Background
My educational background in different disciplines ranging from mechanical engineering, information technology to operations management, has largely influenced the interdisciplinary nature of my practice and research work. My earlier career included designing oil well drilling equipment, conducting applied research in process simulation and optimization, consulting in supply chain and logistics related activity, managing software development and implementation projects and managing an R&D department of a supply chain solutions provider.

As a practitioner and an academic, I am naturally inclined to work on bridging the gap between theory and practice. I am drawn to applied research topics that can be addressed through a combination of decision modeling, simulation gaming and process optimization methodologies.

My current research focuses on the following three areas.
1. Project Management Simulation Environment for Participant-Centered Learning
2. Practical Vehicle Routing Problems with Non-Standard Constraints
3. Intelligent Tutoring for Business Modelling Spreadsheets.

Research Areas
Project Management Simulation Environment for Participant-Centered Learning
Large IT projects are complex coupled with high level of uncertainty, and usually involved multiple partners across functional, organizational and geographical boundaries. The extent to which their performance goals are achieved depends largely on the effectiveness of the project manager in orchestrating and integrating contributions from different partners into a unified solution.

This research initiative seeks to explore different practices in operation management and decision sciences by providing an interactive and adaptive simulation environment for experiencing project management. Such platforms can serve as an engaging and high-energy approach to teach the concepts and best practices of project management that had practical and have lasting value. It is also an excellent means of immersing people in situations that mimic the complexities of real world, challenging them to take risks and make mistakes without real consequences.

I have created a rather complex project management simulation teaching tool using Excel Spreadsheet as the front end and coded much of the logic using the embedded VBA programming language. This teaching tool has since become a key component of a master course (IT project and vendor management) and professional programs
catering to training project managers for a large local bank. The feedback on the simulation game has been positive so far. I also received enquiries from professors in England, Australia and India University who have expressed interest in the simulation game.

The game entrusts the participants with planning and managing an IT project. The project consists of a set of tasks that need to be completed and the participants are firstly required to create a project plan and subsequently execute it. The project plan consists of a Gantt Chart, a network diagram, and an optional training plan. During the execution phase, it is imperative that diverse events and situations will emerge and participants will be required to exercise their judgment in making the right decisions to steer the project towards completion. Participants will also be required to plan project reviews, quality reviews, meetings with team members, and organize social outings. These activities will impact the project schedule, cost, quality, and team motivation.

With this teaching tool, I can explore the effectiveness of employing simulations technique to help project managers develop better decision making skills. Moving forward, I am exploring ways of integrating social network technology into the simulation and have students experience making decisions to management situations in real-time.

**Practical Vehicle Routing Problems with Non-Standard Constraints**

Vehicle routing problem (VRP) is an old unsexy problem that has in the past received much attention by researchers. As a consequent, a large collection of algorithms and methodologies were proposed in the literature seeking to solve this traditional known to be NP-hard problem with some achieving significant result using standard test cases. However, these solutions have largely remained an interesting research topic but scarcely deployed successfully in practice albeit several commercial solutions are available.

Commercial solutions are either too complex for ease of use (difficult to implement) or too rigid to meet the continuously evolving business needs in the supply chain industry. Implementing vehicle routing solutions in third world country where geographical information is not readily available coupled with unpredictable traffic conditions are particularly challenging. Furthermore, charging models designed to maximize profit may contradict the conventional optimization objective function. For instance, minimizing routing distance or maximizing trucks capacity utilization may no longer be a concern if the trucking operations is outsourced to a third party and charged based on the number of drop points rather than distance travelled. Such practices are not uncommon in the distribution of fast moving consumer goods in large city.

In practice, having a quick feasible solution often outweighs the benefits of having an optimal solution as the initial conditions for optimizations are constantly evolving. Data pre-processing and system integration with other logistics execution systems are crucial in ensuring right information is passed during routing optimization. Such
are some of the practical issues that need to be addressed before vehicle routing optimization solutions can achieve widespread adoption.

My research explores the use of heuristic based solutions to solve practical vehicle routing solutions by managing the tradeoffs between optimizations, constraints satisfaction, constraints relaxation and getting a quick solution. I consider a VRP with standard constraints like heterogeneous vehicle fleets with different capacities and multiple time-window restrictions together with non-standard constraints like merge order constraints, maximum drop point constraints, order-vehicle matching constraints and mixed-load constraints. I proposed a solution using a two-stage sweep-based algorithm with local search heuristics and successfully deployed it for a 3PL distribution operation. The results were promising although the capacity utilization of some vehicles was low due to limiting practical constraints. Moving forward, I am looking at applying the improvement and exchange method using the metaheuristic approach to improve the quality of the current solution.

Intelligent Tutoring for Business Modelling Spreadsheets

Ever since joining SMU, I have been teaching a course called “CAT” (Computer as an Analysis Tool) that teaches students to use spreadsheets to solve business problems. In this course students learnt to build spreadsheet models of ill-structured business problems and perform analysis using the model to support the decision making process. I subsequently took over the role of course coordinator for this large university wide core module.

Students generally find this course challenging and fast pace although they appreciate the spreadsheet modeling skill acquired upon completion of the module. Since it is a university wide core module, a typical class will have students of diverse backgrounds and competencies in using spreadsheet. This module is designed with the assumption that students have basic knowledge of using spreadsheets. One of the key challenges in teaching this module is the huge amount of time spent teaching the spreadsheet functionalities rather than teaching the modeling and decision analysis techniques which is the key focus of this module.

I have been exploring different approaches of incorporating some form of e-learning methodology to allow students to self-learn the basic spreadsheet functionalities before coming to class. However, the e-learning methodology currently available that I am aware of has limited cognitive assessment capability.

Moving forward, I will be working with leading faculty from Carnegie Mellon University (CMU) who are experts in developing intelligent tutoring tools for educational purposes to develop a prototype intelligent tutor to provide our CAT students with more personalized feedback in a more scalable and economic way. A key foundational component for this project is to develop a capability to track the progress and work of students as they tackle “CAT” problems. The logged data would include the spreadsheet cells data is placed in, formulas used by students, and the data itself. To have a scalable solution, I first need to address the questions of whether a standalone spreadsheet or a web-based spreadsheet application would be
a more suitable platform to develop the prototype. The “CAT” module currently uses the standalone spreadsheet which is functionally rich but data logging and sharing activity could be challenging while the web-based spreadsheet application offers a simpler solution to data logging and consolidation at the expense of functional richness. This decision is vital as it has huge impact on the design of the course.

If the first stage of the project is successful, it will progress on to the next stage to track students’ interactions and location information in the process of tackling the business problem to investigate the issues of collaboration. Although this is a new initiative, I have accumulated substantial knowledge of spreadsheet modeling to be able to effectively contribute to the success of this project as well as influence the direction of how this project will progress.

**Selected Publications**

- Thin Yin Leong and Wee Leong Lee (2010), “Spreadsheet Modeling to Determine the Optimum Hotel Room Rate for a Short High-Demand Period”, Sept, Vo1 11, 1, INFORMS Transactions in Education
- W.L. Lee (2009), “Project Simulation Game ver 1.0”, A Simulation Software
- W.L. Lee and Don Ferrin (2009), “The Service Level Agreement Outsourcing Negotiation”, Asian Negotiation Programme @ Singapore Management University (Simulation Case Study)

Tangible Outputs
• Computer-based Project Management Simulation Software©2012
• Vehicle Routing Optimization Software, VRoute©2010
• Routing Visualization Software, RouteViz©2012