



THE UNIVERSITY OF  
SYDNEY

# 2nd Annual Australian Social Network Analysis Conference

28 - 29 November 2017  
Charles Perkins Centre



Faculty of Engineering and Information  
Technologies

## Contents

Welcome to ASNAC 2017	3
Introductory Information	4
Full Conference Schedule	6
Keynote Speaker	9
Panelists	10
Poster Session	12
Session Abstracts	13
Poster Session Abstracts	23

# Welcome to ASNAC 2017

The University of Sydney is delighted to welcome you to the Australian Social Network Analysis Conference (ASNAC) 2017. Building on the success of the inaugural ASNAC last year in Melbourne, this is the second time the entire Australian social network community will gather together with guests from overseas to discuss research advances in the field.

To begin I would like to acknowledge the Gadigal People of the Eora nation who are the traditional custodians of the land on which this conference is held and pay my respect to their Elders, both past and present. For Gadigal people, the land on which we gather was an important place of learning, ceremony, and kangaroo hunting. I also extend that respect to other Aboriginal people who are participating in the conference over the next few days.

The conference aims to raise the profile of social network analysis in Australia by bringing together academics, students, and industrial partners from key institutes in Australia and beyond. We wish to start a tradition of meeting all face to face at least once a year to build even stronger social network analysis community in the country, with strong connections to the external region. The conference will explore the breadth of theory, method, and application of social network analysis in contexts ranging from health and the environment to finance and social media. Over the two conference days, we hope you share your insights, hear new perspectives, create new links, and strengthen old links with social network researchers in Australia and the Asia-Pacific region.

We are very pleased you can join us for what will surely be interesting, enlightening, and enjoyable two days.

**Dr Petr Matous**

*Associate Dean, Indigenous Strategy and Services*

## ASNAC 2017 is proudly supported by:

### **INSNA (International Network for Social Network Analysis)**

Australian Social Network Analysis Conference 2017 is fully endorsed by INSNA (International Network for Social Network Analysis). We invite all participants to join INSNA and to participate in the Sunbelt Conferences (next one is 26 June to 1 July, 2018 in Utrecht, NL).

### **The University of Sydney**

The University of Sydney is a leader in project management education and research, and has recently been ranked as fourth in the world for graduate employability. Our project management program spans undergraduate, postgraduate, and executive education, and is applicable across a range of disciplines. Social Network Analysis is one of this program's core research strengths, looking beyond the traditional view of work processes and standards, to engage with the complex dynamics of systems. This conference has been organised with the support of the School of Civil Engineering and the Project Management Program at the University of Sydney.

# Introductory Information

## Dear ASNAC Delegate,

We welcome you to the 2nd Australian Social Network Analysis Conference. We hope that you have had a chance to look at the conference website at <http://www.asnac2017.org.au> where we have included information to facilitate your attendance at the conference.

### Map



### Local Amenities

ASNAC 2017 will be held at The University of Sydney, Charles Perkins Centre Lecture Theatre. Cafes and retail amenities are available in the Holme Building on Science Road within the campus. Glebe Point Road and King Street are the local retail strips.

### Registration and Welcome

Registrations will be from 8:30 AM on Tuesday 28th November 2017 in the Charles Perkins Foyer. Registration will then be followed by a Welcoming Address and the Keynote presentation in the 301 Lecture Theatre. ASNAC 2017 will be held solely within The University of Sydney, Charles Perkins Centre. (Charles Perkins, was a key person in the fight for Aboriginal rights.)

### Conference Program

A digital copy of the program can be found at [www.asnac2017.org.au/program](http://www.asnac2017.org.au/program)

## Wireless Internet

Wireless internet coverage across The University of Sydney is very good. The details on how to access the WiFi network for the conference can be found below. The Wi-Fi details are also reproduced on the back of your identification lanyard.

**WiFi Network name:** ASNAC2017

**Password:** asnac00!

## Social Media

Please use the hashtag **#ASNAC2017** in your social media posts, updates and tweets.

## Food and drink

Lunch and morning/ afternoon tea will be provided for all conference participants. Please inform us of any special dietary requirements. On Tuesday evening, 28 November 2017, we will host the poster session between 5:00pm-7:00pm, which will be accompanied by drinks and canapés.

## Contact

### ASNAC 2017 Academic Contact

Dr Petr Matous

Email: [Petr.Matous@sydney.edu.au](mailto:Petr.Matous@sydney.edu.au)

Tel: (+61) 02 9351 5216

### ASNAC 2017 Conference Manager

Ms Margaret Gardoll

Email: [Margaret.Gardoll@sydney.edu.au](mailto:Margaret.Gardoll@sydney.edu.au)

Tel: (+61) 02 9351 7010

## Travelling around Sydney

### Getting there

The University of Sydney is very close to buses and trains.

Redfern is a major train station, which is a 25 minute walk via Abercrombie St and Central station is a 35 minute walk along City Road and George St. Buses to and from Central are frequent and easy to catch from Parramatta Road or City Road. You will need to purchase an Opal card for travel on public transport.

There are two main entrances to the University campus: one is just past Victoria Road where Broadway becomes Parramatta Road; the other is on City Road at the corner of Butlin Avenue. The Charles Perkins Centre is 10 minute walk through the campus.

If you are from interstate, you can catch the T2 Airport line from the Sydney Domestic and Sydney International Airport train stations and exit at Central station. The Airport line will take 8 minutes and cost approx. \$17. A taxi from the airport will be approx. \$60.

# Full Conference Schedule

Tuesday 28 November 2017	
8:30	<b>Presentation Slides Drop-off</b>
09:00 - 09:30	<b>Registration</b>
09:30 - 09:35	<b>Opening remarks</b> Dr Petr Matous, Associate Dean (Indigenous Strategy and Services)
09:35 - 10:15	<b>Keynote speaker</b> Professor Philippa Pattison, Deputy Vice Chancellor (Education)
10:15 - 10:30	<b>Morning tea</b>
10:30 - 12:30	<b>Session 1: Environment and Health</b>
	<b>Environment</b> 1.1 Cunningham, R, Jacobs, B, Measham, T, & Cvitanovic, C, <i>"Learning from social networks – climate adaptation policy in New South Wales"</i> 1.2 McAllister, R, <i>"Multi-level networks and complex environmental challenges"</i> <b>Health</b> 1.3 Long, J, Ellis, L, Churraca, K, & Braithwaite, J, <i>"Using Social Network Analysis to unravel complex problems in healthcare"</i> 1.4 Pomare, C, Chuttuca, K, Ellis, L, Long, J, & Braithwaite, J, <i>"How do Mental Health Care Professionals Collaborate during Times of Uncertainty: A social network analysis"</i> 1.5 Aboutaleb Karkavandi, M, Robins, G, Lusher, D, Bastian, B, & McKenzie, V, <i>"Expressed and Perceived Friendship Ties in Socially Anxious Adolescents"</i>
12:30 - 13:15	<b>Lunch</b>
13:15 - 15:40	<b>Session 2: Crime and Networks Online</b>
	<b>Crime</b> 2.1 Bright, D, Whelan, C, & Harris-Hogan, S, <i>"The illumination of Australian terrorist networks using social network analysis"</i> 2.2 Diviak, T, Dijkstra, J, & Snijders, T, <i>"The Efficiency/Security Trade-off and Beyond: Testing a Theory on Criminal Networks"</i> 2.3 Coutinho, J, Koskinen, J, Bright, D, & Wright, A, <i>"Competition and Collaboration in Multilevel Organised Criminal Networks"</i> <b>Networks Online</b> 2.4 Wang, P, & Liu, L, <i>"Friends Can Make a Difference: The Effect of Online Social Networks on Consumer Purchase Decisions"</i> 2.5 McCurrie, C, Falzon, L, & Dunn, J, <i>"Information Sharing or Just Impression Managing? Quantitative, Qualitative, and Network Perspectives on Twitter Behavior"</i> 2.6 Ackland, R, Graham, T, & Muhle, F, <i>"Identifying and Analysing Political Conversations on Twitter"</i> 2.7 Poquet, O, Dowell, N, Brooks, C, & Dawson, S, <i>"Changing Patterns of MOOC In-course Communication"</i>
15:40 - 15:55	<b>Afternoon tea</b>

15:55 - 17:15	<b>Session 3: Theory and Methods 1</b>
	<p><b>3.1</b> Stivala, A, Byshkin, M, Mira, A, Robins, G, &amp; Lomi, A, <i>"Efficient Markov Chain Monte Carlo Estimation of Exponential-Family Random Graph models"</i></p> <p><b>3.2</b> Garrard, R, <i>"A Goodness-of-Fit Test for Sampled Subgraphs"</i></p> <p><b>3.3</b> Yang, D, Lin, H, Wu, C, &amp; Shuai, J, <i>"Modelling Moran Process with Network Dynamics for the Evolution of Cooperation"</i></p> <p><b>3.4</b> Altmann, E, Fischer, R, Leitao, J, &amp; Peixoto, T, <i>"Phase transitions in exponential random graph models"</i></p> <p><b>3.5</b> Gygax, A, &amp; Sawyer, K, <i>"An Option Theory of Social Networks"</i></p>
17:15 - 19:00	<b>Posters and drinks</b>

# Wednesday 29 November 2017

8:30	<b>Presentation Slides Drop-off</b>
09:00 - 11:00	<b>Session 4: Theory and Methods II</b>
	<p><b>4.1</b> Koskinen, J, Vartanyan, B, &amp; Stenberg, S, "<i>Bayesian Hierarchical Auto-logistic Node-variable Modelling for analysing Network-level Moderation of Contagion</i>"</p> <p><b>4.2</b> Krivitsky, P, Marcum, C, &amp; Koehly, L, "<i>Exponential-Family Random Graph Models for Multi-Layer Networks</i>"</p> <p><b>4.3</b> Tan, L, &amp; De Iorio, M, "<i>Nonparametric degree-corrected blockmodels for social networks</i>"</p> <p><b>4.4</b> Igarashi, T, Kato, J, Shiraki, Y, Hirashima, T, &amp; Tamai, R, "<i>Chasing stars and confirming alliance: Two effective strategies for learning social network structure</i>"</p> <p><b>4.5</b> Stys, P, Koskinen, J, Papy Muzuri, B, "<i>The social networks of social network data collection: An analysis of eight months of research in the eastern DR Congo</i>"</p>
11:00 – 11:15	<b>Morning Tea</b>
11:15 - 13:00	<b>Session 5: Inter-organisational and Spatial Networks</b>
	<p><b>5.1</b> Todo, Y, Fu, J, &amp; Matous, P, "<i>Propagation of Financial Constraints through the Global Production Network</i>"</p> <p><b>5.2</b> Martinus, K, &amp; Sigler, T, "<i>Spatial and non-spatial proximity dimensions of city clusters</i>"</p> <p><b>5.3</b> Kim, Y, &amp; Todo, Y, "<i>Are Politically Connected Firms More Likely to Export?</i>"</p> <p><b>5.4</b> Kashiwagi, Y, "<i>Propagation of Shocks due to natural disasters through global supply chains</i>"</p> <p><b>5.5</b> Boonstra, T, Larsen, M, Townsend, S, &amp; Christensen, H, "<i>Validation of a smartphone app to map social networks of proximity</i>"</p>
13:00 - 14:00	<b>Lunch</b>
14:00 – 15:20	<b>Session 6: Intra-organisational Networks</b>
	<p><b>6.1</b> Held, F, "<i>Drivers of collaboration in self-organising multidisciplinary research teams</i>"</p> <p><b>6.2</b> Gallagher, C, Monti, A, Robins, G, &amp; Lomi, A, "<i>Influential relations: How experiential learning diffuses in organizations</i>"</p> <p><b>6.3</b> Pitts, A, "<i>Lessons Learnt as an ONA Practitioner and Future Directions</i>"</p> <p><b>6.4</b> Lusher, D, "<i>Tacit and Codified Knowledge Transfer in Advanced Manufacturing Settings</i>"</p>
15:20 – 15:35	<b>Afternoon tea</b>
15:35 – 16:30	<b>Panel discussion</b>



# Keynote Speaker



## Professor Philippa Pattison

*Deputy Vice Chancellor (Education)*

A quantitative psychologist by background, Professor Pattison began her academic career at the University of Melbourne. The primary focus of her research is the development and application of mathematical and statistical models for social

networks and network processes.

Her work has broad application and has most recently focused on the transmission of infectious diseases and the recovery of communities following the 2009 Victorian bushfires.

She was elected a Fellow of the Academy of the Social Sciences in Australia in 1995, and in 2002 she received the International Network for Social Network Analysis Simmel Award.

Professor Pattison was named on the Queen's Birthday 2015 Honours List as an Officer of the Order of Australia for distinguished service to higher education, particularly through contributions to the study of social network modelling, analysis and theory, and to university leadership.

## **Title:** *Four puzzles in modelling the structure and dynamics of social networks*

**Abstract:** In this talk I discuss four enduring challenges that arise in modelling the structure and dynamics of social networks. In each case, I provide an account of the context in which the challenge arises, the approaches that have or might be taken to address the challenge, and the significance of potential solutions.

## Panelists



### Dr Alicia Aitken

Dr Alicia Aitken is leading ANZ's Transformation & Change capability as they transition to a new, more agile, way of working across the organisation.

Prior to her role at ANZ Alicia held the position of Chief Project Officer for Telstra, where she led the organisation's journey to establish project management as a stand-alone capability

separate from IT, business and engineering skills. Alicia spent several years as CEO, Human Systems International now a PML owned company. Her experience ranges through several industries including Telecommunications, Banking & Finance, Defence & Aerospace, Pharmaceutical, Engineering & Construction, Mining, Oil & Gas and Government.

Alicia is the chair of the International Centre for Complex Project Management and holds a PhD in project management and psychology with a particular focus on how project managers cope with stress.



### Kelvin McGrath

Kelvin McGrath is the founder of MeetingQuality, a company which provides software used to predict the ultimate outcome of meetings through measuring individual contribution.

Prior to joining MeetingQuality, Kelvin was the CIO of Asciano Limited for six years. He also served as a director / chairman of 1-Stop Connections for five years.

From 2001 until he joined Asciano in 2010, Mr McGrath was the CIO of international building and construction materials group Boral Limited. Previously, he held a number of executive and senior positions in the IT

industry in Australia, New Zealand, the United Kingdom and Sweden. Mr. McGrath holds a degree in Electrical Engineering and an M.B.A.



### Dr Hilary Armstrong

Hilary is a Director of Changeworks with a focus on collaborative leadership, cultural change, coaching and applied ethics. She is a Master Certified Coach (MCC) with the International Coach Federation, an experienced facilitator, mediator, coach, applied ethics consultant and social researcher. Currently she is transforming businesses using digital insights in a unique 'CollaborationbyDesign' program (with Optimice Pty Ltd.) that begins with a Social Network Analysis as a visual tool to create

digital insights to begin a series of organisational dialogues. It has been used across a broad range of industries, including as the basis for a leadership and ethics program in finance, a collaborative leadership program in a major airline, and for instigating culture change in education, manufacturing mining and infrastructure.



## Greg Simpson

Greg Simpson is an organic chemist who had an extensive career in CSIRO, initially in research however focussing more recently on research management and commercial development of technologies. This included experience in agrochemical and biotechnological industries and focussed on the chemical industry in Australia. He has collaborated extensively across the innovation sector, working on projects with universities, public research agencies and large and small firms across the world. He has over 70 research publications and has cosupervised 12 PhD students. Over the last decade he has engaged in studies aimed at understanding the social processes that operate in innovation. He has worked extensively in the area of sustainable chemical manufacture and more recently established programs in CSIRO to increase links with aboriginal and Torres Strait islanders and the scientific community.

A former President of the Royal Australian Chemical Institute he is currently an Adjunct Professor at Swinburne University working with the social network analysis and history of CSIRO groups. He is also a Professor of Practice at Monash University and continues to enhance collaboration between industry and academic scientists.



## Dr Uma Srinivasan

Dr Uma Srinivasan currently works as a research scientist and mentor for Health Market Quality PhD students at CMCRC. Dr Srinivasan also provides advice to research and product development in the area of health information business intelligence services. Formerly she worked as Principal Research Scientist at CSIRO, Australia leading a team of IT professionals, scientists and engineers in two specialist areas: Health Data Integration and Multimedia Delivery Technologies. Her previous position also includes working as a Project Director at Prince of Wales Hospital Group, South Eastern Sydney Area Health Service, where she was responsible for designing managing implementations of large inter-hospital systems. She has several international publications in the areas of health information systems, multi-database and multimedia systems. She holds a PhD in Computer Science from the University of New South Wales. Dr Srinivasan is an Adjunct Professor at Western Sydney University, Australia. Her research interests include network analytics and predictive modelling for the healthcare sector.



## Harry Toukalas

Harry is the co-founder of Blackhall & Pearl and has significant global experience in the fields of risk and business management. He was previously the Regional Vice President Risk Management Asia/Pacific for Bankers Trust and the Global General Manager of Operational Risk and Compliance for the NAB Group. Harry subsequently became the founding Managing Director of the Bank of Cyprus Australia (now Delphi Bank), building it into a full-service retail bank. In addition to risk management and board performance, Blackhall & Pearl currently consults globally to major organisations in the application of SNA for business transformation through collaboration with the Massachusetts Institute of Technology. Harry is currently completing a PhD combining the fields of Artificial Intelligence, Cognitive Bias and SNA.

## Poster Session

During ASNAC 2017 we will have on display research posters in the AMDC Level 3 Foyer. A list of those posters on display can be found below. Be sure to check them out and discuss with the authors the research on display.

Author(s)	Title
Anichenko, E, Chung, K, & Crawford, L	<i>"Project knowledge networks: Implications for project performance and relational coordination"</i>
Chung, K, Cooper, S, Skinner, R, Lewis, L, Albury, K, Bateson, D, & Lim, M	<i>"Social Networks, Social Media &amp; Sexual Agency : A Study Protocol"</i>
Dutta, R, & Krivitsky, P	<i>"Interaction between covariates on ERGM"</i>
Gygax, A, Hazledine, M, & Martin, J	<i>"Are Directors Really Irrelevant to Capital Structure Choice?"</i>
Higgins, S	<i>"Social discipline and the two sources of authority: an old statement and new evidences from a developmental agricultural project"</i>
Inoue, H, & Todo, Y	<i>"Propagation of Negative Shocks through Firm Networks: Evidence from Simulation on Nation-wide Supply Chain Data"</i>
Karimi, F, & Matous, P	<i>"Students' social life in higher education environment: Mapping the networks of students' extracurricular activities"</i>
King, S, Lusher, D, Hopkins, J, & Simpson, G	<i>"Trash to Treasure: The social processes of industrial symbiosis networks for SMEs"</i>
Lim, K, Lau, L, Matous, P, & Cole, D	<i>"Impacts of a poverty alleviation program on local expressive and instrumental networks"</i>
Ong, S, & Uddin, S	<i>"Discerning Associations in Project Longitudinal Networks"</i>
Pelaez Alvarez, C	<i>"The organization entanglement: mapping the collective mind through Neurometry"</i>
Pollack, J, & Matous, P	<i>"Exploring the efficacy of project team relationship building using a longitudinal, interventionist approach"</i>
Roden, B, Lusher, D, Spurling, T, Gilding, M, Simpson, G, Brennecke, J, Wang, P, Brailly, J, Elsum, I, Klein, T, & Burton, V	<i>"Understanding the impact of Business Models on University-Industry engagement: A social network perspective"</i>
Sadewo, G, Kashima, E, Gallagher, C, & Kashima, Y	<i>"The Relation between International Students' Social Networks and their Cross-Cultural Adjustment"</i>
Senanayake, U, Piraveenan, M, Matous, P, & Todo, Y	<i>"Applying assortativity metrics to quantify internationalisation of supply chain relationships"</i>
Shimamoto, D, Kim, Y, & Todo, Y	<i>"The Role of Information and Social Interactions in Export Activity: Evidence from firm-level data from cam"</i>
Xing, Y, & Chung, K	<i>"Surface and Deep Learning Approaches: A Social Network Perspective"</i>
Yeo, J, Eapen, A & Elsum, I	<i>"Ties with non-market organisations and firm innovation"</i>
Zhu, L, Lu, Y, Ogura, Y, & Todo, Y	<i>"Supply Chain Disruptions and Trade Credits"</i>

# Session Abstracts

## Session 1: Environment and Health

**Rebecca Cunningham**, Institute for Sustainable Futures at University of Technology Sydney

*“Learning from social networks – climate adaptation policy in New South Wales”*

Authors: Cunningham, R, Jacobs, B, Measham, T, Cvitanovic, C, & Dowd, A

**Abstract:** Communication of climate change policy within social networks is essential for climate adaptation. There are still few empirical examples of how this takes place within communities. From 2013 – 2015, research undertaken in New South Wales demonstrated that climate adaptation information flows within communities. Under the NSW Climate Adaptation Research Hub (Adaptive Communities Node) social network analysis was employed in three regions of New South Wales to understand the adaptation knowledge networks. In three discrete regions of Shoalhaven, Bega and Orange, within semi-structured interviews, participants reported how they both sought and shared climate adaptation policy information (N=24, N=29 and N = 31 respectively). The resulting network diagrams share some common features while revealing unique stories of adaptation related to local context.

The findings demonstrated that although each network is dynamic and unique, knowledge flowed through key knowledge brokers that shared similar characteristics. These knowledge brokers each had multiple roles and connections through a cross-section of their communities, and had a relatively deep understanding of the particular social, cultural and industry specific attributes of their region.

The findings may contribute to a topology of effective knowledge diffusion for climate adaptation that identifies the most effective communication channels for each region's communities. This presentation outlines the findings of these three cases and proposes guidelines for further implementation.

**Ryan McAllister**, CSIRO

*“Multi-level networks and complex environmental challenges”*

Author: McAllister, R

**Abstract:** The structure of stakeholder interaction is a critical precursor to the ability to solve complex environmental challenges. The structure relates not just of social interactions, but also of how social actors participate in key policy forums (working groups, technical committees etc.). Accordingly multi-level networks provide a useful framework for the analysis of such problems – with social actors at one level, and policy forums at another. Networks based on stakeholder participation in institutional responses to agricultural pest and disease incursions are analysed. In such networks the spatial complexity of response is further challenged by the need to design and implement plans quickly in order to stop the spread pest and disease of incursions. ERGMs were applied to multi-level

networks collected from Australia's institutional responses to the 2010 myrtle rust (trees) and 2001 black sigatoka (banana) incursions. Lessons from political theory suggest that, in these policy networks, where higher-level decisions are made interactions should denser, with overlapping stakeholder interactions signifying collaboration (bonding-capital, high transaction-costs). Where plans are implemented more-or-less at face value, networks should exhibit lower-transaction cost interactions associated with the socially cheaper task of coordination (bridging-capital, low transaction-costs). Both datasets give some support to these ideas. More generally, methods to identify the mix of coordination and collaboration in networks for solving environmental problems can help target capacity building and institutional design.

**Janet Long**, Macquarie University

*“Using Social Network Analysis to unravel complex problems in healthcare”*

Authors: Long, J, Ellis, L, Churrua, K, & Braithwaite, J

**Abstract:** Healthcare is increasingly complex, with multiple stakeholders, ever more sophisticated treatments, and an ageing population with its attendant rise in chronic conditions. Added to this are problems such as lack of integration, poor adherence to clinical practice guidelines (57% according to CareTrack Australia (1)) and the estimate that 10% of hospital admissions will experience an adverse event (2).

Relationships and social influence as captured by SNA offers a useful lens for understanding and addressing these issues. In this presentation, we provide examples from studies done by us to illustrate how we are using SNA to understand issues such as collaboration, advice-seeking and knowledge dissemination.

In example 1, we examine the communication patterns in an emergency department and a renal ward around seeking advice for medication-related issues (3). It illustrates the distinctive communication patterns (tribal behaviours) that perpetuate in these settings and suggests ways to foster network ties.

Example 2 is a longitudinal study of collaboration ties in a Translational Research Network in the field of cancer (4). It showed the growth of ties between researchers (laboratory-based, and translational social scientists) and bedside clinicians to foster translational research efforts mediated by the network structure. This study revealed hidden key players, deconstructed network leaders' roles and pointed to future risks to the sustainability of the network. It was also used as evidence in a successful rebid for funding for the Network.

Example 3 and 4 are from studies that are currently underway. In the first, we are examining how social influence mediated by a specialist network structure affects adoption of new highly specialised technology. In the second, we are measuring organisational collaboration in a cross-sectoral community health program. The results will inform interventions to address lack of integration of services which has been identified as a barrier to clients engaging in services.

**Chiara Pomare**, Australian Institute of Health Innovation at Macquarie University



*"How do Mental Health Care Professionals Collaborate during Times of Uncertainty: A social network analysis"*

Authors: Pomare, C, Churruca, K, Ellis, L, Long, J, & Braithwaite, J

**Abstract:** Uncertainty is a ubiquitous and dynamic presence across health care that must be tackled with the efficient collaboration of staff. The aim of this project was to identify the types and situations of uncertainty experienced by mental health care professionals, and subsequently evaluate how professionals collaborate in the face of these different situations. The research was conducted in two integrated mental health facilities in Sydney, Australia. An exploratory mixed methods sequential design was employed to address the research questions. Study one involved semi-structured interviews with key staff members, and study two consisted of a survey using social network analysis with all staff to empirically assess patterns of collaboration across situations of uncertainty. Statistical analysis, thematic analysis and social network analysis were employed to analyse data. Social network analysis was used to compare patterns of collaboration dependent upon type of uncertainty, between and within the two centres. The findings of this research will enable a deeper understanding to the uncertainties experienced by mental health care professionals and the manifestations of professional relationships in the face of different uncertainties.

**Maedeh Aboutalebi Karkavandi**, Swinburne University of Technology

*"Expressed and Perceived Friendship Ties in Socially Anxious Adolescents"*

Authors: Aboutalebi Karkavandi, M, Robins, G, Lusher, D, Bastian, B, & McKenzie, V

**Abstract:** This study describes how an individual attribute — in this case, social anxiety — may affect the structure of the friendship network. In the current study, expressed and perceived friendship networks and their intersection are investigated, using multivariate Exponential Random Graph Modelling (ERGM). Expressed friendship refers to the friendship choices made by the actor, a self-report of individual friendship preferences. Perceived friendship refers to an actor's belief of who considers them as a friend. This examination of expressed and perceived networks enables conclusions of how social anxiety relates to actual behaviour (in terms of expressed choices) and to cognitive perceptions of the social environment.

Participants were 94 year-nine students recruited from an all-female high school in Melbourne, Australia. The Social Anxiety Scale for Adolescents was used to measure the level of anxiety in social situations with peers (SAS-A; La Greca & Lopez, 1998). To assess expressed friendships, students were asked "Who are those you like to hang out with?". Because of the behavioural aspect to these questions, this name generator represented expressed friendship. Students were also asked "Who would name you as one of their friends?" This item indicated their perception and understanding of their friendship network environment.

Results indicated that socially anxious students sent fewer expressed friendship nominations than other students, although they were not different from other students in terms of popularity. There was a high level of congruence between expressed and perceived friendship ties such that students expected most of their friendship relations to be mutual. Furthermore, students exhibited a good level of accuracy in understanding of their social standing. The social partners of socially anxious adolescents, however, had a higher level of accuracy above and beyond the other students. The result suggests that social anxiety can influence how students express their friendship relations and how other students perceive their relations with them.

## Session 2: Crime and Networks Online

**David Bright**, Flinders University

*"The illumination of Australian terrorist networks using social network analysis"*

Authors: Bright, D, Whelan, C, & Harris-Hogan, S

**Abstract:** Terrorist groups are usually described as loosely connected networks of individuals and small groups (or cells). Social network analysis (SNA) has been utilised by scholars and law enforcement practitioners as one approach to the description and analysis of terrorist networks. Even though law enforcement agencies utilise social network analysis as an intelligence tool, some temporally asynchronous connections between individuals and between groups of individuals may remain undetected. The current paper uses a case study approach to conduct SNA on discrete groups and compares this to an aggregate network to reveal hidden ties that could facilitate the flow of ideology, tactics, and resources across terrorist cells. We conducted two analyses. First, SNA at three time periods (2004-5, 2011-12, and 2013-15). Second, an aggregated analysis across the three time periods. Results reveal the presence of key actors who may act as conduits between groups (e.g., for ideology, tactics, information). Such actors can link groups that form and fragment at different times, thus enhancing the resilience and durability of the network. We explore the implications of the results for investigations and intelligence collection by law enforcement and security agencies.

**Tomas Diviak**, University of Groningen / Charles University

*"The Efficiency/Security Trade-Off and Beyond: Testing a Theory on Criminal Networks"*

Authors: Diviak, T, Dijkstra, J, & Snijders, T

**Abstract:** The efficiency/security trade-off hypothesis has become prominent in the field of criminal network analysis, although it has been empirically tested in only a small number of studies. This hypothesis states that criminal networks and actors involved generally manoeuvre between the immediate profit from their activities (efficiency) and working slowly towards long-term goals while remaining undetected (security). It has been argued that whether the structure of the criminal

network is efficient or secure depends on the goal of the particular network. That is, networks driven by financial profit (e.g., drug traffickers) are supposed to opt for efficiency, whereas networks driven by ideology (e.g., terrorists) are supposed to opt for secure network structure. In our study we focus on five network mechanisms derived from the efficiency/security trade-off, that is, density, centralization, closure, brokerage and the balance between closure and brokerage. Specifically, we identify for each mechanism tension between individual motives of actors in the criminal network and the overall structure of the network, which may even contradict the initial individual motivation. This is tested in both profit driven and ideological criminal networks using both descriptive measures as well as exponential random graph modelling (ERGMs) and their meta-analysis. Results show very little support for the theory. Findings are discussed in the light of the refinement of theory by accounting for network dynamics, individual psychological attributes, and for other types criminal networks (gangs or corruption).

**James Coutinho**, Swinburne University of Technology  
*"Competition and Collaboration in Multilevel Organised Criminal Networks"*

Authors: Coutinho, J, Koskinen, J, Bright, D, & Wright, A  
**Abstract:** Network analysis has been used to understand processes of collaboration and competition among organisations in competitive legal markets. It has been found that organisations encountering each other in multiple geographical locales ('spatial multipoint competitors') may collaborate and develop complementary specialisations rather than competing directly with one another for market share (Lomi & Pallotti 2012). Though there exists considerable research into criminal networks (e.g. Morselli 2009), there is little research into how organisations operating in illicit markets, such as different types of organised criminal group, compete and collaborate with one another. This paper develops an analytical framework for understanding how organised criminal groups compete and collaborate with one another in large-scale illicit markets. The paper exploits a unique multilevel dataset collected by Canadian Law Enforcement. The data consist of 3137 organised criminals and their affiliations to 293 geographical locations and 188 criminal organisations, as well as attributes of both individuals and organisations. The paper theorizes that complex network structures arise as a result of micro-level competitive and collaborative behaviour among criminals. Using multilevel exponential random graph models (ERGM) to analyse the data, the paper looks at how spatial co-location and common criminal activity shape the competitive and collaborative behaviour of individuals. It also explores variations in competitive and collaborative behaviour across organisation types, comparing Outlaw Motorcycle Gangs with other forms of criminal group.

**Peng Wang**, Swinburne University of Technology  
*"Friends Can Make a Difference: The Effect of Online Social Networks on Consumer Purchase Decision"*  
Authors: Wang, P, & Liu, L

**Abstract:** Online consumer reviews have become increasingly prevalent on the vast majority of online shopping sites, and consumers use them either to find products that match their preferences, or to search information useful for offline purchase. The emergence of online social communities further provide platforms and channels that enhanced the dissemination of consumer opinions, which may affect consumers' purchase decision. Traditional regression analysis have tried to predict the change in sales from a retailer's perspective in relation to online reviews. However, how the complexity of consumer social networks structure may affect purchasing decision making process is unclear. We introduce exponential random graph models (ERGM) for social network analysis as a tool that predicts online purchasing behaviour while taking into considerations of product properties, consumer demographics, product rating networks, as well as consumer online social networks. Testing hypothesis in relation to evidence-based and opinion-based purchase, our findings demonstrate how the multiplexed network systems may affect consumer purchasing behaviour.

**Caitlin McCurrie**, University of Melbourne  
*"Information Sharing or Just Impression Managing? Quantitative, Qualitative, and Network Perspectives on Twitter Behaviour"*

Authors: McCurrie, C, Falzon, L, & Dunn, J  
**Abstract:** Twitter represents an idealised platform for individuals to rapidly and widely share information. The ease with which data can be sourced through Twitter's API has resulted in a disproportionate number of 'big data' studies aimed at assessing what information is most widely propagated through the 'Twittersphere' network and why. The focus on digital data has led researchers to overlook the importance of 'small data' (e.g., survey and experiments). Although big data can measure the impact of Twitter messaging in terms of observable behaviour, the richness at the level of the individual could be lost with the exclusive use of big data approaches, and therefore lead to inappropriate generalisations. We take a different approach, we synthesize survey, digital trace, and social network data to comprehensively examine Twitter behaviour. A survey was designed on the basis of a model of Twitter information sharing informed by prior literature. A sample of 212 Australasian, American, and European Twitter-users answered questions relating to their: motivations for tweeting and following others, their audience, strategies used for facilitating information propagation, and choice of Tweet content. Participants also provided their Twitter handle allowing us to collect data from the Twitter API and construct ego-centred networks of users and their followers; discussion networks; and networks of information flows. We explore each class of network in conjunction with qualitative data to reveal new insights into the spread and reach of Twitter users as information spreaders and the network positional attributes of users. Analyses reveal that many users tweet for ego-centric reasons, rarely engage in discussion, and aren't influenced by

what they read on Twitter. In a subset of American users, we identify two discussion network structures that characterize these user's discussion style: cascades and stars. Additional analyses intend to examine whether these network structures also exist in the cross-cultural sample.

**Robert Ackland**, Australian National University  
*"Identifying and Analysing Political Conversations on Twitter"*

Authors: Ackland, R, Graham, T, & Muhle, F

**Abstract:** The 2016 US presidential election led to considerable interest and concern about the potential role of socio-technical entities (socialbots) – automated software programs that post messages and connect to other users on social media, while presenting themselves as human beings – in infiltrating political discourse, distorting online conversations and manipulating public opinion. To study the potential impact of socialbots on politically-oriented conversations on social media such as Twitter, it is first necessary to identify conversations. While many researchers implicitly regard activity on Twitter as conversations, most research has in fact focused on Twitter as a news media or broadcast platform, not a platform enabling conversations. In this research, we draw on the field of Conversation Analysis to develop a network-based approach for identifying the "structural signatures" of Twitter conversations as sequential and reciprocal phenomena. We demonstrate our approach using a dataset of 6.5 million tweets containing hashtags relating to the 2016 US presidential debates (e.g. #DebateNight). Two hours of Twitter data were collected from 8.45pm to 10.45pm EDT on 26 September, 2016 using the Twitter Firehose API: the time range included the first presidential debate (90 minute duration), and also 15 minutes before and after the debate. We then constructed a weighted and directed network consisting of 1.5 million nodes (representing the set of users) and 6.5 million edges of four types: replies, mentions, retweets and self-loops (which occur when a tweet contained a target hashtag, but did not lead to one of the other three edge types). Having identified conversations that occurred on Twitter during the presidential debate we present some descriptive analysis: how much Twitter activity involved conversations?, what topics were discussed?, who initiated these conversations? We also outline our preliminary work on statistically analysing the conversation dynamics using the relational event modelling (REM) framework.

**Sasha Poquet**, University of South Australia  
*"Changing Patterns of MOOC In-course Communication"*

Authors: Poquet, O, Dowell, N, Brooks, C, & Dawson, S

**Abstract:** Massive open online courses (MOOCs) are open educational environments that allow learners to take courses online for low cost. Since 2008 MOOCs have been widely adopted with millions of adults

engaged in these learning opportunities. Despite the wide adoption, facilitation of learning interactions in MOOC forums is notoriously difficult. Furthermore, evaluating the development of interpersonal interactions in MOOC forums is a challenge. Researchers had applied network analytic concepts to analyse forum communication structures. Yet, the insights from previous network analytic applications are hard to interpret due to the specificity of open online networks, in particular the ebb and flow of MOOC participants. That is, some learners interact on forums regularly, while others appear once or twice, with the forum drop-in behaviour persisting throughout the course. In our past work, we have proposed that reciprocity network features (direct, indirect and triadic-level) can help describe communication patterns of regular forum posters. In this study we model communication networks of MOOC forums using reciprocity features and include the effect of regular forum participants and the forum drop-ins on the network formation. The typology of posters is data-driven and derived through latent class analysis of the intensity and duration of forum behaviour. Analysis illuminates the communication network structures in ten iterations of the same MOOC on offer in the course of three years in an American university. Analysis demonstrates that regular participants have positive effect on the network formation. The results also suggest that communication patterns in this particular MOOC has over time shifted from community-oriented to a more question-answer like patterns. The findings are of relevance to the researchers and practitioners interested in applying network analytic techniques to the analysis of communication networks of open online environments.

### Session 3: Theory and Methods

**Alex Stivala**, Swinburne University of Technology /  
Università della Svizzera italiana

*"Efficient Markov Chain Monte Carlo Estimation of Exponential-Family Random Graph models"*

Authors: Byshkin, M, Stivala, A, Mira, A, Robins, G, & Lomi, A

**Abstract:** The increase in the number and size of large network data sets requires novel efficient methods for their analysis. Exponential Random Graph Models (ERGMs) are a general form of probability distribution widely applicable to the analysis of social and other networks. The scope of ERGMs is limited by the fact that Maximum Likelihood Estimation of the model parameters can be obtained for small networks only: a few thousand nodes at most. We extend a recently developed Auxiliary Parameter MCMC method and propose a new Markov Chain Monte Carlo (MCMC) approach for the Maximum Likelihood Estimation of ERGMs. In contrast to existing estimation approaches (Bayesian, MCMCMLE and Method of Moments) the suggested approach does not carry out a large number of MCMC simulations to draw equilibrium network configurations. The approach is based on properties of equilibrium distributions of Markov chains. Using this approach we design a simple and efficient algorithm that estimates ERGM parameters



several orders of magnitude faster than the existing algorithms. The suggested estimator is tested on small simulated network first: we compute the variance and the bias and compare them with results obtained by Method of Moments. And then we apply the suggested method to the study of large-scale social and biological networks.

**Robert Garrard**, CSIRO

*"A Goodness-of-Fit Test for Sampled Subgraphs"*

Author: Garrard, R

**Abstract:** We consider the problem of testing whether a graph's degree distribution belongs to a particular family, such as poisson or scale-free, given that we only observe a sampled subgraph. In particular, we focus on induced subgraph sampling, a sampling design which systematically distorts the degree distribution of interest. We estimate the parameter indexing the hypothesized family by GMM and utilize the Kolmogorov-Smirnov test statistic to assess goodness-of-fit. Since the distribution in the null hypothesis has been estimated, critical values for the test statistic must be simulated. We propose a novel bootstrap in which we construct a graph whose degree distribution conforms to the null hypothesis from which we may draw pseudo-samples in the form of induced subgraphs. We investigate the properties of this procedure with a monte carlo study which confirms that the bootstrap is able to attain size close to the nominal level while exhibiting power under the alternative hypothesis.

**Dongping Yang**, The University of Sydney

*"Modelling Moran Process with Network Dynamics for the Evolution of Cooperation"*

Authors: Yang, D, Lin, H, Wu, C, & Shuai, J

**Abstract:** A coevolutionary model is introduced to investigate the effects of natural selection on the evolution of cooperation as well as network structure. Both fertility and mortality selection are discussed in the framework of Moran process with network dynamics for the evolution of cooperation. For the fertility selection, three usual social dilemmas are found to have a phase transition at the same value of cost-to-benefit ratio, resulting from the parent-offspring link, which is in line with the Hamilton rule of kin selection. However, the mortality selection is found to play a nontrivial role in the evolution of both cooperation and network structure, where cooperators can self-organise to a cluster and withstand the invasion of defectors by forming a firm cooperating k-core, which will collapse down when the mortality strength intensity is too strong. So the formation and maintenance of the cooperating k-core coordinate with each other at a specific selection intensity to support cooperation at most.

**Eduardo Altmann**, The University of Sydney

*"Phase transitions in exponential random graph models"*

Authors: Fischer, R, Leitao, J, Peixoto, T, & Altmann, E

**Abstract:** What is the expected assortativity of a random graph with a given clustering coefficient? The answer to this and similar questions can be obtained using Exponential Random Graph Models (ERGMs), a

powerful and widely used method in Social Networks Analysis. The mathematical formalism of ERGMs is equivalent to the one used in Statistical Physics to describe thermodynamical systems. In this talk we will build on this equivalence and argue how ideas from Statistical Physics can still contribute to Social Networks Analysis.

Our key observation is the ubiquitous appearance of phase transitions in ERGMs. Phase transitions are well-known in Thermodynamics and correspond to discontinuities in the dependence of an order parameter (e.g., the density) on a control parameter (e.g., the temperature). In ERGMs we find equivalent (first-order) phase transitions on the dependence of the density of motifs (e.g., triangles or other small subgraphs) on the associated ERGM parameter. The significance of this observations is that the estimation of model parameters is known to be extremely difficult near phase transition. Even brute force methods (e.g., the Metropolis-Hastings MCMC) become trapped in meta-stable states and require a prohibitively large computational time. The characterization of phase transitions, and the development of more sophisticated sampling methods (e.g., Multicanonical MCMC) to deal with them, is an essential part of Statistical Physics.

The arguments above show how sophisticated sampling methods are required to estimate the mutual influence of different observables in social networks (e.g., clustering and assortativity). Applying such methods to different social networks we find that their assortativity are much smaller than the transitivity in random graphs with the same clustering coefficient. We also characterize the correlations between different motifs in directed networks, showing that previous analysis based on ""motif profiles"" are driven in a large extent by such correlations.

**André Gyga**, University of Melbourne

*"An Option Theory of Social Networks"*

Authors: Sawyer, K, & Gyga, A

**Abstract:** This paper constructs a new theory of social networks based on the options individuals buy on each other. The model assumes that when an individual connects with another it is equivalent to buying options on the other's reputation. The option model confers advantages not present in existing models. First, the payoff to connecting is endogenously determined by the reputation of the network. Secondly the strategy to connect is an option strategy. Thirdly, the network forms as individuals take option positions; the network evolves as individuals adjust those positions. The model allows for powerful insights into network structure, the price of connecting and the value of connecting.

**Johan Koskinen**, University of Manchester

*"Bayesian Hierarchical Auto-logistic Node-variable Modelling for analysing Network-level Moderation of Contagion"*

Authors: Koskinen, J, Vartanyan, B, & Stenberg, S

**Abstract:** Drawing on the framework for accommodating local dependencies used for deriving exponential random graph, Robins, Pattison, and Elliot,

(2001) proposed a social influence model for modelling binary outcomes with dependence through the network structure. This model was later extended to a general auto-logistic actor attribute model (ALAAM) and likelihood-based estimation elaborated (Daraganova, 2009; Daraganova and Robins, 2013). Here we elaborate the Bayesian inference scheme for ALAAM proposed by Koskinen (2008) to multiply observed networks by imposing a hierarchical modelling structure. The aim is twofold: firstly we allow for heterogeneity across different networks; secondly we may accommodate network-level predictors of local dependencies. For social influence or contagion broadly being defined as the tendency for individuals that are relationally tied to have a higher propensity to be similar on a binary outcome than individuals that are not directly tied, it is plausible to assume that contagion may be stronger in some contexts and weaker, or absent, in others. For example, we may expect to find that peer-influence in smoking is present in some schools but not in others. We aim here to avail researchers of the tools to find school-level or network-level determinants to explain such differences. We illustrate this approach through an application to a historical dataset consisting of a collection of about 600 school-class networks in Sweden.

**Pavel Krivitsky**, University of Wollongong  
*"Exponential-Family Random Graph Models for Multi-Layer Networks"*

Authors: Krivitsky, P, Marcum, C, & Koehly, L

**Abstract:** Networks with multiple layers of relationships are of increasing interdisciplinary interest. Such networks arise in a host of contexts where more than one type of relation may be observed between a common set of actors or vertices. The ability to model dependence processes giving rise to such systems within the exponential-family random graph framework has previously been limited to dependence arising from just two layers. To address this limitation, we introduce an extension to estimate a joint exponential random graph model over all separate measurement types which retains the (possibly correlated) layered nature of the data while facilitating estimation of dependence effects for arbitrary numbers of relations. Specifically, we extend the Conway-Maxwell-Binomial distribution for the sum of edges while simultaneously modelling joint dependence in multi-layer networks arising from cross-layer graph features. Model terms include analogues of familiar ERGM effects for arbitrary numbers of layers in the network and employ a novel "layer logic" in their specification. Our empirical example is drawn from a problem of common interest in the social and psychological sciences: multi-layer family networks of conflict and cohesion.

**Linda Tan**, National University of Singapore  
*"Nonparametric degree-corrected blockmodels for social networks"*

Authors: Tan, L, & De Iorio, M

**Abstract:** A nonparametric approach to the modeling of social networks using degree-corrected stochastic

blockmodels is proposed. The model for static network consists of a stochastic blockmodel using a probit regression formulation and popularity parameters are incorporated to account for degree heterogeneity. We specify a Dirichlet process prior to detect community structure as well as to induce clustering in the popularity parameters. This approach is flexible yet parsimonious as it allows the appropriate number of communities and popularity clusters to be determined automatically by the data. We further discuss and implement extensions of the static model to dynamic networks. In a Bayesian framework we perform posterior inference through MCMC algorithms. The models are illustrated using several real-world benchmark social networks.

**Tasuku Igarashi**, Nagoya University  
*"Chasing stars and confirming alliance: Two effective strategies for learning social network structure"*  
 Authors: Igarashi, T, Kato, J, Shiraki, Y, Hirashima, T, & Tamai, R

**Abstract:** This study reports a novel technique that unveils the process for learning social network structure. In an online experiment, participants were asked to remember and recall the structure of a directed social network (i.e. a set of influence relationships among employees in a company). Participants were shown a list of names of nodes and asked to remember information about who (source) influences whom (target) in the network with a time limit. The information appeared on the display only when participants hovered the mouse pointer over a source node; in other words, participants needed to collect source-target information across all nodes in an efficient way. A social network stimulus was generated at each experimental session based on a random graph varying in three properties: size (5 to 20), density (.05 to .20), and the degree of reciprocity (0 to 1). Analysis of patterns of mouse tracking/fixation across nodes in a generalized linear mixed modeling (GLMM) framework revealed two fundamental strategies that significantly increased a recall rate of whole network structure. The first was a "chasing stars" strategy, or spending more time to remember active (more influential) nodes than inactive (less influential) nodes. The second was a "confirming alliance" strategy, or searching pairs of nodes forming reciprocal relationships, and was notably efficient to improve the performance in the learning task of large social network structure. The current findings suggest that the exploration of information-searching processes for social network learning has potential to understand the nature of network schema/bias.

**Patrycja Stys**, University of Edinburgh  
*"The social networks of social network data collection: An analysis of eight months of research in the eastern DR Congo"*

Authors: Stys, P, Koskinen, J, Papy Muzuri, B

**Abstract:** In considerations of the field and methodology of SNA, Analysis dominates discussions. For the most part, the actual collection of social network data warrants far less attention. This paper seeks to address this lacuna by examining eight months of social network

data collection we completed in the eastern DR Congo (May-December 2017), supported by a team of six local enumerators. Research followed a respondent-driven sampling design, using a seed-set of eight representatives of each of the targeted populations: demobilised and active combatants, pro- and anti-government; civilians unaffiliated with armed groups; men and women across all population sub-sets. The design was a product of collaboration with colleagues at MelNet, the Mitchell Centre, OII, and the University of Surrey; the research was funded by ESRC-DfID Poverty Alleviation Grant 2013-2014 ES/M009130/1. Data collection yielded 397 partially overlapping ego-nets, focusing on social support networks in this conflict-ridden region, ravaged by wars since Congo's independence in 1960.

This particular paper is a reflexive one, addressing the need for acknowledging the 'thick' aspect of complex data, an issue that Garry Robins identified as a lesson to be learned from ethnography. Here, we examine (1) how our enumerators' own social networks affected access to these hidden, hard-to-reach populations; (2) how our respondents' roles transformed from those of 'gatekeepers' to 'facilitators' over the course of the research; (3) whether we altered and affected the social networks we were studying; and (4) whether compositions of enumerator teams affected the data each collected. Through a rigorous analysis of this meta-data, we hope to advance conversations concerning the travails of social network data collection in the field, and of how we ourselves – inevitably – affect the networks we study. In attempts to understand post-conflict (dis)integration, are we possibly fomenting inter-communal discord?

## Session 5: Inter-organisational and Spatial Networks

**Yasuyuki Todo**, Waseda University

*"Propagation of Financial Constraints through the Global Production Network"*

Authors: Fu, J, Matous, P, & Todo, Y

**Abstract:** This study investigates the propagation of financial constraints through the global production network using large-scale firm-level data for approximately 60,000 major firms in the world that include information on transactions of goods and services between firms. Given the unique data, we can identify the full production network of the major firms. Then, we investigate the relationship between firms' upstreamness in the global production network and the ratio of their trade credit to sales. The upstreamness is measured by the average or maximum number of steps from most downstream firms, or firms without any customer firm. Firms often use trade credit, or accounts receivable and payable, in their transactions of goods and services to avoid moral hazard of suppliers. In other words, customers hesitate to pay at the time when they receive goods or services but pay later, worrying about the quality of the goods and services. Theoretical literature suggests that the moral hazard problem is accumulated

upstream through production networks, because suppliers that were imposed trade credit by their customers are more likely to impose more trade credit on their suppliers. Our empirical analysis using the unique firm-level data supports this hypothesis. We also find that firms in less developed countries have larger trade credit if they have customers outside of their country. This implies that firms in less developed countries may face larger barriers to sales to foreign buyers than to domestic buyers because of higher demand for trade credit, in addition to standard barrier to export due to higher costs of transportation and information. These results provide practical policy implications, suggesting that financial support from the government to more upstream firms may be needed to alleviate inefficiency in the financial market due to the market failure in production networks.

**Kirsten Martinus**, University of Western Australia

*"Spatial and non-spatial proximity dimensions of city clusters"*

Authors: Martinus, K, & Sigler, T

**Abstract:** Clusters are often conceptualised in economic geography as spatial groupings of specialised industry sectors of knowledge and information exchange occurring across time and space. They are primarily articulated at metropolitan and regional scales through the economic benefits of enhanced productivity and economies of scale. Drawing from several extant strands of research, this research expands spatial understandings of proximity in clusters by analysing how groups of cities are bound together within global industrial networks. It applies community detection algorithms from social network analysis to corporate office locational data derived from Australian Securities Exchange (ASX) listed firms to identify city clusters. Both spatial and non-spatial city clusters are evident within industry-specific subnetworks, reflecting the complexities of historic and contemporary processes shaping Australia's global connectivity. Its findings and subsequent discussion presents a novel case for how social network analysis can be used to provide more geopolitical and nuanced industry relational understandings of network structures.

**Yu Ri Kim**, Waseda University

*"Are Politically Connected Firms More Likely to Export?"*

Authors: Kim, Y, & Todo, Y

**Abstract:** Lack of information is one of the most significant barriers to export and thus access to information plays an important role in facilitating export and developing business. Another common barrier to trade is credit constraints. Both information and financial resources are heavily controlled by the government in developing countries where there are only limited open data and financial market available. In this setting, one common way to access valuable information and credit is through personal connection to politicians and government officials. This paper explores the effects of

having political ties on export activities, using firm-level data from traditional apparel and textile clusters in Vietnam. Our results suggest that personal connections to people in government authorities increase the chances to get financial supports from the government. Moreover, politically connected firms are more willing to export. However, such governmental supports and enthusiasm for exports do not lead to the actual export. Likely explanations are that discrimination in favor of personal connections does not result in optimal selection of social programs and generates inefficiencies.

**Yuzuka Kashiwagi**, Waseda University

*"Propagation of Shocks due to natural disasters through global supply chains"*

Authors: Kashiwagi, Y, Todo, Y, & Matous, P

**Abstract:** In this paper, we take Hurricane Sandy that hit the east coast of the United States in 2012 as a source of exogenous negative shocks and examine its indirect effects on the global economy through supply chains. More specifically, using firm-level data on global supply chains, we examine how sales growth of firms in and outside the US changes when their direct and indirect suppliers or customers are damaged by the hurricane. Some existing studies have already examined this issue. For example, Barrot and Sauvagnat (2016, The Quarterly Journal of Economics, 131) find a large negative effect of direct and indirect suppliers and customers hit by major disasters in the United States. However, they focus on supply chains within the US, ignoring global supply chains. Boehm et al. (2015, US Census Bureau Center for Economic Studies Paper, No. CES-WP-15-28) find that affiliates of Japanese firms in the US are negatively affected by the Great East Japan earthquake that affected their parent firms in Japan. However, their analysis ignores arm's-length transactions between firms. The present paper overcomes these shortcomings of the existing studies, incorporating most major inter-firm transaction relations in the world including international and arm's-length relations. In addition, we look into shareholding and co-invention networks among firms to see whether other types of a network strengthen or weaken negative effects through supply chains. The investigation of possible interplays between multilevel networks is another innovation and contribution of this paper. In addition, we observe the structure of each firm's ego-network also influences propagation. Our results show how negative effects of natural disasters diffuse differently depending on the network characteristics. Accordingly, this study could provide more practical policy suggestions to prevent amplification of negative shocks through global firm networks.

**Tjeerd Boonstra**, University of New South Wales

*"Validation of a smartphone app to map social networks of proximity"*

Authors: Boonstra, T, Larsen, M, Townsend, S, & Christensen, H

**Abstract:** Social network analysis is a prominent approach to investigate interpersonal relationships. Most studies use self-report data to quantify the

connections between participants and construct social networks. In recent years smartphones have been used as an alternative to map networks by assessing the proximity between participants based on Bluetooth and GPS data. While most studies have handed out specially programmed smartphones to study participants, we developed an application for iOS and Android to collect Bluetooth data from participants' own smartphones. In this study, we compared the networks estimated with the smartphone app to those obtained from sociometric badges and self-report data. Participants ( $n=21$ ) installed the app on their phone and wore a sociometric badge during office hours. Proximity data was collected for 4 weeks. A contingency table revealed a significant association between proximity data ( $\phi = 0.17$ ,  $p < 0.0001$ ), but the marginal odds were higher for the app (8.6%) than for the badges (1.3%), indicating that dyads were more often detected by the app. We then compared the networks that were estimated using the proximity and self-report data. All three networks were significantly correlated, although the correlation with self-reported data was lower for the app ( $\rho = 0.25$ ) than for badges ( $\rho = 0.67$ ). The scanning rates of the app varied considerably between devices and was lower on iOS than on Android. The association between the app and the badges increased when the network was estimated between participants whose app recorded more regularly. These findings suggest that the accuracy of proximity networks can be further improved by reducing missing data and restricting the interpersonal distance at which interactions are detected.

## Session 6: Intra-organisational Networks

**Fabian Held**, The University of Sydney

*"Drivers of collaboration in self-organising multidisciplinary research teams"*

Author: Held, F

**Abstract:** Background: Complex problems often require the collaboration of experts from multiple disciplinary backgrounds. In traditional academic environments, their collaboration faces multiple obstacles, including among others, organisational structure, physical distance, domain specific research practices. The University of Sydney has established several strategic areas for collaboration with the goal to cultivate interdisciplinary academic networks in selected fields. I present the development of collaboration within one such initiative that brings together about 1100+ researchers to collaborate in the area of non-communicable chronic diseases, especially obesity, diabetes and cardiovascular disease.

Methods: Exponential-Family Random Graph models are used to quantify and test the interacting effects of processes that are consistent with the structure of collaboration as evidenced by the joint authorship of peer-reviewed publications. Controlling for Seniority, and Faculty Affiliation, this analysis addresses the interacting effects of several forms of association within the centre: Membership in Research Groups, co-location

in the hub, as well as participation in self-organised centre-wide research projects.

**Results:** Preliminary analysis indicates that the collaboration network is established through a complex interplay of factors, and that there is substantial variation in the strength and significance of effects even within the same class of associations. There are significant activity effects for a subset faculties and research groups, as well as homophily effects for affiliation and research group membership. Internal research projects have varying effects on the observed network.

**Conclusion:** This investigation into the multilevel nature of collaboration in a research intensive organisation contributes to explaining the complex interactions of individuals and their various memberships in groups, projects, their affiliations and location. Multiple affiliations jointly shape collaborative research, thus determining the self-organising of organisational outcomes. Controlling for other relational effects, this analysis also serves as a means to assessing the efficacy of internal research projects.

**Colin Gallagher**, Swinburne University of Technology  
*"Influential relations: How experiential learning diffuses in organizations"*

Authors: Gallagher, C, Monti, A, Robins, G, & Lomi, A

**Abstract:** Vicarious learning – learning from and through others – requires that others be willing to share their experiences, positive and negative. This is difficult particularly when knowledge is the product of trial-and-error learning. Under what organizational conditions are individuals more likely to share their experience? Addressing this question is of central importance to organizations in knowledge-intensive environments where complex technical and procedural information is difficult to convey reliably across organizational boundaries. This is a demanding communication task, that requires organizational participants constantly to refine their own learning through feedback-seeking and assessments of past mistakes. Under such conditions, boundary-spanners occupy a position of potential vulnerability, asked to revisit past errors for the sake of better future performance. These knowledge sharing and transferring processes may operate best under certain network conditions, as well as certain types of self-identification with the (subordinate) team and (superordinate) organization. In this paper, we investigate how network positions increase or, as the case may be, reduce the propensity of organizational participants to share best practices learnt by experience within and across organizational units. We apply a social-influence type model, namely autologistic actor-attribute models (ALAAMs) for social influence in multilevel networks — to data we have collected on advice and help relations among the members of a multi-unit mechanical company (n = 170) involved in the production of high precision components for Formula 1 racing cars.

**Andrew Pitts**, Polinode

*"Lessons Learnt as an ONA Practitioner and Future Directions"*

Author: Pitts, A

**Abstract:** This presentation will reflect on the lessons learnt from three years as an organisational network analysis practitioner using both traditional relationship-based surveys as well as passive electronic data (e.g. email logs, HRIS systems, etc.). Two key questions will be asked - one backwards looking and the other forwards looking: 1. What has worked well and where are the opportunities for improvement? 2. What are the likely future directions in the space, including benchmarking, integration of multiple data sources and the tension between potential 'network interventions / development' and sensitivities around privacy / confidentiality. One of the aims of this presentation will be to proactively try to bridge the gap that often exists between practitioners and the research community.

**Dean Lusher**, Swinburne University of Technology  
*"Tacit and Codified Knowledge Transfer in Advanced Manufacturing Settings"*

Author: Lusher, D

**Abstract:** This paper unpacks the diverging rules underlying the transfer of tacit knowledge and the transfer of codified knowledge in advanced manufacturing settings. We argue that employees' formal and informal hierarchical status in the organization will influence how they transfer the two types of knowledge and will thus shape the structure of tacit and codified knowledge networks. Drawing on data collected in the engineering department of an Australian aerospace organisation, we apply exponential random graph models for multiplex networks to examine empirically the alignment, divergence, and interplay of such knowledge networks. Results show that hierarchical superiors are more active providers of tacit but not of codified knowledge. Likewise, status similarity drives tacit, not codified, knowledge transfers. Finally, tacit knowledge is more likely to be transferred down the organisational hierarchy while codified knowledge is more likely to flow upwards. These results suggest a distinct articulation for tacit and for codified knowledge transfers and organisational hierarchy with implications for knowledge diffusion and innovation.

# Poster Session Abstracts

**Ekaterina Anichenko**, The University of Sydney

*"Project knowledge networks: Implications for project performance and relational coordination"*

Authors: Anichenko, E, Chung, K, & Crawford, L

**Abstract:** Organisations are becoming increasingly reliant on project teams to find solutions to complex problems. Despite their popularity, project teams often encounter issues that hinder project performance or fail to deliver altogether. One of the reasons for such failure may be found in project team's inability to coordinate effectively. To succeed in coordination, literature suggests that project teams need to be aware of their knowledge networks (i.e. who goes to whom for task related knowledge and advice). The social network paradigm offers both a theoretical framework and a methodological approach that can analyse, map out and diagnose such networks, and outline the patterns of knowledge exchange in project teams.

This paper explores the relationship between project knowledge networks, project performance, and relational coordination. It also presents a social network theory-based methodology that will be used for further study in this area.

**Kon Shing Kenneth Chung**, The University of Sydney  
*"Social Networks, Social Media & Sexual Agency: A Study Protocol"*

Authors: Chung, K, Cooper, S, Skinner, R, Lewis, L, Albury, K, Bateson, D, & Lim, M

**Abstract:** This research explores the existence and nature of the relationship between (online and offline) social networks, social media use and the development of sexual agency amongst adolescents in Australia. Sexual agency is considered as the ability for individuals to determine who can obtain sexual pleasure from their bodies and is closely aligned with the individual's decision making process in this regard. While most academic research in adolescent sexual development and social media use have focused on negative outcomes, we postulate that sexual agency development both influences and is influenced by social relations, which in turn is facilitated by face-to-face networks and social media use. In this research-in-progress paper, we describe the theoretical motivation, conceptual model, research methodology and data analysis protocol – to capture the development of sexual behaviours, the online and offline interactions adolescents engage in, and assess adolescents' perceptions of these on their development. This will allow us to understand normal adolescent socialization in the digital age.

**Rajib Dutta**, University of Wollongong  
*"Interaction between covariates on ERGM"*

Authors: Dutta, R, & Krivitsky, P

**Abstract:** Exponential-family random graph model (ERGM) is a very popular framework for modelling complex network processes commonly seen in social, epidemiological, international trade and many more networks. ERGM expresses the probability of observing a given network as proportional to the exponentiation of the linear combination of a set of network statistics selected to embody the network features of interest or those believed to affect the social process. It also takes into account the effects of covariates, both categorical (via dummy variables) and quantitative. For example, effect of an actor-level covariate may represent an activity effect specific to the actor in context; and a dyad-level covariate may represent an effect specific to the pair of actors involved. Then, greater value in the actor-level covariate may indicate greater activity resulting in a higher probability of forming a tie on dyads incident on that actor. It can be shown that an ERGM with dyadic independence reduces to a logistic regression model, for which covariate effects and their interactions as well as their interpretations are well understood. However, what an interaction between covariate effects says about network structure is not as simple. In this presentation, we study interactions of

actor-level and dyad-level covariate effects and how they can be interpreted substantively. Additionally, we consider interactions between covariates and higher-order (dyad-dependent) effects, and when such interactions are meaningful and apply it to data.

**André Gygax**, University of Melbourne  
*"Are Directors Really Irrelevant to Capital Structure Choice?"*

Authors: Gygax, A, Hazledine, M, & Martin, J

**Abstract:** DeAngelo and Roll (2015) observe that leverage cross-sections change significantly over even short periods. This finding is largely incompatible with existing models operating on the assumption that firms choose leverage levels in isolation. In this paper, we examine whether executive networks affect this decision-making process. Using a sample of large US firms, we show that firms sharing directors tend to become more similar in capital structure. Network influence effects are economically significant even on top of traditionally employed capital structure variables and are robust to director selection effects.

**Silvio Salej Higgins**, Universidade Federal de Minas Gerais

*"Social discipline and the two sources of authority: an old statement and new evidences from a developmental agricultural project"*

Author: Higgins, S

**Abstract:** How to emerge social order is the main issue in theoretical and empiricist sociology. Nevertheless, we need more strong evidences on specific social mechanisms that coordinates collective action making able the emergence of a specific social order. Classics studied and discussed (Weber, Parsons, Perrow) a dual order of modern organizational environments: bureaucratic and professional authority. Harrison White's concept on social discipline have inspired our rationale: quality, prestige and purity are not a-priori valuation orders, as a Parsonian sociologist could think, on the contrary they emerge inside of interactional process. In this study, we have examined three main process of collective action, useful information, collaboration and lateral social control, that enhance this two different kind of authority in the organizational setting. The research was focused in the social engineering process for constructing local farmer organizations that crops African oil palm in Colombia. Data was collected in loco using three sociometric questions. Regarding the multiplex nature of data, a dual treatment was imposed, firstly, we have modeled a latent block analysis (Integrated Classification Likelihood) for reconstructing the multiplex system of exchange, secondly, we have modeled a P\* equation for understanding the plausible mechanisms that enhance the emergence of that specific valuable order. The main finding depicts a multiplex process that encourage a mixed discipline, interface and council, yielding a dual authority in the control of the collective process: an expertise authority and hierarchical-bureaucratic authority. In contrast with classical studies,

and taking into account the peasant context, we highlighted that professional authority is simultaneously result of a technical assistance but also of a collaborative apprentice.

**Hiroyasu Inoue**, University of Hyogo

*"Propagation of Negative Shocks through Firm Networks: Evidence from Simulation on Nation-wide Supply Chain Data"*

Authors: Inoue, H, & Todo, Y

**Abstract:** Natural disasters trigger economic damages directly as well as indirectly, as negative shocks of disasters are largely propagated through supply chain disruptions. Such indirect damages are far from negligible and often constitute a large share of total damages. For example, after the Great East Japan earthquake in 2011, a large number of firms unaffected by the earthquake directly including those in foreign countries had to stop operation due to shortage of supplies. To estimate the total damage that includes propagation, considering heterogeneous relationships around firms is critically important because productions of firms depend on suppliers and clients. Although input-output tables and general equilibrium models have been well studied to estimate the indirect damages, they cannot incorporate the heterogeneity of firms and therefore it does not seem that their estimations are reliable.

To overcome the shortcomings, we apply a nation-wide supply-chain network data in Japan to a firm-level model originally proposed Henriot and Hallegatte. We find the following issues. (1) By comparing the actual network and artificial networks used commonly, we highlight the substantially rapid propagation of shocks on the actual network. (2) To highlight the importance of substitution of suppliers in the wake of supply chain disruption, we compare the benchmark case with cases where substitution is more restricted, finding a large role of substitution in mitigating propagation. (3) Based on the actual disaster data of the Great East Japan Earthquake and parameter searches, we find propagation speed is devastating but recovery to resist the propagations is quite strong.

**Faezeh Karimi**, The University of Sydney

*"Students' social life in higher education environment: Mapping the networks of students' extracurricular activities"*

Authors: Karimi, F, & Matous, P

**Abstract:** It is well documented that students' engagement in extracurricular activities is strongly linked with their academic performance, the success of their transition on the job market, and their general well-being.

This study contributes to the field by examining the social network structure of students' extracurricular activities captured by their co-membership in student societies and co-participation in social events. We use unique anonymous secondary data on 52791 student affiliations and active participation in 240 societies over the course of year 2016.

Using social network analysis and visualization techniques, this research maps the relationships between different societies, events, and locations in terms of participation overlaps. The study identifies the structure of patterns of interactions between groups and cliques that emerge among students in the higher education environments, the type of events that are central in connecting students from diverse societies together and the type of specific activities that attract students who would otherwise not attend similar events.

The analysis identifies distinct cliques within the student body corresponding to the students' field of study, geographical origin, and interests (particularly culinary and beverage preferences). The spatial centers of the activities of different cliques are distributed in different parts of the campus. While societies that organize general food-related activities attract the largest numbers of members from across all fields, academic discipline-specific societies are more central in networks based on high participation activity.

The results enrich our understanding of how to foster relations among students from different backgrounds based on shared interests through the support of extracurricular activities. We discuss how to use social network analysis on large datasets of student interactions to design network interventions aimed at promoting an inclusive and pluralistic culture on university campuses.

**Sarah King**, Swinburne University of Technology

*"Trash to Treasure: The social processes of industrial symbiosis networks for SMEs"*

Authors: King, S, Lusher, D, Hopkins, J, & Simpson, G

**Abstract:** ASPIRE (Advisory System for Processing, Innovation and Resource Exchange) is an online matchmaking market. It captures business waste and by-product data and makes suggestions for business to business (B2B) collaboration where waste from one company can be used as an input for another. This concept is known as industrial symbiosis (IS). ASPIRE is a proof of concept Australian designed, web-based system for small to medium enterprises (SMEs). It has been successfully deployed in four Melbourne local government regions.

Much of the literature for IS explores regionally, co-located, heavy industry and neglects the unique need of SMEs. It also has a focus on engineering or economic disciplines. There is a greater need for the application of social sciences to understand underlying features of resource transfer between companies.

IS is a form of sustainable innovation and while inter-organisational collaboration between SMEs occurs predominantly within an economic context, it is laden with social drivers and behaviours that influence the likelihood of relationships forming. This research reviews ASPIRE online B2B collaboration suggestions and the social processes that are important in achieving new, inter-organisational collaboration within a network. By understanding the interaction between digital and social processes at micro, meso and macro scales, we can improve the effectiveness of the ASPIRE network and our understanding of IS at regional scale.



**Lincoln Lau**, International Care Ministries

*"Impacts of a poverty alleviation program on local expressive and instrumental networks"*

Authors: Lim, K, Lau, L, Matous, P, & Cole, D

**Abstract:** People need both expressive and instrumental networks for their wellbeing. Research also shows that low-income communities need both internal and external links for their sustainable development. The question is can local expressive and instrumental social networks be strengthened by external interventions?

In 2015 and 2016, we measured the social networks of 235 Filipinos living on less than \$0.50 a day in 10 communities in Bacolod City before and after a 16-week poverty alleviation intervention that included weekly gathering, social interactions, and lectures in 10 separate groups. We used multiple name generators to elicit the respondents' contacts inside and outside of their group. Specifically, we asked who they know, whom they visit, with whom they discuss personal matters, and whom they know well enough to borrow money if needed.

The intervention had a divergent effect on these different types of networks. While expressive networks, through which the participants shared personal issues, increased in density in all communities, the networks of instrumental help decreased in density in four of the communities. Moreover, although the expressive networks became stronger internally, expressive links to other communities weakened in seven of the studied communities. There appears to be a substitution between strengthening local community networks and weakening external links, which has been found to be necessary for community development. The findings have implications for the design and execution of network interventions.

**Stephen Ong**, The University of Sydney

*"Discerning Associations in Project Longitudinal Networks"*

Authors: Ong, S, & Uddin, S

**Abstract:** Nodes situated within project networks oftentimes create structures which are complex and chaotic. This research recognises that despite this substructure of chaos, recurring configurations between parallel networks can still emerge during the evolution of a project. Due to this, recognition and influence over these systems will inevitably elicit better and more efficient project outcomes. This inquiry intends to determine the nature of these associations and assemblies by drawing on concrete node-edge data obtained from the collateral funding and technical realms of child and infant food consumption programmes. Attained analyses on these aforementioned realms are further examined and juxtaposed between two different countries: Sri Lanka and Bangladesh. Methodically, the process inaugurates with the pinpointing of common nodes between the analogous networks. A total of 63 and 24 common nodes are obtained for the networks for Sri Lanka and Bangladesh, respectively. Inherent edge-level statistics are then processed for Network correlation and

regression. Inherent node-level statistics are analysed accordingly for communities, clans and cliques. Supplemental constitutions such as centrality, reciprocity and transitivity are subsequently deduced further for an even more finessed comprehension. It imperative to note that the constituent dynamic systems convey pivotal project information. The findings are thereafter used to produce evidence-based suggestions and strategies for improving project network structures. This research paves way for further investigations on approaches to project executions as well as innovative applications for network processes and analyses.

**Clara Pelaez Alvarez**, Neuroredes Brasil

*"The organization entanglement: mapping the collective mind through Neurometry"*

Author: Pelaez Alvarez, C

**Abstract:** From billions of connected neurons emerges the human mind, out of billions of connected people emerges the human society. Organizations also emerge from the flow of information that circulates among people who compose them. Neurometry, the SNA method that will be presented, is a graphic narrative. It provides a set of graphs that shows the relational structure of the organization. It is possible to understand how areas communicate with each other, how the flow of information through the organization hierarchy is. It is also able to identify if there is isolated people or a lack of information flow and where it is located, among many other things. With these results it is possible to infer the organization dynamics and figure out a solution to correct any kind of relational problem that may come up.

**Julien Pollack**, The University of Sydney

*"Exploring the efficacy of project team relationship building using a longitudinal, interventionist approach"*

Authors: Pollack, J, & Matous, P

**Abstract:** Project management involves a team of people working together to deliver a unique product or service, in a temporary organisational structure. Project team members have often not worked together, but projects are often under immense time pressure. This means that there is a need for project teams to rapidly learn to trust each other and to develop positive relational norms. However, there is a lack of techniques that have been verified as a way of rapidly developing positive relational norms in project teams.

This research tests the efficacy of a relationship building exercise. The exercise may assist in developing the ways that teams collaborate, and strengthen the communication patterns in a project team environment. Social Network Analysis is used to map patterns of communication and collaboration within a project team, and to identify gaps within the networks that need to be bridged. Gaps to be bridged are identified through consideration of structural holes in the network, and through exploration of the workplace functional needs of the team. Participants in the environment then

selectively participate in the relationship building exercise. Two months after the intervention, Social Network Analysis is then used to establish, whether, and how, the patterns of communication have changed.

Although Social Network Analysis has long been applied in the fields of organizational and knowledge management, its application to project management is still relatively new. Moreover, previous network studies in project management have been mostly focused on the centrality of individual actors, making use of only a limited selection of network analysis techniques. This research extends on previous studies by taking a longitudinal interventionist perspective rarely adopted in Social Network Analysis, and not previously used in the context of project management.

**Bopha Roden**, Swinburne University of Technology

*"Understanding the impact of Business Models on University-Industry engagement: A social network perspective"*

Authors: Roden, B, Lusher, D, Spurling, T, Gilding, M, Simpson, G, Brennecke, J, Wang, P, Brailly, J, Elsum, I, Klein, T, & Bunton, V

**Abstract:** Over the last 10-20 years, countries with public research capacity have seen a political agenda geared at transfers between business and society. However, most countries experience difficulties in developing links between the academic world and industry, as the two "worlds" have very different functions, cultures and operating rules (OECD, 2014). To overcome these challenges, it is vital that we understand why academics collaborate with industry, and how public institutions engage with industry and the effect their adopted business models has on their collaboration networks.

**Giovanni Sadewo**, La Trobe University

*"The Relation between International Students' Social Networks and their Cross-Cultural Adjustment"*

Authors: Sadewo, G, Kashima, E, Gallagher, C, & Kashima, Y

**Abstract:** Settling into a new country requires international students to form new social networks (e.g., friendship and learning groups) as they begin their study, whilst maintaining their good psychological health. This study examined whether the network processes of social selection and social influence can explain the longitudinal adjustment in the classroom of 54 students, enrolled in the same postgraduate course, where the majority of the students were international students. Five adjustment variables were utilised: psychological strain, negative affect, life satisfaction, positive affect, and sociocultural adjustment. We hypothesised that there will be social selection processes (homophily effect) and social influence processes based on adjustment in both friendship and study network. Friendship networks and study partner networks were analysed by using Stochastic Actor Oriented Model (SAOM). The analysis of friendship networks indicated that there was a homophily effect (social selection processes) only on psychological strain, while positive affect and sociocultural adjustment revealed different

pattern of social selection processes. In contrast, evidence of social influence processes in adjustment were not found. The analysis of study partner networks did not find any important homophily effect (social selection processes) or social influence processes based psychological or sociocultural adjustment. Although there were no homophily effect, life satisfaction and sociocultural adjustment revealed other pattern of social selection processes. Additional findings also revealed that homophily effect based on nationality and study cohort were prevalent in both friendship and study network. We concluded that social selection processes were more prevalent in international students friendship and study network compared to social influence processes. Limitations and implications of the study are discussed.

**Upul Senanayake**, The University of Sydney

*"Applying assortativity metrics to quantify internationalisation of supply chain relationships"*

Authors: Senanayake, U, Piraveenan, M, Matous, P, & Todo, Y

**Abstract:** As economic globalization increases, inclination towards domestic protectionism is also increasing in many countries of the world. To improve the productivity and the resilience of national economies, it is important to understand the drivers and the barriers of the internationalization of economic activities. While internationalization of individual economic actors is difficult to explain using traditional theories, aggregate patterns may be explained to a higher degree. We take a network-centric perspective to describe the degrees of corporate internationalization in different countries. Based on Newman's assortativity coefficient, we design a range of assortativity metrics which are appropriate in the firm network context. Using these, we quantify companies' appetite for internationalization in relation to the internationalization of their partners. We use Factset Revere dataset which is provided by FactSet Research Systems Inc. that captures global supply chain relationships between companies. We identify countries where the level of internationalisation is relatively high or low, and we show that subtle differences in the assortativity metrics used change the ranking of countries significantly in terms of assortativity correlation, highlighting that companies in different countries are prone to different types of internationalisation. The implications of our results are important for countries to understand the evolution of international relationships in their corporate environments, and how they compare to other nations in the world.

**Daichi Shimamoto**, Waseda University

*"The Role of Information and Social Interactions in Export Activity: Evidence from firm- level data from Vietnam"*

Authors: Shimamoto, D, Kim, Y, & Todo, Y

**Abstract:** International trade is one of the important factors in economic growth. Exports expand production and improve firm's productivity through learning-by-exporting. However, many firms in less developed countries do not enjoy the benefits of export because of various trade obstacles. Previous studies show that one

of the most significant trade obstacles is low productivity. In addition to low productivity, lack of information may be obstacles to export. In less-developed countries where access to information is limited, informal institutions such can be an essential source of information. This paper investigates whether informal social interactions among firms play an important role in firms' export activity. We use data of SMEs in the traditional apparel and textile clusters in Vietnam to examine whether firms' export activity is affected by their information sharing peers' export experiences. We differentiate direct exporting from indirect exporting through an intermediary. We find that peers' experience of direct exports is positive and statistically significant on firms' direct exports although peers' experience of indirect exports is not. One possible interpretation is that firms exchange information on foreign markets' condition, export procedure, and buyers in foreign markets and start to export directly. On the other hand, firms do not share information about intermediate trading companies.

**Yawen Kirstan Xing**, The University of Sydney  
*"Surface and Deep Learning Approaches: A Social Network Perspective"*  
Authors: Xing, Y, & Chung, K

**Abstract:** This paper studies how individuals' social networks steer their choices of learning approaches. Researches have shown that deep and surface learning approaches have profound impacts on performance. Several learning theories have suggested that learning does not only happen in formal settings, but also in informal settings through personal interactions, past experiences and reflection. This paper focuses on bringing these concepts together and using social network analysis to study individuals' approaches to learning and the resulting outcomes.

This study aims to find out how individuals' social networks affect their learning through social network analysis, stakeholder theory and learning theories. This research analyses data and responses obtained from questionnaires sent out to undergraduate project management students enrolled in an Australian Group of Eight university. The questionnaires have four distinct sections: Demographic details, Informal Network Questions, Learning attitudes and Motivation. The raw data was then analysed using social network analysis and stakeholder theory to test several hypotheses.

The anticipated results at this time for this study is that individuals who occupy more strategic social network positions, in other words, who have more control over information flows will tend to apply deep learning approaches and achieve better performance.

**Jihye Yeo**, Australian National University  
*"Ties with non-market organisations and firm innovation"*  
Author: Yeo, J, Eapen, A & Elsum, I

**Abstract:** Past research has shown that collaboration between firms, universities, and research institutions promote innovation. But do ties with non-market organizations such as Government-initiated organizations and industry associations also help

innovation? Despite a significant interest in network ties and firm innovation, we know relatively little about how a firm's ties with Government-initiated organizations and industry associations affects its innovation. This is an important gap, considering those organizations exist to foster innovation. Furthermore, when Government-initiated organizations and industry associations differ from their origins, we do not yet know their different effects on firm innovation.

In my thesis, I study how a firm's ties to the non-market organizations influence firm innovation. Particularly, I distinguish the separate effects of ties with Government-initiated organizations and industry associations on firm innovation. I will use mixed-method approach. While qualitative methods are used to generate theories, social network methods are to test the theories. I plan to collect unique network dataset in the Australian advanced manufacturing industry.

My thesis contributes to identifying the role of the non-market organizations (i.e., Government-initiated organizations and industry associations) in innovation literature. I will empirically show the independent effects of the different ties on firm innovation. Moreover, I will provide practitioners advice for proper strategies and policies.

**Lianming Zhu**, Waseda University  
*"Supply Chain Disruptions and Trade Credit"*  
Authors: Lu, Y, Ogura, Y, Todo, Y, & Zhu, L

**Abstract:** It has been shown that input-output linkages along supply chains affect firms' performance such as sales, productivity, and innovative capacity. This paper explores a new aspect in the literature, examining how supply chain relations influence financial transactions between firms. More specifically, this paper, using an exhaustive dataset on buyer-supplier networks in Japan, studies whether supply chain disruptions due to the Great East Japan earthquake in 2011 affected firms' utilization of trade credit. We find evidence showing that customers who were affected by the earthquake imposed a larger amount of trade credit on their suppliers (i.e., utilized fewer cash transactions) even two years after the earthquake. In addition, trade credit of indirect suppliers (e.g., suppliers of suppliers) of affected customers also increased, indicating that the effect of supply chain disruptions on trade credit propagates through production linkages. We further find heterogeneous effects of the supply chain disruptions on firms' trade credit; the effect is larger for suppliers with a better financial performance before the disaster.