



# BOOK OF PITCHES

UQAPS 2015  
PITCHING RESEARCH  
COMPETITION FINAL

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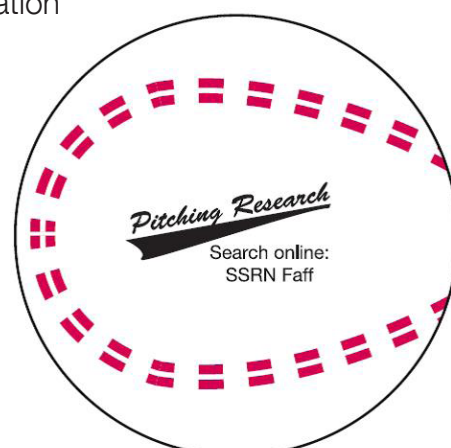
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This booklet contains a brief explanation of the “pitching” concept, followed by completed pitch templates across a broad spectrum of academic disciplines.

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### Faculty/Institute Legend

BEL	Faculty of Business, Economics and Law
EAIT	Faculty of Engineering, Architecture & Information Technology
HABS	Faculty of Health and Behavioural Sciences
HASS	Faculty of Humanities and Social Sciences
MABS	Faculty of Medicine and Biomedical Sciences
QAAFI	Queensland Alliance for Agriculture and Food Innovation
Science	Faculty of Science



# PITCHING RESEARCH

## “PITCHING RESEARCH” TO AN ACADEMIC EXPERT – A DIFFICULT TASK MADE EASIER

Being a PhD student isn't easy. It's especially terrifying right at the onset of your research journey. After wading through the literature, you have some ideas you think might work, but it's easy to be overwhelmed. What is worth pursuing? Will it work? Will it be publishable? You're about to spend the next few years working on your research, but you have no idea where or how to start. You need a reliable plan. Of course, you would also love expert guidance. Let's say that you have identified an ideal research mentor and you have a 30 minute meeting with them to “pitch” (the academic merits of) your idea. Clearly, you want to impress them. What do you do? Panic? No.

That's where Professor Robert Faff's “Pitching Research” paper comes in. It's all about nurturing worthwhile fledgling research projects. This guide for the early stages of research development aims to produce a well-rounded, effective and achievable research project. It does so by providing a simple mechanism for sounding out a new idea and starting a conversation with a potential research mentor – an expert in the field. At its core, the paper proposes a 2-page template tool which recognises that the typical research mentor is heavily over-committed – they are extremely time poor, very busy and usually grumpy. They do not want to (and will not) read pages and pages and pages of rambling thoughts – the mentor just wants all the salient aspects, sufficient to make a call on the inherent academic merits of your idea. Something that they can read and digest in 15 minutes.

For an engaging proposal, here's what you need...

Pitcher's Name	FoR category	Date Completed
(A) Working Title		
(B) Basic Research Question		
(C) Key paper(s)		
(D) Motivation/Puzzle		
THREE	<b>Three</b> core aspects of any empirical research project i.e. the “IDioTs” guide	
(E) Idea?		
(F) Data?		
(G) Tools?		
TWO	<b>Two</b> key questions	
(H) What's New?		
(I) So What?		
ONE	<b>One</b> bottom line	
(J) Contribution?		
(K) Other Considerations?		

**Working Title:** Put it down, however rough, however uncertain. Keep it succinct and make it catchy. Creating a meaningful working title is a non-trivial exercise that will force you to think deeply about what it really is that you want to research. The working title will evolve with your project.

**Basic Research Question:** Say it in just a sentence. You've got to be able to hook a supervisor and rambling just won't cut it.

**Key Papers:** Find three papers crucial to your project. If you can, nominate the most critical single paper. Ideally, these papers have been published recently in top tier journals by "gurus" in your field. You've got to start with the best.

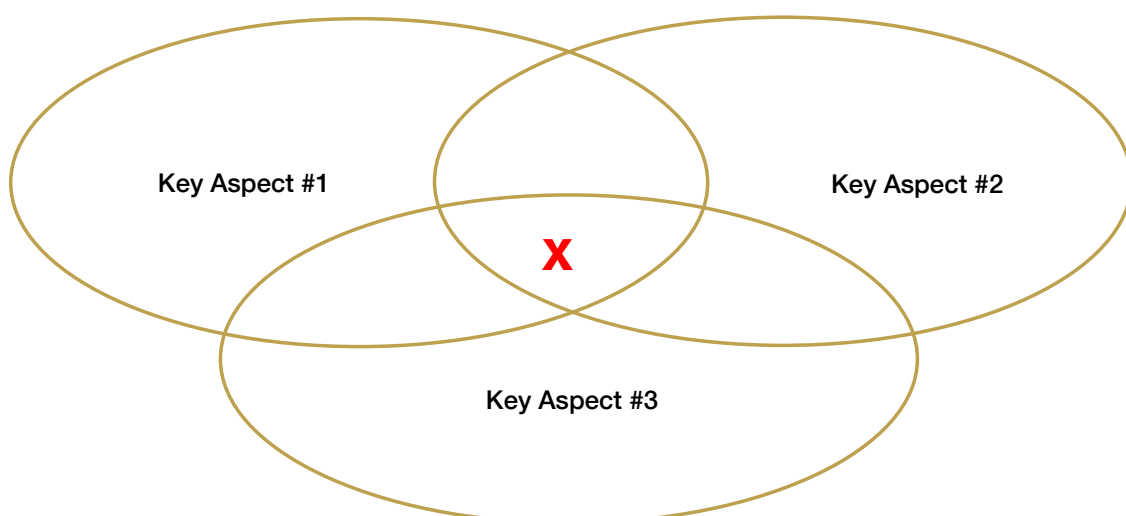
**Motivation:** What is fuelling your research idea? Depending on your research field, this should come from a combination of the literature, observed behaviour or industry patterns. If you don't know why you're doing it, no one else will.

### Three dimensions: Idea, Data and Tools ("IDioTs" guide)

- **Idea:** Get your core idea on paper. This is it. If possible, frame it as a hypothesis and identify any contrasting predictions from pockets of theory relevant to the research question.
- **Data:** Great. You've got that idea on paper. How are you going to explore it? You need data – whether quantitative or qualitative. What will those data look like and how will you get them? What are the core sampling characteristics? Are the data fit for purpose? Are there any important obstacles to create/obtain the sample?
- **Tools:** You have your idea and you know what data you need. Fantastic, but they will not magically "dance" together. How are you going to feasibly perform the analysis? Hint at the planned research method, but keep your description of the tools short – just give the big "signposts", so that the expert reader can broadly see your main toolkit at this stage.

### Two Questions: What's New? And So What?

- **What's New?** What's the novelty? Make sure that you're not simply replicating previous work. No one wants to read that. Use a "Mickey Mouse" diagram (below) to characterise the intersection of novelty for your proposed study ("X" marks the spot).



- **So What?** How useful and important will your novel research be? How will it advance knowledge in your research field? These are the questions journal editors will ask.

**Contribution:** This is the distillation of your entire research project. What is the primary end point? How will it impact understanding in your research area? It might be a cracker of an idea, or maybe your application of data and tools is truly unique. Whatever, you must identify a primary force that defines why your work makes the relevant academic community take notice.

**Other Considerations:** Here it's time to consider a range of miscellaneous factors. Are there any deal-breakers or serious obstacles? Is collaboration necessary? What is your target journal? Is the scope appropriate? What are the (research) risks?

Having done a great job with your research pitch, the busy academic will be well placed to give you instant and insightful feedback – even in the short time remaining in your (first) half-hour meeting together. Moreover, they will not only be receptive to how you deal with the individual pieces of your pitch, the succinct overall format will enable them to readily see how well linked are the component parts. **“Connectivity”** is crucial. Impressed by your serious efforts, the mentor will be encouraged to help you tweak your proposal and get your project underway. Thus, “pitching research” has not only helped **start a conversation**, it has potentially laid the foundations for a fruitful longer-term research collaboration.

## Resources

To read the full “pitching research” paper go to (or simply search online: SSRN Faff):  
SSRN: <http://ssrn.com/abstract=2462059>

To check out the expanding online library of worked pitch examples (>40 different areas) go to:  
[business.uq.edu.au/supplementary-material-pitching-research](http://business.uq.edu.au/supplementary-material-pitching-research)

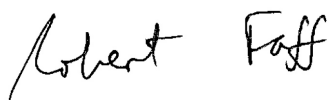
To register and access the “PitchMyResearch” web portal visit: [PitchMyResearch.Com](http://PitchMyResearch.Com)

To access YouTube video pitch talks and examples, visit:

General talk:	<a href="https://youtube.com/watch?v=DtT8pf06aHk&amp;feature=youtu.be">youtube.com/watch?v=DtT8pf06aHk&amp;feature=youtu.be</a>
Sustainable Systems:	<a href="https://youtu.be/QBo2wU0z18o">youtu.be/QBo2wU0z18o</a>
Accounting:	<a href="https://youtu.be/mjBBRnN6gwY">youtu.be/mjBBRnN6gwY</a>
Chemistry:	<a href="https://youtu.be/PmjM9XfxZ4E">youtu.be/PmjM9XfxZ4E</a>
Archaeology:	<a href="https://youtu.be/AyIMABEq4Cc">youtu.be/AyIMABEq4Cc</a>

Or just connect with me on LinkedIn.

The remaining pages comprise **seven** examples of research pitches drawn from a diverse range of disciplines. These pitches represent the finalists for a “pitching competition” jointly supported and sponsored by the UQ Association of Postgraduate Students and UQ Business School in 2015. I hope that you find the contents of this booklet helpful on your research journey.



Robert Faff PhD (Monash) Dr. Hon (ASE Buch)  
Professor of Finance, Director of Research  
UQ Business School

**UQ profile:** [business.uq.edu.au/staff/details/robert-faff](http://business.uq.edu.au/staff/details/robert-faff)

**Google Scholar page:** [scholar.google.com.au/citations?hl=en&user=ZODXCmcAAAAJ](http://scholar.google.com.au/citations?hl=en&user=ZODXCmcAAAAJ)

**RePEc page:** [ideas.repec.org/e/pfa127.html](http://ideas.repec.org/e/pfa127.html)

**SSRN:** [ssrn.com/author=246387](http://ssrn.com/author=246387)

**International Accounting & Finance Symposium:**

[iafds.org/index.php?option=com\\_content&view=article&id=2&Itemid=105](http://iafds.org/index.php?option=com_content&view=article&id=2&Itemid=105)

# EXPLORING THE ROLE OF CORPORATE RETREATS IN RESTORING DIRECTED ATTENTION

**CHELSEA GILL (CATEGORY: TOURISM)**

## BASIC RESEARCH QUESTION

- a) What activities and experiences at a corporate retreat lead to restorative outcomes?
- b) What impacts on the restorative benefits being maintained back in the workplace?

## KEY PAPER(S)

Kaplan, S. (1995). The restorative benefit of nature: toward an integrative framework. *Journal of Environmental Psychology*, 15, 168-182.

Ouellette, P., Kaplan, R., & Kaplan, S. (2005). The monastery as a restorative environment. *Journal of Environmental Psychology*, 25(2), 175-188.

## MOTIVATION/PUZZLE

The capacity of employees to focus attention on work tasks is becoming progressively endangered and diminished due to information overload and increased competing demands. As focusing attention is crucial in order for employees to be able to perform tasks competently, organisations have a responsibility to intervene and restore, not merely deplete, this resource. Otherwise, mental fatigue or organisational ADD (attention deficit disorder) may prevail. Research into Workplace Health interventions focus mainly on aspects of general wellbeing and do not address the issue of mental fatigue. Given that corporate retreats are quite common, this research explores how such an environment could function as a restorative intervention within the workplace.

## THREE CORE ASPECTS OF ANY EMPIRICAL RESEARCH PROJECT

### THE IDEA

This project will explore how a corporate retreat can function as a restorative intervention and improve employees' mental wellbeing. Attention Restoration Theory, which posits that restorative environments effectively replenish fatigued cognitive faculties, will provide the theoretical framework to shape the research. This research will identify the specific activities and experiences that lead to restorative outcomes at a corporate retreat, as well as what factors influence the duration of restorative benefits back at the workplace.

### THE DATA

The research site will consist of one Australian law firm which has their own corporate retreat centre (located away from the workplace). Five-day retreats held most weeks of the year. 150 participants will be sought to complete this research.

A mixed methods research approach will be used in a two-phase study. Qualitative and quantitative data will be collected via diary entries completed each night for the duration of the retreat by retreat participants, along with a follow-up online questionnaire one month after returning to the workplace.

The use of diaries will be explained to participants via a YouTube video (where the researcher will briefly explain the research and what is asked of participants) – this will be shown at the start of the retreat. Diaries will be distributed at the start of retreat and collected at the conclusion of retreat by the retreat manager on-site. One month after the retreat, participants will receive an email with the link to the on-line follow-up questionnaire.

Potential issues with the diary data collection method are that it is self-reported, subjective and may potentially result in incomplete responses. However, the benefits of participants recording the effect of each day's activities and experiences far outweigh the potential drawbacks.

## THE TOOLS

Attention Restoration Theory will influence the research design for this project.

Diary template and survey instruments will be created based on the literature review.

Statistical analysis of quantitative data and thematic analysis of qualitative data will follow.

## TWO KEY QUESTIONS

### WHAT'S NEW

The novelty of this research is the application of Attention Restoration Theory in a new context – a corporate retreat setting.

The diary templates and survey instruments will be developed specifically for this context.

This research will also contribute to literature on workplace health interventions by exploring an avenue to specifically target mental fatigue.

### SO WHAT

Understanding how to effectively restore mental fatigue will ensure organisations support their staff in performing their job roles more efficiently and effectively. This will enable an organisation to potentially maximise the benefits of something they already do (a corporate retreat) for both the organisation and the employees. An organisation's success or failure will depend on its ability to not only understand and manage attention in employees but also restore this significant, intangible and endangered resource. The findings from this research will identify the specific activities and experiences that a corporate retreat should offer in order to promote attention restoration. In addition to presenting an effective design for restorative corporate retreats, insights into how to maximise the longevity of the retreats' restorative benefits once employees are back in the workplace will also be given. These findings will enhance the value and justification of corporate retreats.

## ONE BOTTOM LINE

### THE CONTRIBUTION

The primary contribution of this research is to apply Attention Restoration Theory in a new context and identify the specific activities and experiences of a corporate retreat that lead to attention restoration.

### OTHER CONSIDERATIONS

Collaboration with the organisation providing the context for this research is critical.

Target Journals: visitor experience, organisational management/psychology journals, environmental psychology journals.

There is a low risk of no result, though it is possible that minimal restorative outcomes resulting from the corporate retreat are found.

There is a low risk of competitors undertaking this research first, as there has been no research into corporate retreats, though research into wellness and spiritual retreats is a growing area.

Ethics approval will be sought before any field research is undertaken.

# NUMERICAL SIMULATION OF HEAT TRANSFER IN CONFINED PARTICLE SUSPENSIONS: THERMO-RHEOLOGICAL BEHAVIOUR OF HYDRAULIC FRACTURING FLUIDS

**JON MCCULLOUGH (CATEGORY: MINING ENGINEERING)**

## BASIC RESEARCH QUESTION

How can the effect of heat transfer on the physical behaviour of particle suspensions such as hydraulic fracturing fluids be better resolved and understood?

## KEY PAPER(S)

Feng, Y., Han, K. and Owen, D., Advances in computational modelling of multi-physics in particle-fluid systems, in: E. Onate, R. Owen (eds.), Particle Based Methods, vol. 25 of Computational Methods in Applied Sciences, Springer, Netherlands, 2011, pp. 51-88, doi: 10.1007/978-94-007-0735-1\_2

Hashemi, Z., Abouali, O. and Kamali, R. (2014), Three dimensional thermal Lattice Boltzmann simulation of heating/cooling spheres falling in a Newtonian liquid, International Journal of Thermal Sciences, 82, 23 – 33, doi: 10.1016/j.ijthermalsci.2014.03.008

## MOTIVATION/PUZZLE

A considerable portion of the world's oil and gas reserves are stored in underground reservoirs of low porosity. Here simulation techniques such as hydraulic fracturing (or 'fracking') are usually necessary to facilitate the economic extraction of the resource. Improved understanding of the physical mechanisms and phenomena occurring within this process however is necessary to improve its performance both environmentally, socially and economically. Modelling of such systems requires capturing the physics of a number of interacting behaviours such as viscous fluid flow, particle collisions, fluid-solid interactions, heat transfer mechanisms and varying geometry. Combining these considerations with sufficient accuracy, stability and efficiency is an ongoing research challenge in numerical modelling.

## THREE CORE ASPECTS OF ANY EMPIRICAL RESEARCH PROJECT

### THE IDEA

The behaviour of hydraulic fracturing fluids is inherently complex due to the geometry of a fracture, the heating of the fluid by the reservoir and its nature as a suspension of solid particles within the fluid. With hydraulic fracturing operations occurring up to 4km underground it is difficult to obtain experimental data on how the fluid behaves and thus to optimise the process. An alternative approach to improving understanding of its behaviour is necessary. By design, continuum based numerical models solve the macroscopic variables of a system by dividing the solution domain into multiple small regions and averaging system behaviour in each of them. This approach loses detail on any features of the system that occur at length scales less than the finite cell dimensions used. On the other hand, the full resolution of the molecular interactions of a system becomes intractable for practically sized systems due to the large number of particles needing to be resolved. Direct numerical simulation techniques like the lattice Boltzmann method (LBM) and discrete element method (DEM) provide options to develop models that can capture fluid and solid interactions from a mesoscopic perspective that can minimise the need to adapt to the restrictions imposed by continuum or molecular modelling. Development of a numerical model within an LBM-DEM framework would enable physical flow behaviours of a hydraulic fracturing fluid to be better understood. The result of this would be tailored operations with existing and new formulations that minimise impacts such as pumping time, operational scope and running costs.

### THE DATA

- Numerical data generated by running simulations under a range of conditions for test geometry, input conditions and fracturing fluid formulation. This will occur for both the validation and verification of model components and detailed fracturing fluid investigations.
- Post-processing of data likely to be done with Paraview, MS Excel and Matlab/Python
- Validation and verification of numerical model against classical/analytically tractable layouts for each component (particularly Poiseuille flows in 2D and 3D channels/pipes). Comparison against relevant experimental data would be ideal if such information can be obtained.
- Storage of data will need to be managed carefully. Even a simple simulation can easily generate gigabytes worth of information of which only a small subset may actually be of interest. Make use of existing IT hardware to store important analysed data.
- Data, both analysed and raw, will need a formal framework of the associated metadata to explain what was trying to be done with each trial, the input variables, the version of the model for later review and understanding.



- Output information of interest would include: velocity and temperature flow profiles, heat transfer between fluid and solid surfaces, particle migration behaviour and rheological measures (e.g. effective viscosity resulting from particle presence and heat transfer).

## THE TOOLS

Physical apparatus necessary includes code development and post-processing software (available as open-source or through UQ IT/EAIT agreements), storage space and back-up for active and archival data, desktop computer hardware (for small simulations and code development) and access to supervisor's server (large simulations).

## TWO KEY QUESTIONS

### WHAT'S NEW

The individual numerical components outlined in this proposal aren't new (including their combinations to varying extents) and nor is the numerical modelling of the hydraulic fracturing process. However, the development of a direct numerical model harnessing the strengths of a thermal LBM coupled to DEM to resolve a wide range of physical behaviours would combine the separate facets of existing knowledge in a more detailed manner and be an improvement on current literature. The particular application to the flow of hydraulic fracturing fluids is a further novel aspect of this research.

### SO WHAT

The hydraulic fracturing process has many opponents, particularly on environmental grounds. Better understanding of the flow mechanisms of hydraulic fracturing would aid in developing operational strategies that can alleviate these concerns. Reducing the external impact of bore sites (such as through minimising the number of bores used for a reservoir and their operational time) while still enabling the economic extraction of hydrocarbon resources could be a tangible benefit of this research.

## ONE BOTTOM LINE

### THE CONTRIBUTION

The development of a numerical model within a LBM-DEM framework that can directly resolve a wider variety of thermodynamic, hydrodynamic and rheological behaviours relevant to confined particle suspensions than is achieved with existing methodologies.

### OTHER CONSIDERATIONS

**Collaboration** – Supervisor has contacts with experts in the modelling of particulate systems in both UK and USA. Leveraging of these to optimise the development of the model would be desirable. There are a number of researchers within the School of Mechanical and Mining Engineering with interest and expertise in the numerical modelling of heat transfer in fluids from a 'conventional' modelling perspective. There would be potential to take advantage of their knowledge for both model development and comparison between techniques. Sourcing of experimental data to compare to numerical results would also necessitate some collaboration.

**Target Journals** – International Journal of Heat and Mass Transfer or Granular Matter for initial papers depending on whether the work in the paper is focused more on heat transfer methods (IJHMT) or particle behaviours (GM). These are both A-level journals on the Australian Research Council's 'Excellence in Research for Australia' list. Journal of Computational Physics or Computer Methods in Applied Mechanics and Engineering as target A\*-level journals for more significant papers produced towards the end of candidature. Such journal levels and time-frames have been seen to be met by other engineering PhD candidates.

**Risks: No Result** – LOW: There is sufficient literature on the respective components to provide suitable background towards development of a complete model. The application of such a model to hydraulic fracturing would still yield informative results.

**Competitor** – MODERATE: the development and application of LBM and DEM techniques is ongoing, widespread and, at times, obscure. There are some existing models that capture features of what is desired here but none (to current knowledge) that capture all of them. The ongoing development and scope of these models is unknown. It is thought that the application of such a model to hydraulic fracturing context would be novel.

**Obsolescence** – LOW: focus of project is largely the development of the model rather than its direct application to hydraulic fracturing, as such the ongoing debate over the use of such simulation techniques is of reduced concern. Particle suspensions are also relevant to a wide variety of scientific and engineering disciplines meaning the model would be useful in other fields.

**Scope** – Taking advantage of existing numerical frameworks (both from supervisor's previous research and open-source resources) reduces the potential to be over-ambitious in the aspects being developed in the model.

# FROM A NORMATIVE DISCOURSE TO CONTEXTUALISED PRACTICES: A CASE STUDY OF A HUMAN RIGHTS-BASED APPROACH (HRBA) IN BANGLADESH

**JAE-EUN NOH** (CATEGORY: SOCIOLOGY, SOCIAL WORK)

## BASIC RESEARCH QUESTION

How does the contextualisation of a HRBA take place in an NGO based in a developing country?

## KEY PAPER(S)

Gready, P. & J. Ensor (2005). *Reinventing development?: translating rights-based approaches from theory into practice*. London: Zed Books.

## MOTIVATION/PUZZLE

Despite wide recognition of a HRBA in the UN and European countries, I learned from my five-year work experience with a Korean NGO that the organisational culture and the Korean national context were not favourable to a HRBA. This experience led me to question if a HRBA can be differently understood and practised according to contexts and if the difference should be understood as either an adjustment for contextualised practices or a compromise damaging the intrinsic values of a HRBA.

## THREE CORE ASPECTS OF ANY EMPIRICAL RESEARCH PROJECT

### THE IDEA

This thesis builds on theories of discourse and agency, and argues that discourse of a HRBA is contextualised through the agency of NGO workers.

### THE DATA

- 1) A qualitative case study of a HRBA in an NGO working in a developing country.
- 2) Research Site: ActionAid Bangladesh.
- 3) Reasons for selection: ActionAid adopted a HRBA in 1998 and it is known for its strong commitment to a HRBA. ActionAid is an appropriate NGO to explore the contextualisation process because of its long tradition of valuing local engagement and its decentralised organisational structure, called a 'federal model'. Bangladesh was chosen for its richness of contextual influences. A HRBA is challenged by cultural references (customary law, religion) and the dominance of microfinance NGOs.
- 4) Data sources: documents and interviews.
- 5) Documents: 35 ActionAid documents published or finalised between 1998 (adoption of a HRBA) and 2012 (Field research).
- 6) Interviews: semi-structured interviews with 28 staff members / purposive sampling by position, major role, gender and the length of service.
- 7) Problem: exclusion of Bangla documents, the use of an interpreter when necessary.

### THE TOOLS

Thematic analysis with the aid of NVivo software.

Descriptive indexes are clustered into topic indexes, then developed as analytical themes using thematic framework.

## TWO KEY QUESTIONS

### WHAT'S NEW

This research can inform theories on a HRBA in five ways.

- 1) This research suggests that a HRBA is not necessarily a Northern discourse. This finding differs from previous studies.

2) This research considers both discourse and agency, which are rarely discussed together, for a comprehensive understanding of the HRBA in practice.

3) An explanation for observed group differences in understanding of and commitment to the HRBA is offered. In particular, this research suggests that NGO practitioners with opportunities to learn a HRBA and to have field experience are highly committed to a HRBA.

4) A central argument of this research is the importance of the contextualisation of a discourse. This research illustrates how the HRBA is contextualised by clarifying the nature of knowledge and the process of knowledge acquisition, use, transfer and creation.

5) Individual workers' context-related knowledge contributed to the formation of the HRBA by being informally shared with colleagues.

## SO WHAT

The above findings are important because:

1) Rejection of labelling a HRBA as a Northern discourse can widen its applicability.

2) This research highlights the agency of NGO workers, which is largely neglected in the literature on development discourses. NGO workers are suggested as change agents for the 'contextualisation of a discourse'.

3) This knowledge can contribute to understanding and promoting individuals' internalisation of a development discourse. One suggestion arising from this finding is that NGOs should provide their staff members with HRBA training and opportunities to engage directly with the marginalised.

4) A HRBA can be viewed as a dynamic interactive process which is influenced by contexts, not as a predetermined normative framework.

5) Development NGOs should encourage knowledge sharing and creation for context-appropriate practices with attention to the informal ways of transferring knowledge.

## ONE BOTTOM LINE

### THE CONTRIBUTION

This research contributes to scholarship in the area of development discourse, and a HRBA in particular. This research has heightened the understanding of the HRBA and the contexts in which the HRBA is shaped. Implications arising from this research are mainly for development practices and organisational practices in NGOs.

### OTHER CONSIDERATIONS

1) This research complies with the ethics requirements outlined in the National Statement on Ethical Conduct in Human Research as reviewed by the Ethics Committee of The University of Queensland (UQ). The research topic itself is not overly sensitive. Risk was assessed as low by the UQ Ethics Committee.

2) Target journals: Development In Practice, Journal of International Development, Third World Quarterly, Human Rights Quarterly.

3) Scope: researchable.

4) Limitations: The research findings have a limited transferability given their emergence through a case study. However, knowledge of factors on internalisation and process of contextualisation might be applicable to other NGOs, other countries and even other development discourses.

In relation to data collection, conducting interviews in English could limit the richness of some interviews, particularly those involving a translator, given that English is not the first language of the interviewer and the interviewees.



# SYSTEMS THINKING APPROACH TO EDUCATION FOR SUSTAINABILITY: A CASE STUDY OF UNIVERSITY KEBANGSAAN MALAYSIA

**SITI NUR DIYANA MAHMUD** (CATEGORY: EDUCATION)

## BASIC RESEARCH QUESTION

How might a whole systems thinking view assist understanding of Education for Sustainability at University Kebangsaan Malaysia (UKM)?

Systems thinking is the process of understanding how those things which may be regarded as systems influence one another within a complete entity, or larger system. In an organization like UKM, systems consist of people, structures, and processes that work together to make an organization “healthy” or “unhealthy”.

## KEY PAPER(S)

Espinosa, A., & Walker, J. (2011). *A complexity approach to sustainability*. London, UK: Imperial College Press.

Jickling, B., & Wals, A. E. J. (2012). Debating education for sustainable development 20 Years after Rio: A conversation between Bob Jickling and Arjen Wals. *Journal of Education for Sustainable Development*, 6(1), 49–57. doi:10.1177/097340821100600111

Sterling, S. (2004). Higher education, sustainability and the role of systemic learning. In *Higher Education and the Challenge of Sustainability: Problematics, Promise and Practice* (pp. 49–70). Netherland: Kluwer Academic.

## MOTIVATION/PUZZLE

Sustainability is a complex and contested paradigm. Sustainability can metaphorically be described as a large, irregular-shaped object located in dark space and the equipment to describe this object is a pencil-beam torch. Depending on where we stand with the torch, we will describe a valid but very incomplete picture of the object. Someone viewing from a different perspective sees something different however equally valid. The debate concerning a sustainability definition is undoubtedly important, but is this in reality a mere entertaining diversion for academic minds and is this institutionalization of environmentalism largely responsible for the subject losing its radical edge? Hence there is a need for practical tools in enacting Education for Sustainability (EfS). Accordingly, this study will address the worldview of sustainability, the system structure supporting EfS in UKM and the pedagogical approaches for EfS in higher education.

## THREE CORE ASPECTS OF ANY EMPIRICAL RESEARCH PROJECT

### THE IDEA

To understand the complexity and all-encompassing nature of sustainability, I look to frame the study using a system thinking approach. A system is more than a sum of its parts, it is an interconnected set of elements that is organised in a way to achieve something. At its core, systems thinking is about addressing the root cause of problems and provides a different way of seeing and thinking about the world’s economic, organisational, and societal problems. It allows one to see the interconnections of a problem and to be creative with systems. I choose the Viable System Model (VSM) (Beer, 1984) as theoretical foundation because it focuses more on how a system functions. The VSM involves drawing together potential organisational developments to form new higher order plans. I can reflect on UKM viability by mapping them as viable systems nested at different levels, and by reflecting on any structural factors that may constrain viability. By using the distinctions provided by the VSM, I can first map the structural elements of the organisation (UKM) that related to sustainability, and then assess the system’s viability in terms of how it manages the variety of its interactions with its changing environment.

### THE DATA

**Setting:** Universiti Kebangsaan Malaysia

**Data sources:** Semi-structured interviews with lecturers, focus-group interviews with students, observations during sustainability related classes, sustainability related course learning outlines, Malaysia Education Blueprint 2015-2025, UKM Sustainability Master Plan and UKM 2000-2020 Strategic Plan.

### Trustworthiness of the data:

- Triangulation of the data using multiple sources of data: I will compare and cross-check the consistency of information derived from the document analysis and observations with the semi-structured interviews and focus group interviews
- Member checking: the participants will check their own interview transcript to ensure the accuracy,
- Audit trail: thorough collection of documentation regarding all aspects of the research. Qualitative inquiry

typically involves a design that constantly changes or emerges through the iterative processes of data collection and analysis and requires that the researcher makes frequent decisions that can alter the course of the study. As a result, records of study processes can be vital in later providing justification of these actions.

The audit trail provides a mechanism for retroactive assessment of the conduct of the inquiry and a means to address issues related to the rigor of the research.

## THE TOOLS

**Research design:** Single holistic case study design. UKM is the case, because this study will focus on system dynamics in an institution and cybernetics in its organization.

**Semi-structured interview with lecturers:** The questions will focus on conceptualisation and perception toward sustainability, system structure that drive or restrict enactment of EfS in UKM and what kind of pedagogical approaches the lecturers perceive provide better opportunities to learn sustainability.

**Focus group interviews with students:** The focus group interviews will include pre-activities before a focus group interview to allow participants to gain familiarity and trust. The questions will focus on conceptualisation and perception toward sustainability, system structure that drive or restrict enactment of EfS in UKM and what kind of pedagogical approaches the students perceive provide better opportunities to learn sustainability.

**Observations:** structured - employing an observation schedule that consists of forms prepared prior to the data collection, outlining the behaviour and situational features to be observed and recorded. The observation form: is based on a matrix regarding transformative learning (Sipos et al. (2008)) and will include several criteria eg, during the lesson: content covered, types of activities implemented, role of the lecturer, role of the student and lecturer-students interaction.

**Document analyses:** Malaysia Education Blueprint 2015-2025, UKM Sustainability Master Plan and UKM 2000-2020 Strategic Plan provided background information/historical insight - understanding the historical roots of sustainability initiative in UKM and indicate the conditions that impact the studied phenomena.

**Field notes:** descriptive recording of observations and reflexive process of interpretation.

**Data analysis:** i) familiarizing with the data, ii) generating initial codes and assigning codes (using Computer Assisted Qualitative Data Analysis Software, Atlas.ti), iii) mapping out data pattern(s), iv) theme identification, vi) interpretation of themes.

## TWO KEY QUESTIONS

### WHAT'S NEW

Recent relevant EfS research focuses on different separate elements but ignores systematically combining all elements to create the whole "picture" of EfS in higher education. This study will focus on the dynamics through which the gestalt and its units interact instead of focusing on a specific role, structure or unit. UKM will be conceptualised as dynamic systems which are in continuous interaction with UKM's external environment (i.e., socio-cultural, religious influence, Malaysia national agenda, globalisation and current sustainability crisis) and with its units (i.e., campus operation, curriculum and pedagogy, research activity and management). The homeostasis concept (analogous to human body natural mechanism of maintaining a constant internal environment in response to environment changes), will be applied in analysing the enactment of EfS in UKM. How UKM maintains/sustains its' roles as higher education institution and its' mission to lead the development of a learned, dynamic and moral society during the age of sustainability crisis pressure. How UKM responds to this sustainability pressure and what kind of feedback mechanism implemented.

### SO WHAT

By revisiting the work of Stafford Beer in organisational cybernetics, indicate to relevant researchers and practitioners, how such a synthesis will benefit in the understanding and re-design of social structures and institutions, in forms that are better prepared to foster sustainability.

## ONE BOTTOM LINE

### THE CONTRIBUTION

Innovative research in framing EfS in a higher education institution by using system thinking approach.

### OTHER CONSIDERATIONS

**Target journal:** International Journal of Sustainability in Higher Education, Journal of Education for Sustainable Development and Qualitative Research Journal.

**Ethical clearance:** UQ Ethics Committee, Malaysia Economic Planning Unit and Universiti Kebangsaan Malaysia.

**Ethical considerations:** i) participant access, ii) insider status, iii) language, iv) power disparity and v) participant protection.

# HOW TO STRENGTHEN PSYCHO-SOCIAL EARLY CHILDHOOD DEVELOPMENT (ECD) IN UGANDA'S PUBLIC HEALTH SYSTEMS

**NAKAZINGA (ZINA) NDUGWA (CATEGORY: PUBLIC HEALTH)**

## BASIC RESEARCH QUESTION

What are the key public health system requirements to support or enhance responsive and stimulative caregiving as one way to strengthen psycho-social ecd across uganda's public healthcare system?

## KEY PAPER(S)

Walker, S. P., Wachs, T. D., Grantham-McGregor, S., Black, M. M., Nelson, C. A., Huffman, S. L., Richter, L. (2011). Inequality in early childhood: risk and protective factors for early child development. *The Lancet*, 378(9799), 1325-1338. doi: 10.1016/S0140-6736(11)60555-2

Engle, P. L., Black, M. M., Behrman, J. R., Cabral de Mello, M., Gertler, P. J., Kapiriri, L., Young, M. E. (2007). Strategies to avoid the loss of developmental potential in more than 200 million children in the developing world. *The Lancet*, 369(9557), 229-242. doi: 10.1016/S0140-6736(07)60112-3

World Health Organization (WHO) & United Nations Children's Fund (UNICEF). (2012). *Care for Child Development: improving the care for young children*. Geneva, Switzerland.

## MOTIVATION/PUZZLE

In 2007 it was estimated that 200 million children aged 0-5 years in Sub Sahara Africa and South East Asia were not reaching their development potential; this was estimated to create a 20% loss of adult productivity during the later stages of life. What is concerning is 25% of children in Low and Middle Income Countries (LMICs) were exposed to psycho-social risk factors such as poor stimulation, learning opportunities, parent responsiveness, and parent sensitivity, each of which are linked to caregiving practices and can be prevented using simple public health initiatives like parenting programs. Public healthcare systems have the capacity and potential to reach thousands of children between the ages of 0-5 years. As children and their caregivers access essential child health services, public healthcare systems have been identified as a key access point for ensuring caregivers are made aware of the best ways to support child development. So, given the above, how can we maximise this to broadly enhance and improve development outcomes? Accordingly, the aim of this PhD is to explore how responsive and stimulative caregiving can be universally encouraged across an LMIC public healthcare system.

## THREE CORE ASPECTS OF ANY EMPIRICAL RESEARCH PROJECT

### THE IDEA

ECD has been recognised as a crucial part of human development trajectories and wellbeing. During the early years of life, responsive and stimulative caregiving interventions, have shown higher levels of cognitive functioning and, improved social behaviour, education outcomes and economic benefits amongst children and adults who received increased or greater amounts of stimulation from caregivers. Using Uganda as an LMIC context, this PhD will explore how Uganda's public health systems can better integrate stimulative and responsive caregiving to current ECD and Maternal and Child Health (MCH) services. The essence is to understanding what, governance, finance, service delivery, health workforce, medical technologies and information capacities are required to strengthen this component of ECD across its public healthcare systems.

### THE DATA

The country research setting will be Uganda and the following data collection sources will be used; literature reviews; key informant interviews; focus groups; observational data collection on MCH services, and demographic data on MCH services. A literature review and content analysis of the WHO/UNICEF Care for Child Development (CCD) Package against the six Health System Building Blocks will be used to define the minimum health systems requirements for psycho-social development in the early years. An additional literature review of MCH government policies and strategies will be done to develop a narrative on Uganda's MCH and ECD priorities. To understand the public health governance and service delivery realities key

informant interviews, focus groups and observational data collection will occur in Uganda in March-May 2016. Using purposive and venue based sampling, 20-40 technical and operational experts on MCH will be recruited to partake in semi-structured interviews or focus groups. The observational data collection on MCH services resources and provision will involve physically observing and recording healthcare facility resources and, the interactions between a health worker and mother/caregiver. In addition quantitative demographic data on MCH services will be sourced using census and demographic health surveys. The triangulation of data from the various sources should assist with validity and representation of psycho-social ECD in the health system, however it may not guarantee completeness. Further research on maternal behaviours and multisector engagement will be required but this will be beyond the research scope.

## THE TOOLS

The methodological framework of the research will be framed by Grounded Theory as the data collected will be used to develop provisional theories and relevant recommendations on psycho-social ECD initiatives in Uganda's public health systems. Accordingly inductive tools of reasoning will be used to understand how health structures can dictate psycho-social development in ECD. A qualitative thematic analysis will be employed to develop a psycho-social ECD framework tool using the WHO/UNICEF CCD intervention package and the WHO Health Systems Strengthening Building Blocks. This will provide a comprehensive understanding of what key requirements are needed for health systems to adequately support the psycho-social elements of ECD. The framework will then be used to: 1) thematically code and analyse the data collected from the interviews, focus groups, observational data and demographic data; 2) based on the findings assess Uganda's capabilities and capacities and; 3) develop recommendations.

## TWO KEY QUESTIONS

### WHAT'S NEW

The novelty of this project is exploring how to apply current ECD best practice into an LMIC country setting and, explicitly addressing what would be required to enable health systems to adequately support psycho-social development during the early years of life.

### SO WHAT

The potential that caregiving and mother-child interactions have on improving psycho-social development and wellbeing needs to be maximised through public health systems. Using a health system based approach to support this aspect of ECD can ensure it reaches millions of children and provides good foundations for psycho-social and socioeconomic development. Furthermore this can enable country/national gains with links to reductions in intergenerational poverty, improvements to socio-economic outcomes and increased adult productivity.

## ONE BOTTOM LINE

### THE CONTRIBUTION

Provide a health system based framework that articulates key governance, finance, health workforce, service delivery, medical technologies and information requirements to reinforce psycho-social ECD via public health systems.

## OTHER CONSIDERATIONS

**Collaborations:** Collaborations between Ugandan government agencies and health services will be vital to this research, accordingly stakeholder engagement and relationship building will be a crucial part of the data collection and analysis. **Target Journal:** It is anticipated that the research will be relevant to the Health Policy and Planning journal. **Risk:** The nature of the research makes it a low risk because it will be dealing with experts and publicly available data. There is no foreseeable added risk above the risks of everyday living. **Scope:** Whilst the scope is dynamic it's ideal and feasible, however key aspects will depend on participant and organisation involvement which can be unpredictable.

# DE-MYSTIFYING THE DARK ART OF IN VITRO CULTURE OF BOVINE RESPIRATORY TISSUES

**PATRICIA EATS (CATEGORY: VIROLOGY)**

## BASIC RESEARCH QUESTION

Do complex, proprietary-formulated human respiratory tract tissue culture mediums promote superior bovine trachea explant viability in liquid-air interface culture systems?

## KEY PAPER(S)

Reed, S.E. & Boyde, A., (1972) 'Organ Cultures of Respiratory Epithelium Infected with Rhinovirus or Parainfluenza Virus Studied in a Scanning Electron Microscope'

Niesalla et al.(2009) 'Critical assessment of an in vitro bovine respiratory organ culture system: A model of bovine herpesvirus-1 infection'

## MOTIVATION/ PUZZLE

Successfully developed in vitro models of living, explanted respiratory tract tissues of humans and other mammals have enabled research concerning cystic fibrosis, asthma and bacterial infection. Respiratory tract epithelium models using explant tissue provide the native structural characteristics and biological properties of in vivo tissue, so are the most accurate way to model respiratory diseases. Respiratory illnesses of intensively farmed cattle are significantly detrimental to industry, but published methods for culturing bovine respiratory tract are unreliable. Novel supplements used with success in formulated human respiratory tract culture mediums may improve viability in explanted bovine respiratory epithelium.

## THREE CORE ASPECTS OF ANY EMPIRICAL RESEARCH PROJECT

### THE IDEA

Lonza laboratory supplies produce an upper and lower respiratory tract growth medium, specifically designed for human respiratory tissues in a liquid/air interface culture system that mimics conditions in the tract. Both growth mediums contain insulin and bovine pituitary extract, which are not present in other commercial mediums. No published research on the effect of inclusion of these novel ingredients is available, and their concentrations within the product are a proprietary secret. Explant culture of bovine respiratory tract may currently be unreliable due to lack of a key factor in the growth medium used. This inadequacy in conventionally used mediums may be the cause of failures of in vitro bovine respiratory tract. The hypothesis is that if Lonza supplemented growth mediums are used in the attempted culture of explant bovine respiratory epithelium, then epithelial ciliary beating will be maintained for longer and tissue necrosis will be delayed, enabling more reliable or longer term culture viability. More meaningful study of pathogenesis, pharmacology and virulence would be enabled.

### THE DATA

Observations will be made via visual appraisal of tissue under a light microscope. Key observation parameters will be the observation of coordinated ciliary beating motion, and evidence of necrosis. This study will follow successful models of respiratory tract explant to date, using micro-bead particles deposited on the explant surface within the liquid/air interface culture system. Viable cultures are able to fully disperse the beads via the healthy, coordinated beating motion of the cilia, whilst less viable cultures take longer or are unable to clear the micro-bead particles from their surface. The ability to clear micro-beads from the explant surface will be observed in the form of timed response to the stimulus at 12 hour intervals, for ten days following establishment of the explant culture. Clearance time is a continuous variable whilst presence of necrosis is a categorical variable. Observation of changed ciliary health is a continuous, qualitative observation parameter for which an appropriate classification scale will be developed.

Five medium types will be used: Lonza Upper Respiratory Tract medium, Lonza Lower Respiratory Tract medium, Lonza base medium without bovine pituitary extract and insulin, Life Technologies Minimum Essential Medium with Earles salts and 5% and 10% Bovine Serum, all with added antibiotics and antimycotics (Niesalla et al. 2009). Tissue from all animals and tissue types will be grown in each culture medium.

Tissue explants will be from three respiratory tract sections, obtained within thirty minutes of death from abattoir slaughtered cattle. Tissue types will be trachea epithelium, bronchial bifurcation epithelium and lung lobe slice. Four to six explanted tissue piece replicates of one kind from one animal will be cultured in each culture dish with one medium type. E.g. Animal #001 will have five culture flasks of three tissue types, each with a different medium.



All data will be observed and recorded by one technician in a University PC2 laboratory. Interpretation of observations will be standardized for future reference via employment of effective and specific protocols. No research assistance will be required, but funding will be sought for the purchase of air/liquid interface culture lab-ware. Scholarship and travel sponsorship has been sought for additional operator training, to promote a higher likelihood of success with the explant technique.

The data collection period is concise, limiting risk of missed observation. Duplicated physical observation records will be stored in different locations and copies will also be entered into electronic spreadsheets, saved in an internal and an external hard-drive. Magnified images of cultures will also be collected during the study for comparative validation and illustration purposes.

A good range of variance will be observed between treatment groups, ensuring experimental power adequacy.

Lonza and other medium supply companies are multi-national, so no limitation of applicability of results is expected.

## THE TOOLS

Microscopy is required for the observation of explant tissue viability parameters. The QAAFI laboratories have suitable microscopes and imaging equipment. In the event that additional microscopy services are required, the University of Queensland Microscopy Service is convenient to the QAAFI laboratory, and may be accessed upon subscription.

Standard ANOVA and further statistical analysis applications will be performed using existing subscriptions held by the research group.

## TWO KEY QUESTIONS

### WHAT'S NEW

Current emerging research initiatives inquire into the role of pathogen and cell-type specific host microRNA molecules, which are known to play significant roles in pathogenesis, virulence and other molecular cell biology processes. Cultured cell lines for study of disease are often highly reliable and commonly used models, but may produce inaccurate conclusions due to their immortalized form and non-native target cell type. Viable explant cultures would enable comparison with cultured cell research results, to define the limitations of bovine respiratory tract infection research undertaken to date.

### SO WHAT

Reliable and replicable bovine respiratory tract epithelium models would open new research avenues and increase the accuracy of bovine respiratory infection research undertaken, whilst further reducing, replacing and refining the need for use of animals as models for disease and pharmacology research. It would also enable examination of microRNA factors of the bovine host that are specific to the respiratory tract, which are proposed to have huge influence in susceptibility to pathogens. This may inform about the potential to genetically select animals on the basis of resistance to infection and subsequently limit respiratory infection in cattle industry. Respiratory tract explant cultures could also be used in studies of pathogenesis factors and virulence, enabling improved knowledge of molecular biology factors of pathogens and thereby facilitate novel vaccine development.

## ONE BOTTOM LINE

### THE CONTRIBUTION

Knowledge of any beneficial effect of bovine pituitary extract and insulin in medium on the viability, reliability and replicability of bovine respiratory tract explant cultures.

### OTHER CONSIDERATIONS

Collaboration with the Queensland Brain Institute will enable access to microtome equipment which is capable of precision slicing of the lung tissue. This will confer improved replicability of lung lobe culture replication as a function of standardizing slice characteristics.

Additional standardization and reliability of techniques used would be ensured by collaboration and the undertaking of a training course with the European Collection of Cultured Cells. Scholarships and travel grants have been sought for this purpose.

Findings of this research will be submitted to the Journal of Virological Methods for publication.

The low-level risks associated with the study include the risk that all explant cultures fail to be viable due to issues including contamination, potential differences associated with growing explant tissue in the presence of antibiotic/antimycotic, and a small risk that the individual animals sampled are not representative of the entire population and results are not repeatable on that basis. Animals from which samples of respiratory tract are obtained is assumed to provide a randomized sample of breed, genetic variation, gender.

Animal ethics clearance is not required for the study, as tissue samples will be obtained as a by-product from animals slaughtered within a commercial abattoir facility.

# DEVELOPMENT OF A MICROENCAPSULATION TECHNIQUE FOR FORTIFICATION OF HYDROPHOBIC FUNCTIONAL COMPONENTS USING COMPLEX COACERVATION IN ACIDIC BEVERAGES

**SARA GHORBANI GORJI (CATEGORY: FOOD SCIENCE)**

## BASIC RESEARCH QUESTION

1. Can we develop a technique to fortify liquid acidic food products with hydrophobic functional components by using green delivery system such as complex coacervation of proteins and anionic polysaccharides?
2. Can our new technique improve the retention time of the nutrient in food and allow controlled release at specific times?

## KEY PAPER(S)

Y.D. Livney, "Milk proteins as vehicles for bioactives", *Current opinion in colloid & interface science*, 15 (2010) 73-83.

A. Matalanis et al., "Structured biopolymer-based delivery systems for encapsulation, protection, and release of lipophilic compounds" *Food Hydrocolloids*, 25 (2011) 1865-1880.

## MOTIVATION/PUZZLE

Some chemical compound classes (e.g. antioxidants and vitamins) can provide medical benefits. The value of these supplements led to their application in food fortification to prevent coronary heart disease, cancer and etc., but many of these nutraceuticals are lipophilic. The lipophilic nature of these compounds makes their incorporation into non-fat aqueous foods challenging. These compounds tend to degrade during storage of food. This motivated me to develop a new technique that can enable food producers to incorporate lipophilic nutraceuticals in aqueous food systems with higher storage stability and bioavailability. Next, the limited number of food grade encapsulation materials is problematic, so finding suitable delivery systems is of vital importance.

## THREE CORE ASPECTS OF ANY EMPIRICAL RESEARCH PROJECT

### THE IDEA

The main idea of this research project is to develop microencapsulation technique to obtain microcapsules of hydrophobic functional components using complex coacervation in an acidic fruit juice and dairy fermented drink. The central hypotheses would be: (1) We can produce green delivery systems in order to fortify liquid acidic food products with nutraceutical models: vitamin D, omega 3 and tocopherol. This fortification would be done by complex coacervation of milk protein (sodium caseinate), and vegetable protein (soy bean protein) and anionic polysaccharides (pectin). (2) The produced microcapsules are more stable than free nutraceuticals.

Initially, optimum conditions (pH, protein to polysaccharide ratio and biopolymer concentration) for forming a stable complex between proteins and anionic polysaccharide should be determined.

Secondly, encapsulation efficiency and particle size should be obtained.

Thirdly, nutraceutical nanocomplexes will be used in the enrichment of fruit juice and dairy drink.

Finally, after *in vitro* digestion, the bio accessibility of nutraceuticals will be assessed.

### THE DATA

The data required to support our hypothesis is obtained via assessing several specific objectives:

1. The nature of the interactions between above-mentioned proteins and anionic polysaccharide. Outcome data: critical pH values such as  $pH_c$ ,  $pH\phi_1$ ,  $pH_{opt}$  and  $pH\phi_2$ .
2. The effect of pH on the binding ability of proteins to nutraceutical. This test gives us the idea to find the optimum pH of interaction between protein and nutraceutical.

3. The binding and diffusion of the nutraceutical using nuclear magnetic resonance. This test helps us understand the bioavailability of nutraceutical after encapsulation.
4. The chemical and structural characterization of microcapsules in order to find out the behaviour of nutraceutical after encapsulation in food.

## THE TOOLS

The major instruments required to conduct the necessary tests for this study are:

1. UV/visible light spectrophotometer: Critical pH values will be determined by turbidity measurement.
2. Isothermal titration calorimetry (ITC): ITC shows the enthalpic and entropic changes due to protein-polysaccharide interactions.
3. Particle size and zeta potential analyser.
4. Optical microscopy and Cryogenic Scanning Electron Microscopy: Microcapsules morphology will be analysed.

The following procedures are also required:

5. Yield, encapsulation efficiency, encapsulation loading and morphology.
6. Sensory evaluation.
7. *In vitro* digestion model: to assess the behaviour of the nanocapsules on their exposure to simulated gastric and intestinal fluid.

## TWO KEY QUESTIONS

### WHAT'S NEW

The novelty in this idea is to develop a new microencapsulation technique for hydrophobic functional components using complex coacervation. Not only the technique I will use in this project is new, but also the final product has not been developed before. Moreover, this innovative technique will allow industries to produce a commercially available fortified fruit juice and acidified dairy drink in a way which is health promoting without any adverse sensory properties.

### SO WHAT

Fortifying food products is challenging for food producers because of several difficulties such as:

1. There are only a limited number of food grade ingredients which can be used as the encapsulation materials.
2. There are very limited number of techniques for encapsulation of hydrophobic functional components.
3. Although some techniques may work in theory, in practice, commercialisation of these food products need sensory acceptability.

In this research I will address these problems and I will find a way to overcome these obstacles which will simultaneously benefit food producers and consumers.

## ONE BOTTOM LINE

### THE CONTRIBUTION

This research will have several significant contributions to science and industry:

1. A new microencapsulation technique will be introduced to food science. This technique has major benefits: (1) being applicable in other fields including pharmacy, (2) the material used in this technique is green.
2. Nutraceuticals will be more stable during storage.
3. We will improve the bioavailability of these nutraceuticals.
4. A health promoting food product will be produced which is sensory acceptable, and so the consumers will choose to consume them enthusiastically.

### OTHER CONSIDERATIONS

Collaboration is needed from a food-industry company in order to help produce the final product.

The results from this research will be published in high impact-factor journals such as: *Molecular Nutrition & Food Research* and *Food Hydrocolloids*.

No result risk: low, literature shows the high possibility of success for this technique.

Competitor risk: low, as complex coacervation is a new technique the odds of implementing the same technique and producing the same microcapsules by other researchers is very low.

Obsolescence risk: low, making this technique commercially available has not been done before.



UQ Business School  
The University of Queensland  
Brisbane QLD AUSTRALIA 4072

P +61 7 **3346 8100**  
F +61 7 3346 8166  
E [info@business.uq.edu.au](mailto:info@business.uq.edu.au)

CRICOS Provider Number 00025B

[business.uq.edu.au](http://business.uq.edu.au)