more could be done, provided technology and funds are available. The results are convincing and numerically checked with the work of Davydychev and Ussyukina, Phys. Lett. B 298 363 (1993).

# **Integrated Financial Management System: An Exemplified Approach Towards Strengthening Public Sector's Financial Management Practices in Papua New Guinea**

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## **Abstract**

This study explored the relationship of efficiency, effectiveness, economy and security of the IFMS' implementation by departments of Finance, Treasury and National Planning & Monitoring from 2011 to 2015. It sought answer to the main question **“Does the implementation of the Integrated Financial Management System (IFMS) by departments of Finance and the Treasury demonstrate viability for it to be rolled out more broadly to other national and provincial governments?”**

Specifically, the research answered these questions: (1) What is the impact of IFMS implementation to the implementers' job responsibilities along budget preparation and execution, accounting and reporting, monitoring and evaluation? (2) Is there a relationship between efficiency, effectiveness, economy and security and IFMS' implementation by the departments of Finance and Treasury? (3) What are the challenges faced by the implementers and stakeholders on the IFMS' implementation? In furtherance with specific question 2, a null hypothesis was used.

To further reinforce the thesis, the study was anchored on the Contingency Theory. The descriptive research design was employed. Questionnaire and interview schedule were used to collect primary data from 15 staff-IFMS-implementers of the Department of Finance, Department of Treasury and National Planning and Monitoring; and 34 internal auditors of various government agencies of PNG. The data were analyzed using simple descriptive statistics, regression and correlation

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**Keywords:** IFMIS, effectiveness, efficiency, economy and security

**Relation with Field of Discipline:** Management Accounting, Strategic Financial Management and Corporate Governance

## **Studies on Aggregates from Papua New Guinea: The Testing of Materials from Busu, Bumbu and Yalu Rivers, Morobe Province**

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### **Abstract**

Various local quarries (mining sites of sand and gravel or aggregates) have been operating for decades in the Busu and Bumbu rivers and, until relatively recently, the Yalu river. River aggregates are consumed in large quantities in Lae alone for civil and other construction purposes. However, little is known by consumers about the quality of gravel. To ensure construction aggregates are fit for purpose and meet the requirements of the end-users it is important to have an understanding of the Geology of the resources, production processes and standards and test methods used to evaluate their suitability. This study will be conducted to evaluate quality of river gravel to know their suitability for aggregate (raw material for concrete and road construction). The samples of river gravel will be analyzed for petrographic, physical, mechanical and chemical properties. Preliminary work on samples obtained from Yalu and Bumbu showed material were sedimentary(predominant) and volcanic in nature. The clasts seem to be well graded. The majority of the samples were rounded, with significant irregular shapes. The surface texture of the clasts was rough to smooth. In terms of the shape, workability of the gravel appears satisfactory. Work is still in progress to complete physical tests to determine water absorption value, porosity, dry density of samples. Mechanical tests of Aggregate Impact Value and Los Angeles Abrasion tests will be employed to determine hardness of the samples. Magnesium Sulphate Value test will be employed to determine resistance against chemical weathering and frosting. All these values will be compared against PNG Standards, Australian standards and American Standards of testing of materials to ascertain if studied materials are suitable as aggregates for concrete and road construction purposes. It is hoped that the research results will complement the work and testing being done by the civil and construction industry.

# **A Decomposed Alternating Sequence Morphological Fault Detection Algorithm - For Smart Protection in Future Electricity Distribution Networks**

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## **Abstract**

Electricity distribution network is evolving with more inverter interfaced small scale active generation, creating bidirectional current flows with reduced fault current levels and high DC offsets. Traditional power system protection techniques and associated algorithms may not be able to maintain existing level of reliability and security of the future distribution networks. Several relay algorithms, including Discrete Fourier Transform (DFT) and the Discrete Wavelet Transform (DWT) have been proposed in the past. Although these algorithms have proven to be very effective and reliable in the detection and identification of most power system conditions, their ability to effectively detect DC-offsets and High Impedance Faults (HIFs) is limited. The HIFs occur when a conductor, either broken or still intact makes contact with high impedance surfaces like, asphalt, concrete, gravel, sand, grass, etc., or brushing against tree limb or branches. Arcing generates unsymmetrical fault current that is intermittent and highly nonlinear every half cycle resulting in shoulder shaped waveform, with harmonics and high frequency components. HIFs has much lower fault current hence can't be easily detected. Furthermore, transients following a short-circuit condition results in the fault current with an exponentially decaying DC-offset. The integrity, accuracy and effectiveness of the DFT and DWT based algorithms are based on the simple assumption that the periodicity of the current and voltage signal waveform is maintained during fault duration. However, it is very well known that transients follow any power system disturbance, and the exponentially decaying DC-offset is present during any short-circuit fault conditions. These phenomena distort the fault signal waveforms and may compromise the integrity of traditional algorithms thereby resulting in computational delay in the detection and isolation of the fault condition. As the accuracy and speed of convergence of conventional DFT and DWT algorithms rely on the periodicity of the fault current and voltage signal, their effectiveness under DC-offsets and HIFs are limited.

Therefore, this research focuses on the design of a smart protection system which will be able to detect and isolate the faults under abovementioned scenarios. There are two major parts to this research; **(1) focuses on the design of a new algorithm for the Detection and Identification of HIFs, and has also has immunity to the effects of the exponentially decaying DC offset;** and (2) extended the research to develop a decision logic system based on knowledge and rule based method to declare a fault, determine the faulted phase and the fault location.

This seminar presentation will be confined to the design of the fault detection algorithm and initial simulation results. The design of the algorithm is based on a nonlinear image/signal processing technique called “Mathematical Morphology (MM)”. The nonlinear filtering characteristics of MM are exploited by strategic cascading of different filter blocks to form a multistage fault detector. The feature characteristics of the fault detector to provide immunity to the effect of DC-offset as well as fault detection are accomplished in association with the use of an eccentrically decreasing convex structuring element (SE) designed based on power system signal parameters. The computational efficiency of the algorithm is enhanced by decomposition of the SE into linearly sloped components, thus minimizing the detection delay and allowing for successive and sequential transformation of the input signal for feature extraction necessary for fault detection and identification.

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<sup>1</sup> Currently, a PhD student at the Queensland University of Technology, Australia

## Hexagrammums: Star, Full, Mysticum, Sejfried and Conics

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### Abstract

The paper is devoted to the investigation of hexagrammums. The starting materials for the work are based on firstly, delightful drawings (the research) of Hirotaka Ebisui, and secondly, the GInMA software, which makes it easy to explore the geometric configurations and exercise their conversions. Typically, the only one unusual point found by Hirotaka has served as the source for the study. As a result, the sequences of collinear points have been found. In each case, the method of barycentric coordinates has been used for the formal proof. The evident solution have been found in many cases with the use of mappings. This may introduce the solution of the problems in the standard courses of geometry.

The "Star" Hexagrammum is based on six points, three of which determine three straight lines  $AB$ ,  $BC$  and  $AC$ . Three remaining points  $K$ ,  $L$ ,  $M$  are located one by one on these lines. The straight line  $LM$  intersects the straight line  $AK$  at the point  $L_1$ , the straight line  $KM$  intersects the straight line  $CL$  at the point  $K_1$ , and so on. In this configuration the points  $E_3, E, M_2, D, D_3$  are collinear, the points  $M_1, M_3, M_5$ , (and so on) are collinear, the straight lines  $BM_3, KL_2, M_1M_2, E_2D_2, LK_2, L_0D_0, K_0E_0, LK_2$  and  $L_1K_1$  are concurrent (at the point  $Q$ ) as it is shown in Figure 1a. Performing the projective transformation we obtain the image for which all of the statements are trivial and obvious (see Figure 1b). Similarly, the proofs for the other problems have been performed.

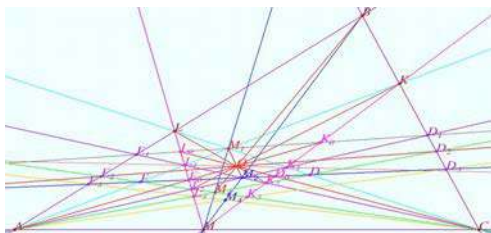


Figure 1a

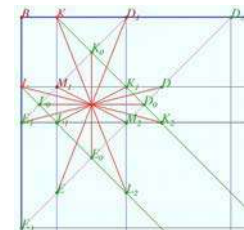


Figure 1b

The Full Hexagrammum is based on six points  $A, B, C, D, E,$  and  $F$  of general position. The straight lines  $AD, BE$  and  $CF$  are intersecting at the points 1, 2, 3, and straight lines  $A_3, B_2, \dots$  are intersecting at the points 4 ... 9 (see Figure 2a). Then we build the points of intersection  $K (45 \cap 89), L (45 \cap 67), M (89 \cap 67),$  and so on (see Figure 2b and 2c). We can find six (red) straight lines containing groups of four points such as  $B'K_3E'$  (see Figure 2b) and three straight lines shown in pink, containing the groups of four points (for example  $KK'1K''$ ), see Figure 2c. These lines are concurrent if given points belong to the same conic.

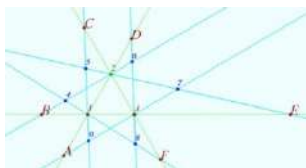


Figure 2a



Figure 2b

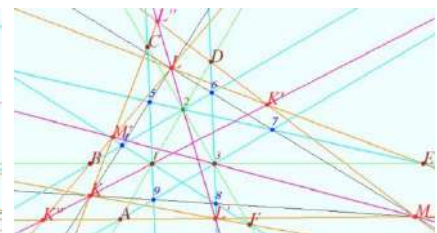


Figure 2c

The Hexagrammum Mysticum is mapped on the sphere that allows us to consider all the points on each line (see Figure 3).

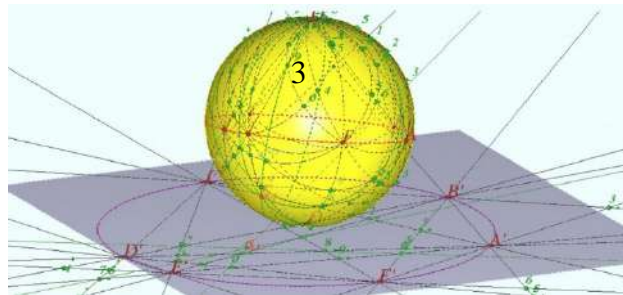


Figure 3

Let's take the pair of conics in any position and try to find the common Pascal lines. We need pairs of the points placed on each conic and one more for each conic to fix the position of the conic on the plane. This collection of points allows us to build the set of 4 common Pascal lines. Each of them contains four collinear points  $(P, P', Q, Q')$ . These lines are shown in red, see Figure 4. The secants in the case of the common secant  $AA'$  are shown in Figure 4.



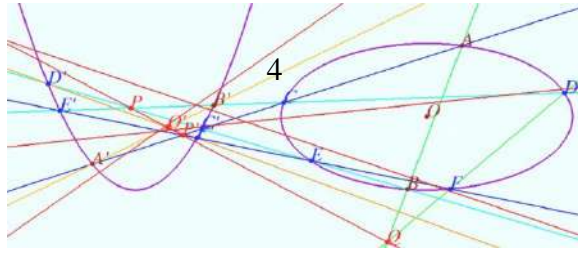


Figure 4

Given arbitrary triangles  $ABC$  and  $A'B'C'$ . Nine points of pairwise intersections of straight lines containing the sides of the triangles  $D, E, F, D', E', F', D'', E'', F''$ , and red 1,2,3,4, green 1,2,3,4 and blue 1,2,3,4 points are shown. Hirotaka Ebisui have found that the triples of blue points  $1 - 3 - F$  and  $2 - 4 - F'$  and the triples of red points  $2 - 4 - F'$  and  $1 - 3 - F$  are collinear (Blue and Red Rose lines theorems). Other groups of similar points have been found by the author (Green Rose lines theorem). The paper shows that the straight lines connecting similar blue and red points  $1 - 1, 2 - 2, 3 - 3, 4 - 4$  are concurrent (at the point  $O$ ), the straight lines connecting similar blue and green points  $1 - 1, 2 - 2, 3 - 3, 4 - 4$  are concurrent (at the point  $O'$ ), the straight lines connecting similar red and green points  $1 - 1 - 4 - 4 - B' - G'$  and  $1 - 2 - 3 - 3 - B - G$  are concurrent (at the point  $O''$ ), and points  $O, O', O''$  are collinear (The Papua New Guinea Rose theorem).

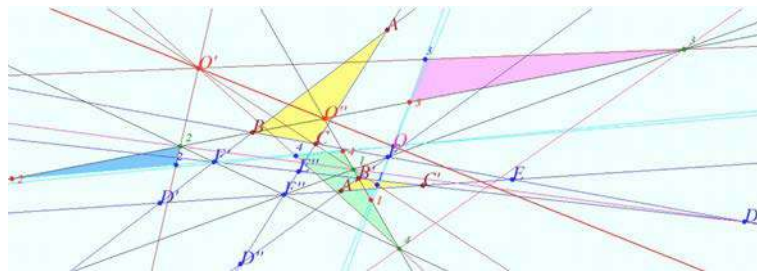


Figure 5

The material from this work may be used for teaching the course of geometry (projective or computer geometry) as an interesting visual manual.

**Keywords:** Hexagrammum, Hexagrammum Mysticum, Pascal line, Mapping, Collinear, Concurrent.



## **Feasibility Study of a Brachytherapy Applicator Using Caesium-137 LDR Sources**

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### **Abstract**

The purpose of this study was to determine if a brachytherapy applicator could be developed for the treatment of small superficial lesions using Caesium-137 LDR tube sources with acceptable treatment quality to be used in a clinical environment where there is an absence of HDR Brachytherapy, linear accelerator (electron beams) or kV units. The brachytherapy applicator design was performed using a Theraplan Plus treatment planning system utilizing AAPM TG-43 data to determine a uniform dose distribution at the applicator surface. The materials used in construction were Aluminium sheets, Delrin and Lead. The measurement and comparison of the results with the planning system were done by calibration of Cs-137 sources in air with an NE2571 ionisation chamber using TECDOC 1247 (IAEA). The dose distribution was measured using Gafchromic EBT3 film across the applicator surface and with depth beneath the applicator in a RW3 Solid Water phantom. There was a good agreement between Theraplan and film measurement with approximately 9% difference.

## **Employability Skills of Business Studies Degree Students in PNG**

**Dr Wise Mainga, Mr Reuben Maino Daniel and Dr Luis Alamil\***

Senior Lecturer and Head  
Department of Business Studies

### **Abstract**

Over the last four decades, the global economy has witnessed accelerated technological change, increased global competition, rapid accumulation of new knowledge, and increased need for ever-rising workforce capabilities. Adaptability and the need to manage growing complexity has been the key to most organizations' survival and thriving. Increasingly, business and non-profit organizations alike look for different types of workforce, which inevitably raised questions about the nature of graduates leaving the tertiary education system. Several studies conducted in developed countries disclosed some discrepancies between skills graduates possess after university studies versus what employers are looking for. As a consequence, many governments and employers have increasingly questioned and emphasize the need for business graduates to possess "employability skills" necessary to be considered for entry-level positions. The current exploratory study was initially done at one university in PNG to determine the content and purpose of the Curriculum offerings of its Business Studies' degree programs, with regard to Employability Skills. The objective of the study was to examine the perceptions of three groups of respondents with respect to the relative importance of different employability skills for Business Studies graduates when seeking initial employment. Three sets of semi-structured survey questionnaires were administered to HR representatives from industry, business lecturers, and final-year business studies students to determine gaps, if any, on the perceptions of the three groups. The primary data was analysed using SPSS 16. In line with most previous research, we detect some variations in perceptions of relative importance of different employability skills between the three groups of respondents. Tentative findings suggest areas for potential improvement on how business students are educated and the nature of "employability skills" they should possess at graduation, in order to more align with the employers' needs.

**Keywords:** Employability, Business Education, Curriculum-Practitioner Gap

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\* Dr Luis Alamil presented the seminar. The research was done along with Dr Wise Mainga ([wise.mainga@pnguot.ac.pg](mailto:wise.mainga@pnguot.ac.pg)) and Mr Reuben Daniel ([reuben.daniel@pnguot.ac.pg](mailto:reuben.daniel@pnguot.ac.pg))

## **Managing Technology & Innovation in Papua New Guinea University of Technology as Adaptation Approaches to Emerging Crisis**

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### **Abstract**

The Papua New Guinea University of Technology (UNITECH or PNGUOT) is the only Technological University in the South Pacific, outside Australia and New Zealand housed on a 223-hectare site in Lae City, the Country's industrial hub, and the gateway to the Highlands and the Maritime provinces. Since PNGUOT's inception, the technologist, scientist and engineers had helped shape the country. In 2011, PNG became the 6th fastest growing economy in the world due to its strong growth in mining and resource sector. However, about one-third of the population are in extreme poverty living on less than US\$1.25 per day. They are threatened with the risk of global warming, sea level rise and climate change resulting in malaria outbreak, evacuation of inhabitants of Carteret Island due to rise in sea level, rainfall shifts, storm frequency, and intensity, inundation, flooding, erosion and intrusion of sea water. It implies that there is a need to provide for adaptable measures to the posed crisis by strengthening the country's technological capability. The Study was descriptive, use unstructured interview, and field investigation, to determine present and future technologies and impact to communities. The paper's focus is on how improvements in technology development and management will contribute to human capital, education, research and technology, and an optimal industrial and services strategy to nation's future prosperity. Within this framework, the different ways of technologies that can help the people cope up with the emerging risks are looked into as approaches for adaptation of appropriate and innovative technology use.

**Keywords:** Technology Management, Technology, Management, Technology Adaptation

## **Rejection of Arsenic in Copper Concentrators: A Review**

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### **Abstract**

Arsenic (As) in copper ores presents a tremendous challenge to metallurgists and mining companies owing to its toxicity. Copper concentrators incur hefty smelter penalties when copper concentrates contain high levels of arsenic. The toxicity is related to a diverse oxidation states of arsenic, which defines their crystal chemical reactivity. Arsenic appears mainly in four oxidation states:  $As^0$  (metallic arsenic),  $As^{3+}$  as in  $As_2O_3$ , which is known as ‘white arsenic’ (iii)  $As^{3-}$  as in Arsine,  $AsH_3$ , a by-product of electro-refining and is highly toxic and (iv)  $As^{5+}$  as in realgar,  $Sb_2As_3$ , which is stable and environmentally benign. The As(III) forms of arsenic is known to be toxic, and high-level poisoning of humans leads to death. To date the disposal of arsenic in a form that is environmentally safe remains a major challenge to researchers and metallurgists worldwide. This paper reviews various strategies that have been employed to reject arsenic with an attempt to highlight the best possible strategies as well as arose the minds of aspiring researchers.

**Key Words:** copper ores, froth floatation, arsenic, toxicity, arsenic disposal

## **Bridging the Gap between Physical Planning Legislation and City Liveability in Papua New Guinea: Fantasy or Reality?**

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### **Abstract**

This study investigates the causes and effects of the gap between physical planning legislation and city liveability in Papua New Guinea, a South Pacific country that is blessed with abundant natural resources and once described as the sixth fastest growing economy in the world. Given these two rare national assets, one would expect the strong expectations about PNG's cities to manifest in qualitative built-environment-experience and city liveability in real terms, but this is really not the case. While this paradox is not unique to PNG, particularly in the context of cities in the developing world, the author argues that PNG with a population of about 7.5 million is, nonetheless, sufficiently blessed and well-positioned to be able to synergize its comparative advantages for purposes of achieving higher environmental standards and better quality of life in the country's villages, towns and cities. In terms of methodology, the dialectical approach is adopted for the study in order to establish the truth through reasoned arguments and propose a way forward for PNG towards attaining its dream with regards to the country's Vision 2050.

## **Spline Function- An Interesting Tool for Approximation and Interpolation**

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### **Abstract**

In this presentation, we will learn about the spline functions. We will also see how spline came in use, its origin and history. Various types of Spline functions, their use will also be seen. We will learn - How we can form or construct a spline function using some interpolating conditions. These functions are very much useful in various fields of engineering and technology, but here in this talk we will see its Mathematical applications in approximating and interpolating some functions. Some Interpolation problems using these spline functions will also be shown.

## **Mapping Remnant Vegetation using High Resolution Satellite Data**

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### **Abstract**

Vegetation mapping depends on different data sources for extraction and compilation. Remote sensing is a convenient data source from which vegetation classes can be extracted for assessment and monitoring. This paper was done using the object-oriented classification approach and the traditional pixel-based approach to classify remnant vegetation types in the Tara Downs sub-bioregion in Queensland. The aims of this research were to: 1) develop a suit of digital image processing techniques for mapping, characterization and classification of remnant vegetation using high resolution satellite imagery and, 2) ascertain the level of accuracy of image classification for each of the two approaches or techniques that were implemented. The techniques employed can be used by foresters, environmentalist or ecologists to aid them in further research by determining precise levels of biodiversity or remnant vegetation distribution within a regional ecosystem.

## **Teachers' Welfare: The Significant Enabler in Improving the Quality of Education Delivery in Papua New Guinea**

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### **Abstract**

Papua New Guinea is currently experiencing the impact of education through the increase in national development social and economic activities. The National Government had budgeted quiet a larger amount of funds to educate all Papua New Guinean child by offering free tuition fees for all students from Elementary Schools to Secondary all across the nation. Whilst the nation is embracing the need to be “... *a smart, wise, fair, healthy and happy society...*” (*The Papua New Guinea Government PNGVISION2050; 2007*) as enshrined in the Papua New Guinea VISION2050, the need for citizen involvement in the wealth- building economy by direct and/or indirect participation is important and necessary. There is more emphasis on the students learning with lesser attention given to the teachers' welfare which will be the facilitators to meet the government agenda.

The teachers are the most important enabler in improving the quality of education delivery in Papua New Guinea. The national government is currently emphasising on increasing the quality and quantity of formal education service delivery in Papua New Guinea for all the eligible citizens. In order to meet the government agenda as in par with the PNG Vision 2050, the welfare of the teachers must be considered as the paramount important enabler to achieve the Government agenda.

This paper proposes a suggestion on effectively addressing the welfare of the teachers in Papua New Guinea in order to improve the quality of education delivery in Papua New Guinea.

As a means for applied research, this paper focuses on the need to address the teacher's welfare need and to effectively contribute to develop an educated wealthy society in the future to meet the PNG Vision 2050.



## **Prevalence of *Salmonella* and *Campylobacter* spp. in Chicken in PNG**

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### **Abstract**

Food borne diseases are of high significance in many countries around the world and special emphasis is given to control them. But the basic information is lacking in PNG, hence an attempt was made to know the status of some of the food borne organisms in poultry.

A total 385 DNA extracts from cloacal swabs: 333 samples from chicken and 52 samples from ducks, were collected between 2011 and 2012 from poultry farms around the country. The samples were subjected to DNA extraction and analysed using real-time polymerase chain reaction (PCR).

A total of 8 cloacal swabs were collected from commercial farms, 6 from semi-commercial and 33 from non-commercial farms. *Salmonella* was not observed among the farming methods. However, *Campylobacter* was observed at 83.3% (5/6) in semi-commercial farms and 6.1% (2/33) in non-commercial farms but absent in commercial farms. Significant differences were observed only for *Campylobacter* spp. in commercial and semi-commercial farms and semi-commercial and non-commercial farms.

## **Identifying Tilapia (*O. niloticus*) Diets in Fertilized Pond-based Aquaculture in PNG Using Stable Isotope Analysis**

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### **Abstract**

The high cost of fish feed is an impediment to the sustainability and growth of the aquaculture industry in Papua New Guinea. An understanding of the dietary requirements of farmed species is essential to develop cost-effective feeding strategies. At present the contribution of formulated feed and natural food to the growth of the Genetically Improved Farmed Tilapia (GIFT, also known as Super Tilapia) is poorly understood in PNG.

Consequently, feeding strategies are currently not based on scientific knowledge on the contributions of different nutritional inputs in the farming systems. Stable isotopes, in combination with standard growth measurements and stomach content analysis, may provide more insight into the role of different sources of nutrients in the growth of GIFT. A 90-day feeding experiment was conducted to estimate the relative contributions of different food sources in the diet of GIFT. The overall aim of the research was to determine the role of different nutrient sources to underpin future work on modified feeding strategies that can reduce the cost of GIFT farming in PNG.

Standard growth measurement (BW & TL) was undertaken every 21 days, while pond water quality was monitored daily from before the first feeding. Algae, detritus and plankton, as well as sediment organic matter and muscle tissue, were sampled for stable isotope analysis at the conclusion of the experiment.

Results from stomach content analysis revealed that the frequency of occurrence of dietary items found in the randomly sampled tilapia guts were in the order: detritus > algae & phytoplankton > zooplankton > formulated feed. Furthermore, stable isotope analysis revealed that detritus and algae remain the main dietary items of the GIFT during the 90-day grow-out.

The research demonstrated that stable isotope methods, in combination with standard growth measurements and, to a lesser extent, stomach content analysis, can be used to better understand the utilization of different sources of nutrients in the production of GIFT. The study forms the basis for further work on selection of alternative feed ingredients, and feeding and fertilizer strategies for GIFT in PNG.

## **Potential Use of Oilfield Water in Agriculture**

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### **Abstract**

Water that is being produced with oil forms the largest single waste in the entire oil producing industry. In the Sultanate of Oman, the volume of produced water (oil field water) is more than triple that of produced oil. In the northern oil fields, the separated water is re-injected into the oil bearing strata to maintain the reservoir pressure. In the southern oil fields with stable reservoir pressure, the dehydrated water was disposed of in the upper water bearing strata in the past. When this disposal method was banned by the government of Oman because of concern about long-term ground water contamination, the waste water was injected into deeper water bearing strata. However, deep well disposal method is very expensive. Consequently, a joint research project between Sultan Qaboos University, Oman, and the Petroleum Energy Center, Japan, was initiated to develop and establish a process whereby the large quantities of produced water can be effectively treated and utilized for irrigation. The highlights of our research findings are presented in this seminar.

## **Big Data, Analytics and Intelligence**

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### **Abstract**

This presentation explores big data, analytics and intelligence. It proposes ten big characteristics of big data, a Boolean framework of big data, analytics and intelligence. It also introduces the presenter's research in big data, big data analytics, business analytics and business intelligence in PNG. The approach proposed in the presentation might facilitate the research and development of big data, big data analytics, business analytics and business intelligence.

## Plant Exploitation and Domestication in Papua New Guinea

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### Abstract

New Guinea is one of the most biologically diverse islands on earth. The island occupies less than 1% of the world's land area, and yet it is home to about 6 – 8% of the world's species, and with extraordinarily high levels of endemism. New Guinea contains the third largest tract of rainforest in the world. This diverse and peculiar biota somewhat reflects its geological history and physiographic diversity. New Guinea as one of the world's centres of plant diversity, with about 15,000 to 25,000 species of vascular plants and as high 70% species endemism. With such a rich plant life, it is no coincidence that this landmass has a long history of agriculture and plant domestication. For a long time Papua New Guinea was considered as a passive recipient of domesticated plants and animals from Southeast Asia and beyond. However, recent archaeological evidence indicates that PNG is one of the few places on earth where agricultural practices have developed independently. Papua New Guineans were definitely exploiting plants such as taro (*Colocasia esculenta*), bananas (*Musa spp.*), sugarcane (*Saccharum officinarum*), etc. for at least 10,000 years. Only a few regions are geographically suited to become the homelands of full agricultural systems, and New Guinea is definitely one of them.

The presentation will discuss the exploitation and domestication of plants by Papua New Guinea societies to meet basic human needs. Most plants were exploited for food, as starch, fruits and nuts. A number of food plants are considered to have been first domesticated in New Guinea, and these include *Pandanus spp.* (*P. brosimos*, *P. julianettii*, *P. ewen*, and *P. conoideus*), *Canarium spp.*, *Terminalia spp.*, sago (*Metroxylon sagu*), sugarcane (*Saccharum officinarum*), bananas (*Musa spp.*), etc.

## **Geochemical Indicators of Mantle Metasomatism in Seamounts from the Mariana Arc- Basin System**

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### **Abstract**

The Eifuku, West Eifuku, Nikko, Kasuga and Daikoku are a chain of seamounts located along the Mariana arc – basin system. All the seamounts are located at depths ranging from 390 meters (Kasuga) to 2800 meters (SE Eifuku) below sea level. The crater and submarine flanks of the seamounts were not explored until 2013. The manned submersible Shinkai 6500 and ROV Hyper -Dolphin were used to explore the seamounts during Cruise NT0518. The whole rock chemical data for sixteen (16) volcanic rocks sampled from the six (6) seamounts along the Mariana Arc are examined to reassess mechanisms of melt-fluid interaction with volcanic rocks and their relative role versus melt composition in mantle metasomatism. The sixteen samples were analyzed using LA-ICPMS for the concentration of K, Rb, Sr, Ba, and the Rare earth elements (REE). The data shows strong variation along the arc, being depleted in some seamounts while it is strongly enriched in some seamounts. The SE Eifuku seamount is strongly enriched in large ion lithophile elements (LILE) and light REE elements (1100ppm Sr, 1900ppm Ba and 31 ppm La) compared to the other seamounts (250-400 ppm Sr, 200-600 ppm Ba and 12-20 ppm La). The inconsistency among the seamounts can be explained as resulting from source or melt mixing. The SE Eifuku seamount is derived from an enriched source or melt which has been recharged with K, Rb, Sr and Ba by hydrous fluid from the subducting slab. These variations are interpreted as reflecting from the evolution of the subarc asthenosphere, with a depletion in time resulting from the continuous extraction of basaltic melts.

## **Development of a Local Geoid Model**

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### **Abstract**

In geodesy three basic surfaces are encountered: the physical surface of the earth, the geoid and the reference ellipsoid. In relation to these three surfaces another three entities are defined: the orthometric height ( $h$ ), the ellipsoidal height ( $H$ ) and the geoidal undulation/separation ( $N$ ). The orthometric height (equivalent to the Mean Sea Level height) is the height with reference to the Geoid whereas the corresponding ellipsoidal height is with regard to the reference ellipsoid. The vertical separation between the ellipsoid and the geoid is known as geoidal undulation or separation. A mathematical relation depicting the surface of the geoid with regard to the reference ellipsoid is known as geoid model. In a simple way the model gives a relation between the geoidal separation ( $N$ ) and the horizontal location such as the Easting ( $x$ ) and Northing ( $y$ ) of a point.

The advent of Global Navigational Satellite System (GNSS) has facilitated precise positioning of a point/feature on the surface of the earth including the vertical positioning with reference to ellipsoid i.e. the ellipsoidal height. The ellipsoidal heights need conversion to a more usable simple format, the orthometric heights. This is done by integrating the ellipsoidal heights with a global or regional or local geoid model. The accuracy of the conversion directly depends on the accuracy of the geoid model. Therefore, development of a geoid model has become a current area of research in geodesy.

The objective of this study is to develop a local geoid model and assess its accuracy. Madang town of Papua New Guinea has been taken up for the purpose. Various polynomial models have been employed to develop the geoid model. A comparative analysis of suitability of different polynomial models in terms of accuracy has been carried out.

**Key words:** Orthometric height, ellipsoidal height, geoidal undulation, geoid model, GNSS



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