



# THE DOCTORAL RESEARCH

## ABSTRACT

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INSTITUTE of GRADUATE STUDIES

*Leading You To Greater Heights, Degree by Degree*

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# FOREWORD

**Congratulations** to Institute of Graduate Studies on the 1st issue of The Doctoral Research Abstracts. This inaugural issue consists of 40 abstracts from our PhD graduands receiving their scrolls in the UiTM's 76th Convocation.

This convocation is very significant especially for UiTM since we are celebrating the success of 40 PhD graduands from 12 of the university's 25 faculties – the largest number ever conferred at any one time.

To the 40 doctorates, I would like it to be known that you have most certainly done UiTM proud by journeying through the scholastic path with its endless challenges and impediments, and by persevering right till the very end.

Let it remain in your thoughts and hearts that knowledge is God-given, and for those of us who have some to spare, never fear to share with those around us, and never be sparing in serving the community and the country, in the name of the Almighty.



*Dato' Prof Ir Dr Sahol Hamid Bin Abu Bakar , FASc  
Vice Chancellor  
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1

**Name :** Arun Mohamed, PhD  
**Title :** The Value Relevance Of Financial Reporting Standards And The Accounting Information Prepared Under Specific Ifrss In Malaysia  
**Faculty:** Accountancy  
**Supervisor :** Prof. Dr. Muhd Kamil Bin Ibrahim (MS)

The thesis aims to examine the value relevance of accounting information in Malaysia. In particular it aims to determine the value relevance of accounting information produced under different financial reporting standards (IASs/MASs, MASB standards and FRSS) used in Malaysia from 1995 to 2008. It also aims to examine the value relevance of specific standards upon the adoption of IFRSS in Malaysia in 2006. The samples consist of companies listed on the Main Board of Bursa Malaysia using data obtained from the International Datastream and the annual reports. The multiple regression analyses are used to determine the value relevance of accounting information. The findings suggest that there is significant upward trend in the combined value relevance and book value but not earnings relevance. There is no significant difference in the value relevance after the introduction of the MASB standards. However, the use of FRSS in place of MASB standards exhibits higher value relevance. Earnings are more important than book value in the valuation of the firms when IASs/MASs and FRSS were used but not MASB standards. Even though book value under FRSS exhibits greater information content than book value under MASB standards, the incremental contribution of book value under MASB standards is greater than the incremental

contribution of book value when the FRSS are introduced. After excluding loss firms (which are prevalent under MASB standards) and controlling for size of the firms, the value relevance between the financial reporting standards and measures (earnings and book value) remain unchanged. The results also suggest that regulations together with the use of FRSS (but not MASB standards) increase the value relevance of accounting information in Malaysia. The adoption of IFRSS in 2006 are value relevant for property, plant and equipment, prepaid lease payments, assets held for sale, earnings from discontinued operations, goodwill and other intangible assets. However, there is very little evidence to suggest the adoption of IFRSS relating to investment property and share-based expense to be value relevant. The use of fair value estimates and the increasing discretion available to managers may result in the two items providing little evidence on value relevance. The study contributes to the existing value relevance literature and the role of financial reporting standards and regulations in improving the quality of financial reporting. The results suggest that the use of regulations without proper enforcement mechanisms may not be effective. Additionally, financial reporting standards that are based on the local economy have resulted in the decrease in earnings relevance. The use of more superior standards like the IFRSS may not be value relevant if managers have the opportunity to act on their best interest rather on the interest of the firms. The study provides preliminary evidence on the adoption of IFRSS in Malaysia before the full implementation of IFRSS is expected to take place in 2012.

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**Name :** Faizal Mohamed Yusof, PhD  
**Title :** The Value Of Sales Forecasting For Firms With High Strategic Adaptation Ability: A Case Study In The Automotive Industry  
**Faculty:** Accountancy  
**Supervisor :** Prof. Dr. Rozainun Abdul Aziz (MS)  
 Associate Prof. Dr. Donna Davis (CS)

The purpose of this study is to delineate and signify the value of sales forecasting by examining the relationship between strategic adaptation ability and sales forecasting management. In doing so, this study also address an on-going debate on whether there should be 'less or more' forecasting in a competitive and volatile market environment. In addressing this gap, UMW Toyota (UMWT), an automotive firm with high strategic adaptation ability was identified for the study. This study employs a mixed-methods case study approach which is predominantly qualitative. A quantitative strategic adaptation framework based on Eunni et al. (2005) provides the context for resulting organizational adaptation capability of UMWT. Data were collected from Malaysian Automotive Association (MAA) and companies commission of Malaysia (CCM). The sales Forecasting Benchmarking Model (SFBM) from mentzer and Moon (2005) offers a framework to qualitatively analyse the sales forecasting management of UMWT. Based on pilot and in-depth inquiries conducted at

UMWT, the data were analyzed using a pattern matching process. Thus, in this multidisciplinary study the definition of value creation was derived from the perspective of management accounting. Based on the analysis, the results indicate that strategic adaptation ability has a high association with the functional integration dimension and a moderate association with the approach dimension of the SFBM. In addition, it has a low association with the system dimension and a moderate association with the performance measurement dimension of the SFBM. The findings reveal that at UMWT, functional integration is seen to be the most important factor in its sales forecasting management with the least emphasis on the systems dimension. Overall, the study demonstrates that the value of sales forecasting at UMWT resides in the 'use' of sales forecast information through 'shared interpretation' across the value chain based on the 'rundown management'. The findings contribute to the body of knowledge in several areas, which include refining and validating the SFBM, and providing better insights into the ongoing debate stated above. The study also illustrates an innovative practice of the rundown management. All these are summarized in the value creation map and the matrix map. It is hoped that this study will enhance our understating of how a successful 'shared interpretation' process is applied across the value chain through an innovative sales forecasting management practice.

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**Name :** Mohd Halim Bin Kadri, PhD  
**Title :** Value Relevance Of Balanced Scorecard: Malaysian Evidence  
**Faculty:** Accountancy  
**Supervisor :** Prof. Dr. Muhd Kamil Bin Ibrahim (MS)  
Prof. Dr. Rozainun Abd Aziz (CS)

This thesis is aimed at investigating the value relevance of Balanced Scorecard (BSC) measures incremental to book value and earnings of Malaysian public listed firms. The objectives of the thesis are to investigate (a) whether book value and earnings are still value relevance; (b) whether BSC measures are value relevance; (c) whether firm specific characteristics influence the value relevance of BSC measures; (d) whether book value and earnings could predict future market price; and (e) whether BSC measures

could predict future market price. The sample was selected from Malaysian firms that have been listed for more than 10 years. Using a six year data from 2003 – 2008, the sample size is 1899 firm-years for the analysis current year market price and 1467 firm-years for the analysis of future year market price. This thesis employed equity valuation models that are developed based on established and well accepted equity valuation models. The results reveal that book value and earnings are still value relevance in Malaysian market over a six year period under study to the extent that the coefficient of correlation of book value is stable. At the same time, the coefficient of earnings is in an increasing trend. All BSC metrics are value relevant to investors. The thesis also finds that firm specific characteristics influenced the composition of relevance BSC measures. It was further found that book value, earnings and BSC measures could predict future market price. The availability of BSC variables that suit all sectors is the main limitation of the study. The empirical results provide a concrete and practical framework for the use of BSC in valuation of firms. The model helps the management in monitoring firm performance and at the same time helps the investors in evaluating firm performance. The study is original with regards to methodology in which the sample is selected from Malaysia, a developing country, an inefficient market and not tested before. Unlike previous studies, all sectors are selected as sample except for banking due to its different setting and regulation. The valuation model also includes variables that are not tested previously in equity valuation.

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**Name :** Suaini binti Othman, PhD  
**Title :** Corporate Social Responsibility Reporting And Corporate Reputation: An Institutional And Resource-Based Perspective  
**Faculty:** Accountancy  
**Supervisor :** Associate Prof. Dr. Faizah Darus (MS)  
Associate Prof. Dr. Roshayani Dato' Arshad (CS)

Prompted by calls for greater accountability and transparency and in line with the prevailing Corporate Social Responsibility (CSR) reporting practices at the international level, the Malaysian regulatory authorities have made it mandatory for all public-listed companies to disclose their CSR activities in their annual reports beginning with the financial year ending 31 December 2007. The government believes that CSR reporting can be a potent tool for Malaysian companies to realise their enhanced reputation and in turn will assist them to compete effectively in the global market. Therefore, the objective of this study is to examine factors that influenced managements' decisions on the quantity and quality of CSR disclosure during the unregulated (2005 and 2006) to the regulated (2007 and 2008) periods and whether these disclosures will have any effect on corporate reputation. The moderating and mediating effects in relation to CSR disclosures are also examined. Institutional Theory and Resource-based Perspective have been integrated to underpin this study. This study embarked upon a sequential mixed method approach, a combination of qualitative and quantitative investigations. The qualitative investigation involved face-to-face interviews with CSR managers while the quantitative investigation was based on content analysis of the annual reports of 248 companies listed on the main board of Bursa Malaysia over a period of four years, involving a total of 992 firm-year observations. The quantity of CSR disclosure was

measured using word counts while the quality disclosure was measured based on an index comprised of 100 indicators, using international and national CSR values as yardsticks. An objective measure for corporate reputation based on dimensions of the RepTrak TM model modified according to suggestions made by a panel of experts was also constructed. The findings provide evidence that the quality of CSR disclosures enhances corporate reputation. The results of both the quantity and quality measures indicate strong evidence that government regulation is an effective mechanism in enhancing CSR disclosure. While the government-owned companies expressed strong support for the regulator's call for more accountability and transparency in relation to their CSR disclosures, the family-owned companies were less inclined to disclose information beyond the basic regulatory requirements. Nevertheless, the results demonstrate that the presence of superior leadership can moderate the resistance to change by these family-owned companies towards CSR reporting. The competencies of these superior leaders are shown to be central in driving excellence of CSR disclosures in Malaysia. In situations of uncertainty, companies in the concentrated industry tend to emulate the CSR disclosure practices of companies that advocated quality reporting as their benchmark. Finally, the mediation tests affirm that both the quantity and quality of CSR disclosures can function as information signals to enhance corporate reputation. Overall, these results suggest that CSR disclosures are important tools for corporate reputation enhancement. These findings provide valuable insights to the regulators, practitioners and academicians in enhancing corporate accountability and transparency. The results are also expected to address concerns often expressed by sceptics about the tangible benefits of CSR disclosure, thus underscoring the importance of CSR reporting.

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**Name :** Radziah Mahmud, PhD  
**Title :** Earnings Quality, Ownership Structure And Firm Performance: Malaysian Evidence  
**Faculty:** Accountancy  
**Supervisor :** Prof. Dr. Muhd Kamil Hj Ibrahim (MS)  
 Associate Prof. Dr. Alya Sarah @ Pok Wee Ching (CS)

Flexibility in accounting principles allows managers to opportunistically manipulate earnings figure. Accounting scandals around the world provide evidence that earnings manipulation affects the quality and usefulness of reported earnings that will be used by users of financial information to evaluate their investment decisions. Due to imperfect and incomplete market, managers have better information to enable them to engross in the accounting discretion in order to maximise their own interest at the expense of the shareholders. Ownership structure has been acknowledged in the literature as one of the corporate governance mechanisms which can be used to reduce agency and information asymmetry problems. However, the empirical evidence on the influence of ownership structure on firm performance is inconclusive. To address this issue, this study examines whether earnings quality and ownership structure of Malaysian public listed firms are associated with firm performance based on 285 listed firms on the main board of Bursa Malaysia for the period from 2000 to 2007. Earnings quality used in this study is based on the qualitative characteristics specified in the Framework

for the Preparation and Presentation of Financial Statements (2007) namely relevance and reliability. The common types of ownership structure found in Malaysian listed firms which are managerial ownership, institutional ownership, government ownership and foreign ownership are taken into consideration. The firm performance measures used are returns on assets (ROA), cash flows from operations (CFO) and Tobin's Q. After controlling for firm-specific effects, this study suggests that earnings quality of Malaysian firms is significantly and positively associated with firm performance. Instead of linear association, the association between ownership structure of Malaysian firms and firm performance is generally found to be U-shaped. Managerial ownership, institutional ownership and foreign ownership have initially significant negative association with firm performance. Beyond a certain ownership level, the association becomes significant positive. Government ownership is significantly and negatively associated with firm performance at lower level. Government ownership has no influence on firm performance after it reaches a certain level. This study also finds that while managerial ownership and government ownership moderate the association between earnings quality and firm performance, institutional ownership and foreign ownership do not moderate such association. In general, this study makes a contribution to extant literature by providing empirical evidence that firm performance depends on earnings quality and compositions of ownership structure that needs to be investigated from different theoretical perspective.

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**Name :** Dahlia Mohd Shariff, PhD  
**Title :** Impact On Creative Thinking By An Intrinsic Calm Approach Of Interior Architecture Students  
**Faculty:** Art & Design  
**Supervisor :** Associate Prof. Dr. Ruzaika Binti Omar Basaree (MS)

Creativity, generation of ideas and artistic ability for visual communication are highly essential to an interior architect. Interior Architecture/Design educators and creativity theorists differ in their perspectives towards the activity of generating ideas, how ideas arise in the mind, the "Eureka" or "Ah-ha" experience, the point of illumination. To the creativity practitioners, calmness helps to improve creativity, to the Interior Architecture/Design educators this is not so. The education and training of the interior architects are still very orthodox and places high emphasis of achievement and performance through stressful measures of overload of work and time datelines. This research studied the effects of being calm onto the creative thinking and artistic performance, intrinsically, within a person, and not from the external. The first insight, incubation and illumination stages of the creative process are very intuitive and not easily explained unlike the preparation and verification stages. The value of this research would be to investigate the effect of the intrinsic calm approach which could be attained within the individual's self and can be called upon at will, internally,

instantly and be very useful to any individual requiring creative thinking. The recommended Brain Gym exercises, were verified by a medical doctor, was the treatment applied to achieve the clam mind state of the participants. The Department of Interior Architecture, UiTM was chosen as it was the pioneer and the oldest education institute offering Interior Design and Interior Architecture since 1975. This department was responsible for the formation of the Malaysian Institute of Interior Designers. It has to date the highest number of academically qualified teaching staff and highest number of achievers. Its accomplishment is evident in the large number of graduates, approximately 3500 (2009). This research was carried out in three parts. Part A was an experiment involving 57 participants with Control Group (no treatment) and Experimental Group (with treatment) carried out UiTM Shah Alam using six art tests by art educators and creativity theorists. This directly observed actual, intuitive and spontaneous visual responses objectively and showed the creative performance at the intuitive stage of the creative process. Objectivity was ensured by addressing sensitivities in creativity experiments; using categorical assessment of artistic elements; and sincere self-evaluations by the participants themselves. Part B examined the academic success and performance of the groups by comparing examination results of ten subjects and interviews with the lecturers concerned. Part C surveyed 313 respondents as to their experience and conditions at the illumination stage.

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**Name :** Hushinaidi bin Hj. Abdul Hamid, *PhD*  
**Title :** Experiments On Micrometer And Nanosizes Of Shale And Lateritic Rock As Colorants On Canvas  
**Faculty :** Art & Design  
**Supervisor :** Associate Prof. Dr. Ahmad Rashidi Bin Yan Ibrahim (MS)  
Prof. Dr. Wan Yunus Bin Wan Ahmad (CS)

Malaysian lands are very rich in natural resources especially Shale and Lateritic rocks. The transformations of coloured rocks to colorants for artwork can give a huge impact for the government, industries and consumer. This research project aimed to process and produce natural colorants from shale and lateritic rocks into two sizes which are in micrometer and nano size range. X-Ray Fluorescent (XRF) was carried out to identify element content in each rock whilst Field Emission Scanning Electron Microscopy (FESEM)

was performed in order to determine the sizes of the rocks after grinding accurately. Two grinding methods were carried out, which were by using jar mill and planetary mono mill. The rock colorants were applied to cotton, linen and polyflax based canvasses. All of the rock colorants were mixed with acrylic medium and then applied on canvas by nylon flat brush. The applications on canvasses were divided into three stages which are single colour application, tint and shade and the colour mixing. The painted samples (single colour application) were then evaluated based on fastness to light. All of the painted samples in micrometer and nano sizes colorants exhibited excellent results of light fastness testing. The ranges of colours that are available when converted to colorants are not wide but enough to be used as a substitute colorants beside synthetic colorants

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**Name :** Nor Azlin Binti Hamidon, *PhD*  
**Title :** Islamic Calligraphy In Contemporary Art Of Malaysia  
**Faculty :** Art & Design  
**Supervisor :** Prof. Dr. Dzul Haimi Bin Md Zain (MS)

This research entitled Islamic Calligraphy in Contemporary Art of Malaysia contribute to the most neglected area in the development of the history of art of Malaysia. The combination of three different traditions – Islam, Malay and Western traditions had made significant marks on the form, content and context of the Islamic calligraphy in the Contemporary Art of Malaysia. The objectives of this study are firstly to document contemporary art works of Malaysia that constitutes of Islamic calligraphy. Secondly, is to establish the styles through formal analysis, in terms of its size, medium, techniques, orientation, shape and type of calligraphy. Thirdly, is to uncover the themes of the calligraphy, the sources of quotation and its meanings. Fourthly, is to discover the underlying factors and forces that influence the production of these art works; and finally, to discern the spiritual manifestation from the art works. This study, which covers contemporary art works of Malaysian artists since 1940's until 2005, managed to give a better picture on aspects that have been neglected by the art historians regarding Islamic and Western impact on the art of Malaysia. In doing so, the researcher is inclining to the theory of Iconology proposed by Erwin Panofsky that covers three levels of analysis, i.e. the pre-iconographical description, iconological analysis and iconographical interpretation. Since this research

deals with the content and context of the Islamic art, the Panofsky's approach has been evaluated within the classification of knowledge by al-Imam al-Ghazzali. A new level of interpretation that deals with spiritual dimension was introduced in the theory of iconology. The findings highlighted that the educational background determines the major styles of Islamic Contemporary Art of Malaysia. The style was expressive, if the artists were trained in western-educational system, whereas the traditional calligraphers tend to produce hard-edged calligraphy adhering to the rules of writing calligraphy. Within these styles, there was a fusion of these two traditions that made Malaysia as a melting pot. Artists of different races practice Islamic calligraphy in their art works as a manifestation of cultural integration and realization of political policies. The external forces, such as Islamic resurgence had been one of the main factors that increase the production of art works. On the other hand, internal forces and personal motivation based on spiritual drives and inner consciousness had become a major factor that drives the artists to commit themselves with this art throughout their lives. Finally, the findings of this research formulated five main categorizations of Islamic contemporary calligraphy, based on two main considerations: meaning and style. They are Traditional Calligraphy, Rudimentary/Modern Calligraphy, Abstract Calligraphy, Marginal Calligraphy and Gestural/Pseudo Calligraphy. These findings are so meaningful, as they enlighten future area of studies pertaining to the History of Islamic Art in Malaysia as well as the South East Asia regions.

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**Name :** Nik Mohamad Farid Bin Nik Ismail, PhD  
**Title :** Knowledge Based Computational Support System To Enhance Industrial Design: Conceptual Design Decision Making  
**Faculty :** Art & Design  
**Supervisor :** Associate Prof. Dr. Kamaruzaman Bin Md Isa (MS)  
 Allahyarham Prof. Dr. Muhamad Tamyez (CS)

Researchers have always acknowledged the difficulty faced by industrial designers in understanding new designs in the process of sketching ideas. In exploring new concepts, industrial designers are required to support their reasoning based on concrete objects and ideas. In doing so, industrial designers normally use sketches to bring forward the ideas and tailor the explanations based on prior knowledge to come up with the new concepts. It is often observed that there is a lack of interactive pedagogical agents that can coach industrial designer's reasoning and to adapt the explanations to their cognitive state. The design of such agents can be based on learning theories that explains how industrial designers understand new concepts, as well as from studies on how industrial designers support conceptual understanding. Further goal of this research is to develop a computational framework to inform the designers of a pedagogical agent capable of engaging in a drawing dialogue that supports industrial designer's conceptual understanding. This thesis proposes an approach for Schema Support System Conceptual Activation ("SSCA") to support cognitive tasks that occur when an industrial designer is learning during the exploration of new concepts through one-to-one interaction with a computer agent. The approach is based on visual art schematic theory that explains how meaning-making occurs and stresses the importance of prior knowledge, and on the results of sketches analysis

study that identifies idea exploring method designers use to keep up schema-based cognitive tasks. A novel architecture of a pedagogical agent whose behaviour is based on visual art schematic theory is described. The architecture addresses three important issues: describing the process of idea activation and idea modification of industrial designer's relevant prior knowledge to be used in introducing new concepts, defining the reasoning and decision making of the agent to promote visual art schema-based cognitive tasks, and providing adaptive explanations tailored to the industrial designer's relevant prior knowledge. The SSCA agent's visual arts schematic knowledge is represented as frames; the idea coaching is planned as a sequence of drawing dialogue, and the interactive drawing language is implemented with idea transformation templates extracted from a study of the sketches. The applicability of the SSCA approach has been demonstrated in a multimedia e-learning system as an integrated component in a knowledge exploration and information seeking session. An experimental study with the multimedia system has validated the SSCA design approach and has examined the usefulness of the agent in supporting industrial designer's conceptual understanding in terms of improving their visual art schematic knowledge. The thesis makes original contributions to the fields of Artificial Intelligence in Education by defining reasoning and decision making process based on the principles of visual art schema theory and by designing a visual art schema-based pedagogical agent to support industrial designer's conceptual understanding; sketching by demonstrating the application of learning theories to inform the design of intelligent coaching systems; and Knowledge-based systems by demonstrating the feasibility of frames as the representation formalism in Conceptual Design Coaching Systems, and by proposing some original mechanisms for using frames to design pedagogical agents.

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**Name :** Wan Jamarul Imran Bin Wan Abdullah Thani, PhD  
**Title :** Electronic Technology As An Artistic Medium In The Malaysian Visual Arts Practices  
**Faculty :** Art & Design  
**Supervisor :** Associate Prof. Dr. Mustaffa Halabi Bin Hj Azahari (MS)

well as the progress. This research was employed the qualitative research methodology, which focuses on interviews and documentation analysis as a data collection. From the research has shown that there were significance values in the approach and practice of electronic technology in art practices. These significance values involve several factors such as the artists' tendency, establishment, and current factors of technological developments. Therefore, the research asserts that the practice of electronic artwork generates a potential visual art development in Malaysia. In this research the essential elements such as function and purpose of electronic technology to the artist as well to the art practices were outlined. It also forwarded a comprehensive documentation on the development of electronic arts in Malaysia. Practically, this research contributes to the development of Malaysian contemporary art.

Presently, the approach of electronic technology in art practices and the creation of electronic artwork in the Malaysian Art Scene are considered a common scenario. Most artists who practice on electronic artwork have made the electronic technological medium as an expansion of existing media in visual art practices. This research explores the approach of electronic technological medium in the practice of electronic artwork. The purpose of the research is to develop a better understanding on the significance of electronic technology in art practices as

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**Name :** Fathi Farag Mughrabi, PhD  
**Title :** Biological Activities Of Dithiocarbazate Schiff Base Derivatives On Normal And Diabetic Rats  
**Faculty :** Applied Sciences  
**Supervisor :** Associate Prof. Dr. Harifa Binti Hashim (MS)  
 Prof. Dr. Hapipah Binti H. Mohd Ali (CS)

The present study was performed to evaluate the acute toxicity, anti-ulcer, wound healing, antioxidant and antibacterial activities of a Schiff base namely benzyl N'-(indol-3-ylmethylidene)-hydrazinecarbodithioate (BIHC) and its metal complexes, BIHCZn and BIHCNi. The three compounds namely BIHC, BIHCZn and BIHCNi are subsequently collectively referred to as BIHCD. Acute and subchronic toxicity investigation of BIHCD did not show any signs or symptoms of toxicity and all animals remained alive.

Blood biochemistry, hematology, and histopathology analysis did not show any significant differences between control and treated groups. BIHCD appears to be safe and no drug-related toxicity was detected even at the highest dose investigated (400mg/kg). Antiulcer activity of BIHCD against ethanol-induced gastric ulcer was studied. Gastric juice was collected for the determination of pH and mucous weight. Grossly, the ulcer control group exhibited severe mucosal injury, whereas pre-treatment with either derivative compounds or Omeprazole resulted in significant protection of gastric mucosal injury. Flattening of gastric mucosal folds was also observed in rats pretreated with BIHCD. Histological studies of the gastric wall of ulcer control group revealed severe damage of gastric mucosa, along with oedema and leucocytes infiltration of the submucosal layer compared to rats pre-treated with either BIHCD or Omeprazole where there were marked gastric protection along with the reduction or absence of oedema and leucocytes infiltration of the submucosal layer. BIHCD and its derivatives promote ulcer protection as ascertained by the comparative decreases in ulcer areas, reduction of oedema and leucocytes infiltration of the submucosal layer. Topical application of BIHC and its metal complexes on the wounds in normal and diabetic rats showed that wound dressed with BIHCD healed significantly earlier than those treated with 10% Tween 20. Also, wound dressed with 100 mg/ml BIHCD showed an accelerated rate of wound healing compared to wounds dressed with Intrasite gel (control), 25 mg/ml, 50 mg/ml and 100mg/ml BIHCD. Histological analysis of healed wound with BIHCD showed less scar width at wound enclosure and granulation tissue of healed wound contained comparatively less macrophages and large amount of collagen with angiogenesis compared to wounds dressed with 10% Tween 20. Based on the antioxidant activity studies, samples appear to contain low antioxidant properties compared to controls (Trolox, Retin, Ascorbic acid and Gallic acid). For the antibacterial activity, BIHCD appears to possess potential antibacterial activity against *Staphylococcus aureus* *Pseudomonas aeruginosa*, *Klebsiella Phenumoniae* but none against *Streptococcus Group A*. Determination of minimum inhibitory concentration values showed that BIHCD have less potential antibacterial activity than Gentamicin.

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**Name :** Zuraida Binti Khusaimi, PhD  
**Title :** Synthesis And Characterisation Of Low-Dimensional Zinc Oxide Nanostructures By Solution-Immersion And Mist-Atomisation  
**Faculty :** Applied Sciences  
**Supervisor :** Associate Prof. Dr. Mohamad Rusop Mahmood (MS)  
 Prof. Dr. Saifollah Bin Abdullah (CS)  
 Associate. Prof. Dr. Norbani Binti Abdullah (CS)

Zinc oxide (ZnO) nanostructures on gold-seeded silicon (Si) substrate were prepared using a low-temperature solution-immersion method. Optimised ZnO structures were then used as a template to grow a second layer of ZnO nanostructures by mistatomisation method. Low-dimensional, vertically-aligned ZnO nanorods were successfully synthesised by the solution-immersion method through optimisation of the reaction parameters, such as concentration of precursor, ratio of stabiliser, alignment of substrate in solution, heating medium, gold-seeded substrates and its thickness, transition metal-seeded substrates, immersion temperature and time, pH of precursor solution, annealing temperature and doping with Mg. SEM, FESEM, TGA, FTIR, XRD, EDX, PL-Raman and I-V were the selected characterisation tools to analyse the structural, morphological, bonding, optical and electrical properties of the nanostructures. TGA and FTIR analyses gave evidence that the prepared

ZnO nanostructures were pure with no traces of starting material or contamination. The results give evidence that 6 nm thickness of gold-seeded on Si substrate immersed for 4 hours at 70°C in precursor concentration of 0.005 – 0.05 M zinc nitrate hexahydrate ( $Zn(NO_3)_2 \cdot 6H_2O$ ) and hexamethylenetetramine (HMTA) at 1:1 ratio has successfully formed (002) plane, c-axis, aligned ZnO nanorods with diameter of approximately  $60 \pm 20$  nm. The nanorods prepared at low immersion temperatures were found to be readily crystalline with no additional heat treatment. Precursor solution of pH 6.8 and 5 produced ZnO nanorods, while at pH 9 produced ZnO flower-like structures. 1 atomic % of Mg-doped ZnO nanorods were found to produce the highest electrical conductivity relative to as-prepared ZnO, and higher doping content of 3, 5, 7 and 9 atomic %. PL emission spectra of ZnO nanorods consistently produced UV (362-388 nm) and visible emissions (400-800 nm), confirming the formation of a semi-conducting ZnO. The relevant chemical equations were suggested throughout the study, while a novel growth mechanism of ZnO nanorods on gold-seeded Si was proposed. The optimised thin-film of ZnO nanorods was applied as a seeding template for the growth of ZnO nanoparticles deposited by mist-atomisation method, and was found to form the smallest crystallite size of 6.34 nm at substrate temperature of 400°C. The chamber box, which was specially designed to contain the mist, was found to be practical, functional and an effective invention. The mist-atomisation deposition of ZnO produced nanogranular structures in the range of 50-120 nm.

\* (MS) = Main Supervisor  
 (CS) = Co Supervisor

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**Name :** Mohd Zahid Bin Abidin, PhD  
**Title :** Optimisation Of Emulsion-Based Edible Coating And Development Of Coating Applicator Machine For Postharvest Life Study Of Guavas (*Psidium Guajava* L.)  
**Faculty :** Applied Sciences  
**Supervisor :** Associate Prof. Dr. Cheow Chong Seng (MS)  
 Associate Prof. Dr. Norizzah Binti Abd Rashid (CS)

Application of edible coating represents a method that can extend the shelf life of picked guava by minimising the weight loss mainly due to natural migration process of moisture and gases. Response surface methodology (RSM) was employed to search for best composition of edible coating comprised of three variables namely palm stearin, palm kernel olein and beeswax. The RSM was also used to investigate the influence of temperature of coating emulsion and dipping time on the coating pickup for the optimisation of coating process condition. From the RSM-generated model, optimum coating composition for minimising guava weight loss was 4.5% (w/v) palm stearin, 1% (w/v) palm kernel olein and 1% (w/v) beeswax. The RSM predicted and experimental weight loss (7%) were not significantly different from each other. The weight loss of uncoated guava was 19% or 2.7 times higher than the coated guava as measured on the 7th day at ambient storage (25-27°C, RH 80-90%). The optimised process condition for coating application was at 63°C temperature of coating emulsion and 15 s dipping time in minimising the coating pickup to 0.15% by the coated guava. A coating applicator was designed, fabricated and evaluated based on dipping technique. It was built as a model to meet the functional requirement of coating application on guava fruits based on the optimised coating emulsion and process condition. The machine comprises of 7 major components, namely conveyor chain, motor, dipping tank, heater, blower, controller and receptacle. The coating applicator had an estimated coating capacity of at least 270 fruits/h and coating emulsion usage of 1 kg/1740 guava fruits. Delay in senescence and metabolic activities of coated guava were indicated by lower changes in weight loss, firmness, surface colour development, titratable acidity, total soluble solid as well as CO<sub>2</sub> concentration compared to uncoated guava. In terms of sensory evaluation, the panellists significantly (P<0.05) preferred the colour and texture of the coated guava and the sweetness and taste of the uncoated guava. However, the overall acceptability of the coated and uncoated guavas was comparable to each other evaluated on the 7th and 12th days at cold storage (12-13°C, RH 80-90%). Coated guavas could be stored for up to 10 days at ambient condition and 30 days in cold storage. Application of emulsion-based edible coating developed in this study, in combination with coating applicator machine and cold storage seems to be a promising way to extend the storage life and marketability of the guava cultivar Vietnam/Cambodia; however, further work needs to be carried out on large scale trials prior to its commercial use.

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**Name :** Azira Binti Abd Aziz, PhD  
**Title :** Carbon Nanotubes Growth From Camphoric Carbon Sources Using Transition Metal Catalysts  
**Faculty :** Applied Sciences  
**Supervisor :** Associate Prof. Dr. Mohamad Rusop Mahmood (MS)  
 Prof. Dr. Saifollah Bin Abdullah (CS)

This thesis covers the analysis of catalytic growth of carbon nanotubes (CNTs) under well-defined conditions, the optimization of the catalyst and introduces model for the growth mechanism based on the experimental results. Experimental investigations are presented to obtain a comprehensive picture on the catalytic growth of CNTs. The overall aim of this thesis is to deposit CNTs by the seeded catalyst method and the modified fluidized floating catalyst method by Chemical Vapour Deposition (CVD) and to investigate the effects of starting material and catalysts on the morphology and structure of the deposited CNTs. Camphor (C<sub>10</sub>H<sub>16</sub>O, crystalline state) and camphor oil (liquid state) are the precursor materials used as the source of CNTs. Transition metal (Fe, Ni, Co, Mn, Al, Mg) catalysts were prepared and the effect on their catalytic behavior were studied. Metal catalysts have been prepared by sol-gel method with or without support catalyst. Correlation between the catalyst particle size and CNT diameter has been the motivation to reduce the catalyst particle size down to nanoparticle size. Evolution of the catalyst particle size distribution during CNT synthesis

is inevitable due to collision and evaporation of metal particles at high temperatures. In CVD the physical and chemical interactions between catalyst particle and support surface groups may be utilized in controlling the evolution of the particle size distribution. Physico-chemical properties of nanoparticles differ from the bulk values due to the high ratio of surface atoms to internal atoms. With varying catalyst loading with/without the catalyst support, the catalyst can form alloy and prevent the nanoparticles from segregating at high temperature. However, high fraction of the catalyst will form an isolated catalytic phase in the reduced catalyst. By controlling the mixture of catalyst can affect active catalyst particle, and also on the diameter of the CNTs. Catalytic carbon deposition reactions using camphor and camphor oil as the carbon containing feedstock have also been investigated over different type of transition metal catalyst with or without addition of support catalyst using seeded catalyst method and floating catalyst method. The CVD temperatures are varied between 650°C, 750°C and 850°C. Samples were characterized using a number of complementary techniques including, field emission scanning electron microscope (FESEM), Fourier Transmission Infrared (FTIR), X-ray diffraction (XRD) and Raman Spectroscopy. The findings from these techniques were used to explain the observed type and amount of carbon deposited. The subsequent studies of the morphology of the carbon structures grown by CVD revealed a significant influence of the deposition temperature and the catalyst material on the quality of the carbon structures. Fe/Ni/Mn was

\* (MS) = Main Supervisor  
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found to be the most active catalyst to deposit CNTs by using camphor while Fe/Co/Al with ratio (1:2:1) was found to be the most active catalyst for camphor oil using seeded catalyst method with the deposition temperature of 850°C. However, high quality CNTs have been produced by fluidized floating catalyst method in which the precursor (camphor oil) and the catalyst Fe/Ni/Mg are placed in the same boat at moderate temperature of 650°C. The activity of metal catalyst was found to be dependent on a number of factors; mass of the catalyst, deposition temperature and type of precursor. It was found, in all cases that increasing deposition temperature resulted in higher deposition rates. Based on those experimental results a mechanism for the growth of CNTs is suggested. Carbon precursor dissociated catalytically on the catalyst nanoparticles spread on the catalyst boat. In the first stage, the carbon material reduces the metal oxide nanoparticles to pure metal. The further catalytic dissociation of carbon material presumably takes place at facets of well-defined crystallographic orientation and the carbon diffuses into the particle. The resulting density gradient of carbon dissolved in the particle drives the diffusion of carbon through the particle. In order to avoid dangling bonds, the carbon atoms assemble at a less reactive facet of the particle, which leads to the formation of a nanotube. Thicker nanotubes at higher temperatures are generated due to the dissociation of carbon material in the gas phase, which leads to the formation of carbon molecules that condense on the catalytically grown structures. Strong catalyst interaction between the catalysts is thought to be the dominant factor in improving the nanotube growth. In addition, the formation of a catalyst alloy is also possible in enhancing reactivity of the catalyst for the optimum growth of CNTs.

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**Name :** Suriani Binti Abu Bakar, PhD  
**Title :** Controlled Growth Of Vertically Aligned Carbon Nanotubes From Palm Oil Precursor Using Thermal Chemical Vapour Deposition Method And Its Field Electron Emission Properties

**Faculty:** Applied Sciences

**Supervisor :** Associate Prof. Dr. Mohamad Rusop Mahmood (MS)  
Prof. Dr. Saifollah Bin Abdullah (CS)  
Associate Prof. Dr. Roslan Bin Md Nor (CS)

Vertically aligned carbon nanotubes (VACNT) were synthesized using palm oil as an environmentally friendly starting material. The synthesis was carried out in a thermal chemical vapour deposition reactor. Parametric studies were done to determine the optimum parameters to obtain VACNT with favourable properties at high volume. The parameters included seeded and floated catalyst preparation method, stacking substrate configuration (lower and upper growth), synthesis temperature (700-900°C), palm oil vaporization temperature (300-600°C), synthesis time (5-90 min), different carbon precursor (palm oil and waste cooking palm oil), substrate positioning (position 1-6), ferrocene concentration (0.67-5.33 wt%) and different carrier gas (argon and nitrogen). The carbon nanotubes (CNT) products were then characterized using several analytical techniques which were electron microscopy, energy dispersive x-ray analysis, micro-Raman and Fourier transform infrared (FTIR) spectroscopy, thermogravimetry analysis (TGA) and CHNS-O analysis. Prior to the synthesis process, several analyses such as TGA, gas chromatography-mass spectrometry and FTIR characterizations were done on the carbon precursor namely palm oil and waste cooking palm oil in order to facilitate the optimization procedures of VACNT. For every synthesis parameter, the nanotubes growth rates were measured and the nucleation as well as termination factor were investigated. CNT diameter, degree of alignment, crystallinity and purity were extensively studied as they were found to be greatly affected by the synthesis parameters.

Based on the inspection of the morphology and crystallinity of CNT it was found that the following parameters can be considered as the optimized parameter to produce higher quality of bulk VACNT in our reactor; the floated catalyst and lower growth approach at the synthesis temperature in range of 750-800°C, precursor vaporization temperature in the range of 400-500°C, the synthesis temperature of 15 to 35 mins, sample position at P2 and P3, and ferrocene concentration of 1.33 - 5.33 wt%. Synthesizing VACNT within nitrogen ambient produces higher VACNT growth rate with considerably more bamboo-like structure as compared to argon ambient. In this study, we have also demonstrated that waste cooking palm oil from domestic frying can be utilized as an efficient, economical and environmentally friendly carbon source for VACNT and bulk CNT synthesis. A mixed bottom-tip growth model has been proposed for the floated catalytic CVD synthesis with the bottom growth mechanism was believed to take place in the early stage of the synthesis. The VACNT growth can also be initiated by the yarmulke growth mechanism. The yarmulke growth has been used to explain the presence of tubes with bamboo-type structure. By examining CNT synthesized under different conditions, it was found that an amorphous carbon coating of roughly 8 nm within 6 min synthesis time was sufficient to completely terminate the growth. However in a controlled condition, the growth was not expected (not) to terminate even though for 1 hour synthesis time. We also assessed the potential of palm oil based VACNT as field emitter by measuring its field electron emission (FEE) properties. Field emission from the VACNT synthesized within nitrogen ambient at 2.5 wt% ferrocene concentration indicated the lowest turn-on field at 2.95 V $\mu\text{m}^{-1}$  which corresponded to the current density of 10  $\mu\text{Acm}^{-2}$ . The threshold field was observed to be about 3.55 V $\mu\text{m}^{-1}$  at 1  $\text{mAcm}^{-2}$ . The maximum current density of 7.30  $\text{mAcm}^{-2}$  measured was obtained for 4.30 V $\mu\text{m}^{-1}$  and good emission stability with low degradation. Electrode separation of 200  $\mu\text{m}$  gave the best FEE performance and smaller or larger electrode separations gave inferior results. It can be concluded that the VACNT from the bio-hydrocarbon precursor palm oil was stable for applications in field emission devices such as flat panel displays and flat lamps.

\* (MS) = Main Supervisor  
(CS) = Co Supervisor

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Name : **Ahmad Zafir, PhD**  
 Title : **The Preparation And Characteristics Of  
 Chicken Feather/Epoxy Composites**  
 Faculty : **Applied Sciences**  
 Supervisor : **Associate Prof. Dr. Mohd Hanafiah Bin  
 Abidin (MS)**  
**Dr. Hazizan Bin Md. Akil (CS)**

The uses of the natural fibre in the fabrication of the composites are being studied all over the world. Most of the fibre used comes from trees. In this research, the fibre or filler used is obtained from chicken feather. The chicken feather was washed and pulverised to obtain a shorter and uniform fibre. Few tests were carried out as to ensure the processed chicken feather will not degrade due to the washing and drying. The tests are the Thermal

Gravimetric Analysis and optimising drying time. The pulverised chicken feather was mixed with the epoxy resins and undergo a fabrication process called 'pressure assisted' hand-layup techniques and this requires a steel mould. The amount of pulverised chicken feather were varies at 10%, 20%, 30% 40% and 50% by weight. The sample (chicken feather composites) comes out from the mould has a dimension of (25 X 25 X 3)mm and was cut using a precision cutter to form the required sample for the physical and mechanical test. The physical test involves are the water absorption test and the density test. Tensile, 3-point bending and impact test were used to evaluate the mechanical properties of the chicken feather composites. For the comparison purposes, sample from the vein and the main shaft of the chicken feather was also fabricated (10% and 50% by weight). The water absorption test shows that with the increase percentage of the chicken feather cause an increase in the water absorption properties. The density test reveals something interesting whereby the chicken feather fabricated confer to two theoretical densities that is the bulk (0.8g/cm<sup>3</sup>) and the keratin (1.21g/cm<sup>3</sup>). This behaviour gives a significant effect towards the mechanical properties. The tensile and 3-point bending test shows a decreasing pattern of the strength value as the percentage of the chicken feather increases but the strength are comparably the same after 30% of chicken feather loading. The impact test on the other hand shows an increasing pattern with the increase of chicken feather loading. From all the test that was carried out, a simple correlation studies was carried out and it shows that it is in-significant to separate the main shaft and the vein of the chicken feather in order to obtain an overall good mechanical properties for the chicken feather composites. From the research that was carried out, it shows that the higher the chicken feather loading (30% and above), it will give good overall performance for the mechanical properties and also increased the water absorption behaviour.

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Name : **Misbah Binti Hassan, PhD**  
 Title : **Effects Of Hot-Spot Temperature,  
 Microstructure And BaA12O4 Addition  
 On Oxygen Sensing Properties Of  
 REBa<sub>2</sub>CU<sub>3</sub>O<sub>7</sub>-δ(RE=Er, Dy) Ceramic Rods**  
 Faculty : **Applied Sciences**  
 Supervisor : **Prof. Dr. Ahmad Kamal Hayati Bin Yahya  
 (MS)**  
**Associate Prof. Dr. Umi Sarah Binti Jais (CS)**

Oxygen sensing properties of REBa<sub>2</sub>Cu<sub>3</sub>O<sub>7</sub>-d-based (RE123, RE = Er and Dy) ceramics utilizing the hot spot phenomenon have been investigated. Although shorter rods of around 12 mm are more practical for industrial use compared to previously reported rods longer than 30 mm, their oxygen sensing properties have not been previously reported. Bulk 123 materials were synthesized using the conventional solid-state method and fabricated into short rods of around 12-mm length with cross sectional area of

0.65 mm ´ 0.65 mm. In the first part of this study, influence of hot-spot temperature in the range of 160 °C to 810 °C on oxygen sensing behavior of Er123 rods was studied. Simultaneous measurements of hot-spot temperature and output current response in different oxygen partial pressures between 1 % and 100 % with hot-spots operating at temperatures as low as 660 °C in 1 % oxygen partial pressure produced good sensor current stability as well as repeatability. Response time for oxygen sensing was observed to decrease with increasing hot-spot temperature, with minimum value of 0.50 s recorded at 695 °C in 1 % oxygen partial pressure. In addition, a large change in activation energy of oxygen ion migration from 2.8 eV to 0.626 eV was established at around 670 °C. By using wider Er123 rod, it was demonstrated that hot spot formation starts from local heating at a point of defect before growing in size. In the second part of this study, performance test of the sensor from as low as 0.025 % pO<sub>2</sub> to 100 % pO<sub>2</sub> showed very good repeatability and stability of output current. Electrical conductivity for pO<sub>2</sub> from 5 % to 100 % showed good proportional relation to pO<sub>2</sub><sup>1/6</sup> and in agreement with the mass action law. In the third part of this

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study, effect of addition of BaAl<sub>2</sub>O<sub>4</sub> on the durability of Er123 rods was studied. It was found that although durability was enhanced, the addition also increased minimum power consumption of Er123 rods. Interestingly, further addition of BaAl<sub>2</sub>O<sub>4</sub> from 5 to 30 wt.% has resulted in a reduced minimum power consumption from 1.23 to 1.16 W. Compared to using longer Gd123 rods as reported in a previous study, using Er123 with 30 wt. % BaAl<sub>2</sub>O<sub>4</sub> has proven to lower minimum power consumption by at least around 42%. Addition of BaAl<sub>2</sub>O<sub>4</sub> also reduced the fluctuation of current and increased the sensitivity for below 10 % pO<sub>2</sub>. In the fourth part of this study, oxygen response of hot spot on Dy123 ceramic rods fabricated under different heat treatments has also been studied. It was observed that increasing the sintering temperature from 900 °C to 960 °C reduced the voltage at peak current by half but only slightly reduced the power consumption. In terms of durability the best performance is shown by the sample which was sintered for 48 hours at around 900 °C. The sample which was reheated at around 910 °C for 24 hours after being fabricated into rod shape showed the largest reduction in voltage at peak current and the lowest in power consumption but it was the least durable. The effect of heat treatment on I-V behavior was discussed in terms of differences in microstructure and initial oxygen content of the samples. These studies have shown that stability of hot-spot based oxygen sensing properties of shorter RE123 rods of around 12 mm in length is influenced by hot-spot temperature, addition of BaAl<sub>2</sub>O<sub>4</sub> as well as changes in microstructure as a result of differences in heat treatment. Electrical conductivities of the rods involve oxygen ions and obey the mass action law. At the end of this study, a qualitative model of a special material to control maximum hot-spot temperature based on the temperature at maximum resistivity of the rod material for ceramic rods with hot spot has been proposed.

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**Name :** Abang Zainoren Abang Abdulrahman, PhD  
**Title :** Dimension Of Customer Preference In The Malaysian Foodservice Industry:the Relationship With Customer Satisfaction And Loyalty  
**Faculty:** Business Management  
**Supervisor :** Dato' Prof. Dr. Jamil Bin Hj Hamali (MS)  
Associate Prof. Dr. Firdaus Bin Abdullah (CS)

Today's foodservice industry management must place a high priority on understanding the growing markets, as a result of rapid urbanization and rising numbers of tourists. This fast growing industry has a huge influence on the global economy, however it is greatly affected by customers' ever-changing preferences. It is essential for managers to gain and sustain strategic advantage in the highly competitive industry due to the low entrant barrier. However to be competitive in this industry requires a local customer preference assessment. Most studies in this area are from outside Malaysia, subsequently they might not be appropriate for any strategy development that will improve customer satisfaction and loyalty in the Malaysian setting. This thesis presents the dimensions of customer preference in the Malaysian foodservice industry in rank order and proposes the framework of customer preference in the Malaysian foodservice industry. A questionnaire was constructed using 30 items related to customer preference, and distributed to 1000 foodservice

customers, yielding a response rate of 64.2%. Factorial analysis involving exploratory factor and confirmatory factor analysis highlighted five new dimensions which critically determine customer preference. The five dimensions in order of importance are Halal, Price, Quality of Service, Branding and Tangibles. A Multiple Regression analysis indicates that all the dimensions contributed significantly towards explaining the variance in the overall customers' satisfaction level except for Tangibles. The findings also suggest that the correlation between customer satisfaction and customer loyalty is positive and high. However, the other findings highlight that race has consistent influence over the five dimensions compared to other customer demographic profiles. The open ended question indicates that most of the weaknesses that need to be improved are related to quality of service. Likewise, the strengths of the foodservice industry are associated with Price and Tangibles. This thesis also offers crucial strategies that can be guidelines for practitioners and authorities in enhancing the foodservice industry in Malaysia. Hence the framework of customer preference is proposed, encompassing the five dimensions. Using the framework as the guideline, the following specific strategies are recommended; adopting halal as a marketing strategy, developing effective pricing methods, emphasis quality of service, identifying a creative branding strategy, and promoting the importance of ambience and service support system.

\* (MS) = Main Supervisor  
(CS) = Co Supervisor

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**Name :** Akmal Aini Binti Othman, PhD  
**Title :** Modelling Marketing Resources, Procurement Process Coordination Firm Performance In The Building Construction Industry: The Integration Of Resource Based View And Coordination Theories  
**Faculty:** Business Management  
**Supervisor :** Prof. Dr. Sofiah Binti Abd Rahman (MS)

The construction industry is a complex and the most people-intensive sector in the national economy. While it forms a major pillar to a nation's socio-economic development, past studies have found that this industry, with particular reference to the building materials resources, were not sufficiently managed, leading to a waste of bad material management with time and cost overrun. Problems in the inaccuracy of data, unplanned deliveries, wrong and defective deliveries for instance, require the supply chain members to be coordinated. In view of this, there is a need to investigate the procurement process coordination (PPC) between the contractor and his building materials suppliers, focusing on the opportunities of the improvement in operational and customer performance. Thus, the present study looked into the coordination between the construction firm and its main building materials suppliers to allow for greater understanding in the field of supply chain management (SCM). Drawing upon two theories namely Resource Based View (RBV) and Coordination Theory (CT), it also analysed the relationship of the three critical constructs; marketing resources, PPC and firm performance. This study intended to shed light into the potential implication of the link in a more coherent and integrated approach particularly from the lens of construction supply chain. With this backdrop, the objective of the study was formulated to establish a

link between these constructs (marketing resources, PPC and firm performance) and their dimensions as well as to examine the mediating role of PPC on this link. This study contributes to the new knowledge by detailing the activities involved in PPC instead of testing it in a general setting. Data for this study was gathered through a survey questionnaire. The analysis was conducted using Structural Equation Modelling (SEM) technique by examining two competing models that represent full and partial mediation. The findings revealed that marketing resources have positive and significant effects on PPC dimensions. It was also found that PPC fully mediates the relationship between marketing resources and firm performance. Result from the Sobel test provides evidence that joint operational planning and supplier relationship development appeared to confirm their role as mediating factor in the relationship between marketing resources and firm performance. In other words these two dimensions of PPC facilitate the conversion of marketing resources into firm performance. This finding was consistent with the movement of the industry players towards 'best practices' which emphasised on SCM, client orientation and innovativeness. Following these findings, a number of implications are offered for the construction industry. First, construction industry players should adopt and emphasis on such orientations in order to enhance their performance particularly with the operational and customer performance. Second, PPC, in particular joint decision planning and supplier relationship development provided greater room for understanding on the impact of marketing resources on the effectiveness and efficiency of the construction supply chain. Finally, the industry players must act upon the importance of marketing resources in order to optimise their supply chain coordination capability.

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**Name :** Mohammad Nazri Mohd Nor, PhD  
**Title :** The Relationship Between Students' Absorptive Capacity And Motivation, And Knowledge Transfer Effectiveness In Malaysian Community Colleges  
**Faculty:** Business Management  
**Supervisor :** Associate Prof. Dr. Norzanah Mat Nor (MS)  
 Associate Prof. Dr. Norzaidi Mohd Daud (CS)

absorptive capacity and motivation, and knowledge transfer effectiveness in Malaysian community colleges. A total of 387 self-administered questionnaires were sent in August 2010 to respondents in 18 colleges by using cluster random sampling technique. With a valid response of 87 per cent (338 respondents), descriptive, multiple and hierarchical regression analyses were conducted using the Statistical Package of Social Science (SPSS) version 17.0. With regard to its main objective, empirical evidence indicated that hypotheses in relation to both students' absorptive capacity and motivation effect on knowledge transfer effectiveness were statistically significant. For subsequent objectives, parental involvement was found to have a statistically significant positive moderating

Apart from public and private universities, community colleges serve as alternative paths for SPM school leavers to further their education. However, low community colleges students' previous academic achievement and the fact that the students formed the highest rate of graduate unemployment among other higher learning institutions have raised questions on the effectiveness of knowledge transfer in Malaysian community colleges. Thus, the main objective of this study is to determine the relationship between students'

\* (MS) = Main Supervisor  
 (CS) = Co Supervisor

impact on the relationship between students' absorptive capacity and knowledge transfer effectiveness except for students' motivation. However, lecturer support showed no statistically significant moderating impact on both of the relationships. The results suggest that students' absorptive capacity and students' motivation need to be improved to increase the effectiveness of knowledge transfer, such as by providing more encouragement, awareness and effective intervention programmes. In addition to that, though there was only one situation where moderating impact of parental involvement was significant, in reality the impact of lecturer support and parental involvement in increasing knowledge transfer effectiveness may have a different bearing. Hence, this needs to be investigated further in future research. In a nutshell, this study could provide insights and understanding towards improving knowledge transfer effectiveness in Malaysian community colleges which is important for enhancing students' academic performance and their future job prospects. At the same time, the perceived academically underprepared students will not be left out in the quest for better knowledge that would enhance economic development of the nation. Producing better quality students would help improve the Malaysian community colleges' image and increase the employment prospects among its graduates. Indeed, this would help to produce credible higher learning institutions and indirectly help Malaysia to leap forward towards becoming a developed nation.

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**Name :** Jamaliah Binti Mohd Yusof, PhD  
**Title :** The Effects Of Self-Congruity, Functional Store Image, And Social Responsibility Image On Store Loyalty  
**Faculty:** Business Management  
**Supervisor :** Prof. Dr. Sofiah Binti Abd. Rahman (MS)  
Associate Prof Dr Rosidah Musa (CS)

The concept of image of a retail store has received greater attention by researchers since last few decades. Its usefulness as the basis of various customer behavioral outcomes such as loyalty, patronage intention, purchase intention, and repatronage intention are widely acknowledged from previous empirical studies. Meanwhile, in the retailing environment, the intensified competition among retailers which has long become the challenge for success has required retailers to focus their marketing activities on the basis of their marketing mix which is reflected by its image as perceived by customers. In that regard, within the constantly evolving business landscape, the focus of academic research and by practitioners on the concept of store image has undergone rapid growth over the decades and accordingly, is the primary focus of this study. This study was mainly aimed at understanding the perceptions of Malaysian consumers to the image of the store, which in turn examined its effect on store loyalty. Self-Congruity theory was employed as a theoretical foundation for developing the present conceptual model. More significantly, this study investigated the symbolic store image and self-image congruence, functional store image and social responsibility image relationships in addition to shopping orientations and past shopping experience as antecedents. Accordingly, the data for this study was collected from a sample of consumers in the Klang Valley using drop-off and collect technique. Shopping behavior of respondent from 565 usable questionnaires was analyzed. Using structural equation

modeling, the data was analyzed and it provides the empirical findings for the thesis. Specifically, ten of the hypotheses links were supported and two rejected. With some minor modification of the hypotheses links, a plausible model that has a statistical and explanatory power for interpretation of results confidently was established. The findings should provide several key contributions to the marketing and retailing theory as well as retail practitioners. Firstly, it identified atmosphere as the key determinant of functional store image, and legal and ethical aspects as the main influencing factor of social responsibility image. Additionally, actual congruity emerged as the most influential determinant of store image and self-image congruence. Secondly, the findings also suggest that among the three image constructs, functional store image remains as the key determinant of store loyalty while there is no relationship between self-congruity and store loyalty. Nevertheless, the self-congruity relationship with store loyalty was mediated by functional store image and social responsibility image. Interestingly, social responsibility image illuminated its contribution to store loyalty. Notably, shopping orientations and past shopping experience also exhibit a significant positive relationship on image constructs. Two new paths that link between shopping orientations and past shopping experience with self-congruity were supported. Past shopping experience appears to be a stronger determinant of functional store image and social responsibility image. Whilst shopping orientations has a stronger influence on self-congruity. The result also provides strong evidence of the relationship between past shopping experience and store loyalty. The findings in this study form part of the strategic recommendations to retailers in the face of competition. Apart from providing empirical results in understanding the Malaysian retailing industry, the findings also established an empirical foundation for future research.

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**Name :** Rezian-na Binti Muhammed Kassim, PhD  
**Title :** Determinants And Consequences Of Total Spectator Experience (Tse): Empirical Evidence From A Sport Tourism Event Formula One (F1)  
**Faculty:** Business Management  
**Supervisor :** Associate Prof. Dr. Rosidah Musa (MS)  
 Prof. Dr. Rosmimah Binti Mohd Roslin (CS)  
 Associate Prof. Dr. Kwame Ampofo Boeting (CS)

wave of interest on the conceptualization and measurement of total spectators (customers) experience been vigorously conducted by the marketers and academic research to understand the factors that trigger their memorable experience and has influence on continue attending the special event. These waves have caused a recent surge in research that has explored many aspects of experiences' consumption. However, existing sport or tourism research has provided little explanation of the factors that portray the spectators' experience. The purpose of this study was to develop valid and reliable cues of Total Spectators' Experience (TSE) Scale and to examine the relationship among TSE, emotion, satisfaction and loyalty. This study applies Environmental Psychology Model (Mehrabian-Russell

Mode, 1974) to a sample of 424 sport spectators from Sport Motor Mega Event. Based on the literature, a theoretical model was developed and tested using data collected from spectators attending a major motor sports event (Formula One). The research design of this study also applies the focus group, exploratory, descriptive, convenient sampling and cross-sectional method. The data was collected using survey questionnaire and data analyzes was tested using structural equation modelling (SEM) via AMOS (Analysis of Moment Structures) software package Version 18.0. Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were performed to validate the scales. All major goodness fit indices showed that the models acceptable. From eight (8) hypotheses only six (6) were accepted. Result of hypothesizes model acceptable fit was CMIN/DF=2.822, RMSEA=0.066, GFI = 0.914, AGFI = 0.901, IFI= 0.913 and CFI=0.912. The findings from this study point to support the M-R model in sport tourism setting. The results showed the overall TSE significantly contributes to spectator's emotion, satisfaction and loyalty. On the other hand, spectator's satisfaction had a negative effect on loyalty simultaneously. Discussions of the results are provided along with implication for the event organizers and government and recommendations for future research.

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**Name :** Zainuddin Bin Zakaria, PhD  
**Title :** The Influence Of Market Orientation And Relationship Quality On Relationship Outcome Between Public Universities And Their Associated Colleges In Malaysia  
**Faculty :** Business Management  
**Supervisor :** Prof. Dr. Rosmimah Binti Mohd Roslin (MS)  
 Associate Prof. Dr. Yeop Husin Bidin (CS)

market orientation. A field survey, using questionnaire as the main instrument is the chosen method of collecting data from the management team of both public universities and their associated colleges throughout the country. Samples were chosen from the private colleges using purposive sampling while all the management staff of the public universities was chosen as the respondents. At the end, two hundred seven respondents from 33 private HLLs and 59 respondents from seven public universities that included branch campuses participated in the survey. Findings of the Multiple Regression Analysis revealed a mixed result. Even though all hypotheses were accepted, some variables did not indicate the relationship as expected. The level of affective commitment is influenced by benevolence, perception of partner's market orientation and credibility while the changes in calculative commitment are associated with the changes in benevolence and market orientation.

This thesis is the culmination of more than three years of effort to study the elements and factors that are able to influence the quality of relationship. The core elements identified in the conceptual model are trust and commitment. Together with three dimensions of relational norms, these variables are hypothesised to influence the economic, non-economic satisfaction and the intention of the partners to continue their relationship in the future. Two antecedents have also been identified in the conceptual model, namely are the organisation's perception of its own market orientation and their perception of their partners'

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Both elements of trust (benevolence and credibility) are influenced by the changes in the partners' affective commitment and their own market orientation. Affective commitment, participation and credibility are discovered to have an impact on the changes in both economic and non-economic satisfaction. Calculative commitment on the other hand had influenced only the economic satisfaction, while solidarity only influences the changes in non-economic satisfaction. The intention of the higher education institutions to renew their contract is only influenced by both economic and non-economic satisfaction felt by both institutions and both types of commitment, i.e. calculative and affective commitment. The t-test revealed that two variables, the participation norms and affective commitment showed by the public universities and the private colleges had a significant difference. These findings revealed that market orientation is an important antecedent in influencing the levels of trust and commitment. Trust and commitment showed a reciprocal nature in the higher education alliance. Solidarity, Participation and Flexibility norms are proven an important variable in the commitment trust model and are influential in affecting the relational satisfaction and intention of both parties to renew their alliance. Management of both institutions would reap handsome reward if they incorporated market-oriented activities and improve their relational norms to ensure a long and fruitful alliance. In the end, strong alliances between the public universities and their associated colleges will benefit the citizen of the country who aspires to obtain tertiary education through the variety and accessibility of programmes. As more citizens are educated at the tertiary level, the vision of the leaders of the country to achieve the objectives of Vision 2020 of producing quality human capital will materialise.

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**Name :** Zarina Binti Denan, PhD  
**Title :** Absorptive Capacity And Performance In Malaysian Manufacturing SMEs  
**Faculty:** Business Management  
**Supervisor :** Prof. Dr. Noraini Ismail (MS)  
Prof. Dr. Noormala Dato' Amir Ishak (CS)

Many small and medium-sized enterprises (SMEs) presently evolve in a complex business environment characterized by globalization the internationalization of markets and the need for greater efficiency effectiveness and competitiveness based on innovation and knowledge. This has put increasing pressure upon the management of these firms especially manufacturing and technological SMEs that must now compete globally. Many entrepreneurial researches

have highlighted the significance of potential strategies, technological innovation, or entrepreneurial orientation in improving SMEs productivity. However, a few have identified the SMEs capabilities in knowledge process leading to excellent business performance. This research is concerned with identifying those answers through various knowledge capabilities that small business in Malaysia can adopt to enhance their performance, by employing the knowledge-based view approach. SMEs represent more than 95% of total manufacturing establishments in Malaysia, 75% of which encompasses textiles and apparel sector, food and beverages, metal and metal products, publishing, printing and reproducing of recorded media, furniture sector, rubber and plastics products and wood and wood products industry. Questionnaires were personally administered to 180 companies belonging to the above industries. Simple, multiple and hierarchical regression analyses were performed to examine relationships among the variables under study. The simple regression analysis suggested a significant and positive relationship between SMEs owners/managers' prior knowledge and absorptive capacity. The results also indicated that there was a significant and positive relationship between the SMEs owners/managers' prior knowledge and absorptive capacity. A positive and significant relationship between absorptive capacity and financial performance was also found. The other two performances (operational and innovation were found to have insignificant relationship with absorptive capacity. Hierarchical regression was utilized to test the impact of moderating variables, environmental dynamism, strategic planning formality and strategic decision making process on absorptive capacity-performance relationship. The study highlighted only strategic decision making process had some impact on absorptive capacity-operational performance relationship. The study also obtained significant and negative effect of strategic decision making process on absorptive capacity-innovation performance relationship. In summary, findings highlighted the importance of SMEs to develop their own knowledge-based not only for survival but to have sustainable competitive advantage.

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**Name :** Mas Anom Abdul Rashid, PhD  
**Title :** Electronic Government Maturity Stage, User's Adoption And User's Satisfaction Level  
**Faculty:** Business Management  
**Supervisor :** Associate Prof. Dr. Narehan Hassan (MS)  
 Associate Prof. Dr. Rudzi Munap (MS)

E-government is the use of information communication technology in deliver ring public service via internet (web-based). Western countries are convinced that the information society will result in economic and social benefits. The Organisation for Economic Cooperation and Development believes that information infrastructures are expected to stimulate economic growth, increase productivity, create jobs and improve the quality of life, and that is why Malaysia in its New Economic Model 2010 (NEM, 2010) has put government public service as the second pillar to upgrade the quality of the citizens' lives. To achieve e-government success, the government has to evaluate each e-government project at every government administration level, namely the federal, state, local and municipal. Since e-government at the state level is equally important to ensure the overall success of Malaysian e-government, this research has been conducted in Pahang, one of the states in Malaysia, to determine the extent of e-government implemented based on the United Nation E-Government Maturity Stage Model. The study covers the aspects of e-government maturity stage, infrastructure,

website quality, user's adoption and user's satisfaction level. The research design used in this study was the quantitative method based on the descriptive analysis of the website content, criteria set by MAMPU and the quantitative data from the surveys. A total of 16 websites which are directly administered by the state government had been chosen to be observed for two months. Questionnaires were distributed to 440 samples of the administrative staff at all the District and Land Offices in the state of Pahang to gain their responses. A total of 340 responses were received (77.3% response rate) and the results showed that e-government maturity level in Pahang was at the minimal level of the third stage of the UN-DEPA maturity model, which was the interactive stage. It was also found that infrastructures, website quality, i.e. content and usability as well as user's needs, trust and acceptance are the main predictors of user's satisfaction of e-government. The most common transactions performed in Pahang was getting news and information as well as downloading forms. To increase the level of e-government user's adoption, the state government has to develop more citizen-centric online services to ensure efficiency and effectiveness of the public service. The government has to continuously measure e-government maturity stage and user's satisfaction level as these will provide the indicator of the overall success of Malaysian e-government. The success of the New Economic Model's second pillar which is the Government Transformation Programme depends on the effectiveness and efficiency of e-government in delivering better public service as part of the government's effort to achieve Vision 2020.

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**Name :** Marina Binti Yusoff, PhD  
**Title :** Flash Flood Evacuation With Discrete Particle Swarm Optimization  
**Faculty:** Computer & Mathematical Sciences  
**Supervisor :** Prof. Dr. Azlinah Binti Mohamed (MS)  
 Prof. Ir. Dr. Junaidah Binti Ariffin (CS)

During flash flood evacuation processes, the most challenging task is to move people to safer locations. Uneven distributions of transport, untimely assistance and poor coordination at the operation level have always been the major problem in evacuation process. Currently, no proper procedure is available in managing the evacuation vehicle assignment problem (EVAP) and evacuation vehicle routing problem (EVRP). A discrete particle swarm optimization (DPSO) algorithm is proposed to solve the EVRP and the EVRP. Discrete particle position is proposed to support the implementation of the DPSO known as myVAP-A for the EVAP. Particle positions are initially calculated based on the average passenger capacity of evacuation vehicle. Computational experiments were done with different numbers of PFA using two types of sequences for vehicle capacity: random and sort ascending order. Both of these sequences were tested with inertia weight and constriction factor (CF). Performance of each vehicle allocation was analyzed in four variations namely myVAP-A using inertia weight with random vehicle capacity, myVAP-A using inertia weight with sort ascending order of vehicle capacity, myVAP-A using CF with random vehicle capacity, and myVAP-A using CF with sort ascending of vehicle capacity. Flash flood evacuation datasets from Malaysia were used in the experiment. myVAP-A using inertia weight with random capacity was found to give the best results compared to the other variations of experiment and outperformed a genetic algorithm (GA) with random vehicle capacity and a GA

with sort ascending of vehicle capacity in solving the EVAP. However, the problem of local minimum was determined, and this algorithm was enhanced to overcome this problem with the use of velocity clamping procedure known as myVAP-AVL. This procedure had shown some improvement, but nevertheless it failed to give an optimal solution, particularly for large dataset. Thus, a modification of this algorithm was done by applying a min-max approach and named as myVAP-MM. myVAP-MM was tested and analyzed using the same variations of experiment as in myVAP-A, and myVAP-AVL. myVAP-MMVL-WR outperformed all variations of experiment and the VAP-A and VAP-MM in fitness value and processing time for all datasets. It achieved an optimum solution and successfully avoided the local minimum problem for the EVAP. For EVRP, the step for finding the solution starts with the investigation of the solution for the shortest path problem (SPP). DPSO\_SPP algorithm was proposed using a new solution representation for SPP. The solution representation was incorporated with a search strategy and random selection of priority value. The purpose of this representation is to reduce the searching space of the particles, which has led to better solution. This solution representation was modified to accommodate the EVRP and embedded in the myVRP\_2 algorithm. The algorithm was tested using the EVRP dataset of road network for flash flood evacuation in Johor, Malaysia and compared with myVRP\_1 from the previous solution. Comparative analyses were carried on both myVRP\_2 and myVRP\_1 with the GA. The results indicate that the proposed myVRP\_2 are highly competitive and showed good performance in both fitness value (total travelling time) and processing time. The validation processes confirmed that myVAP-MMVL-WR showed good performance in maximizing the number of people to vehicles while myVRP\_2 gave good performance in minimizing the total travelling time from vehicle location to PFA. These algorithms have successfully solved the evacuation planning with a better solution quality (fitness value) and less processing time.

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**Name :** Noraini Binti Seman, PhD  
**Title :** Coalition Of Genetic Algorithms And Artificial Neural Network For Isolated Spoken Malay Speech Recognition  
**Faculty:** Computer & Mathematical Sciences  
**Supervisor :** Prof. Dr. Zainab Binti Abu Bakar (MS)  
 Associate Prof Dr Nordin Bin Abu Bakar (CS)

The automatic speech recognition (ASR) field has become one of the leading speech technology areas using artificial intelligence (AI) approaches. Despite all of the advances in the speech recognition area, the problem is far from being completely solved. Various methods have been introduced to develop an efficient ASR system. A variety of automatic knowledge acquisition or learning and adaptation concepts need to be established in speech recognition using AI approaches. These key concepts can only be implemented using artificial neural networks (ANNs) approach. However, traditional ANNs have many fundamental problems regarding a long and uncertain training process, which in most cases learning or training of a neural network is based on a trial and error method. Genetic Algorithm (GA) based learning technique provides an alternative way that involves controlling the learning complexity by adjusting the number of weights of the ANN. However, due to the stochastic nature of this algorithm, the learning process can reach an optimal solution with much higher probability than many standard neural network techniques. In this research, coalition of AI

learning techniques for the training of a feed-forward ANN has been proposed to increase the speech recognition performance for an isolated spoken Malay speech recognition system. The data collections contain manual segmentation signals of 5,000 (100 words with 50 repetitions) isolated Malay words which are most frequently uttered by the committee members of Parliament of Malaysia. The data collection is used to create an automated dataset through three different speech endpoints detection (SED) methods. Out of 5,000 words, 60% were used for training and the remaining 40% is divided equally for validation and testing purposes. The approach combines GA with second order gradient based learning algorithms, namely conjugate gradient (CG) methods to achieve optimum weights for hidden and output layers. The proposed method is to apply GA in the first layer and CG in the second layer of the ANN. The methodology also proposed to find optimum number of hidden neurons (HNN) using a hierarchical and dynamic connection strategies for combining weights in ANN architecture. Result shows that the network with coalition of mutation GA (mGA) and CG method produces 98.93% in terms of recognition accuracy and show more than 10% improvement when compared with standard GA and conventional ANN based learning algorithm. From the overall experiments, it can be concluded that the coalition of AI approach, which combines GA and CG algorithm gives highest improvement results in terms of recognition accuracy and less learning time performance for isolated spoken Malay speech recognition system respectively.

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**Name :** Nik Azmi Bin Nik Omar, PhD  
**Title :** A Comprehensive Assessment Framework For Mykad  
**Faculty:** Computer & Mathematical Sciences  
**Supervisor :** Prof. Dr. Saadiah Binti Yahaya (MS)  
 Dr. Kamarul Ariffin Bin Abdul Jalil (CS)

the benefit and one of these is using multi-application smartcard which included personal identification. This is followed by other governments from various countries that launched a multipurpose identification smartcard. However, at the same time, being in the forefront has its own shortfall especially in the area of ensuring that smartcard is protected from any security breach. MyKad is a multipurpose smartcard which was introduced by the Malaysian government to identify its citizens. It is of paramount importance that the Malaysian government attain the public confidence to ensure that MyKad is 'tampered proof' so as the public can accept in using the applications and services affiliated with it. To achieve this, MyKad must be evaluated and pass through an acceptable level of security certification process and be assessed to the various types of possible security breach such as information tampering and the cloning of MyKad. This thesis therefore proposed a new MyKad Testing Strategy model for logical attacks. Furthermore, a comprehensive security assessment framework was proposed in the implementation of the certification of MyKad aligning with the framework of Common Criteria (CC). In view of this, the proposed framework follows the requirements of Vulnerabilities Assessment test (AVA) of ISO/IEC 15408-3 of CC. The objective of this assessment test is to evaluate the potential factors that potentially threaten the security of MyKad. The security assessment test of MyKad includes the aspects of security of information stored and evaluates the mechanism of handling the open data and providing application access to work with MyKad in the secured manner for enabling multiple applications. The security test assessment deployed on MyKad was using the test strategy from Alain Merle (2005) and adopting the common criteria (CC, 2009). Four vulnerabilities have been disclosed from the security assessment of MyKad done in this study. The vulnerabilities are firstly, Application Protocol Data Unit (APDU) can be collected from MyKad; next, open data can be read using the APDU commands; thirdly, the open data can be written to another sample of smartcard by cloning the data in MyKad; and lastly, the assessment has successfully uncover the communication vulnerability of MyKad with Card Acceptance Devices (CAD) towards being tapped. The significance of this research will benefit the government; public and private sector by proposing testing strategy model and security assessment framework for MyKad. As for the future extension of this study, researcher should emphasize on the development of a new generic Software Development Kit (SDK), standards for Card Acceptance Device (CAD) and identification of certification body for CAD and SDK.

We have witnessed a quantum leap in information communication technology (ICT). It is now pervasive with our everyday life and this has resulted in recent development of many new applications using ICT. Governments and Private Sectors have capitalized on this technological advancement in a variety of applications. Essentially technology is applied to increase efficiency and effectiveness. In some business entities, it can be used as a competitive advantage. The Malaysian government too has applied technology to gain

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**Name :** Wan Rozita Binti Wan Mahiyuddin, PhD  
**Title :** Short-Term Effects Of Air Pollution On Mortality In The Klang Valley, Malaysia  
**Faculty:** Computer & Mathematical Sciences  
**Supervisor :** Associate Prof. Dr. Rasimah Binti Aripin (MS)  
 Dr. Mazrura Sahani (CS)

The problem of urban air pollution is felt worldwide and transcends national boundaries. Malaysia's goal to be a fully industrialized country by 2020 has started impacting on the quality of air in major cities. The main objective of this study is to estimate the mortality risk attributed to air pollution in Klang Valley, Malaysia, based on a seven-year daily data from 2000 to 2006. The mortality data were provided by the Statistics Department. The daily level of five main pollutants, namely, particulate matter less than 10 g/m<sup>3</sup> (PM<sub>10</sub>), nitrogen dioxide (NO<sub>2</sub>), sulfur dioxide (SO<sub>2</sub>), ozone (O<sub>3</sub>) and carbon monoxide (CO) were obtained from the Department of Environment, while relevant meteorological information was obtained from the Meteorological Services Department. The short-term effects of pollutants on daily mortality counts were modeled according to the standard protocol used in the multicity study, the Public Health and Air Pollution in Asia (PAPA) project. Single and multi-pollutant models using

Poisson regression with natural spline smoothers for time and weather variables were applied. The results showed significant risks of two pollutants related to natural mortality. In particular, 1-day lag PM<sub>10</sub> level, 2-day lag O<sub>3</sub> level and the average of O<sub>3</sub> at lag<sub>0</sub> and 2-day lag were significantly associated with natural mortality in the single pollutant model. These two air pollutants were then combined to construct the multi-pollutant models. The 2-day lag O<sub>3</sub> level showed the strongest association with natural mortality after controlling for 1-day lag PM<sub>10</sub> level in the multi-pollutant model. All pollutants in the single pollutant model, except for SO<sub>2</sub>, were found to be significantly associated with respiratory mortality. The highest RR was for the 3-day lag O<sub>3</sub> level, followed by the 2-day lag NO<sub>2</sub> level. Although none of the pollutants in the multi-pollutant models was found to be significant, O<sub>3</sub> relatively has the strongest association with respiratory mortality. The findings on the association between mortality risks and air pollutants, particularly O<sub>3</sub> and PM<sub>10</sub>, are consistent with those of similar studies worldwide. The ER estimates were found to be higher in respiratory mortality than in natural mortality. Also, O<sub>3</sub> and PM<sub>10</sub> were identified as the most harmful pollutants in Klang Valley. The findings of this study contribute substantially to literature in this particular area, while the results are important for improving regulatory process.

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**Name :** Adnan Bin Derahman, PhD  
**Title :** Pullout Behaviour Of Anchor Block Under Saturated And Unsaturated Soil Conditions  
**Faculty:** Civil Engineering  
**Supervisor :** Associate Prof. Dr. Jamaluddin Md Noor (MS)  
 Associate Prof. Dr. Mohamed Bin Ahmad Hafez Jaheen (MS) (CS)

This also gives the implication that the application of the curved surface envelope shear strength model will be more conservative than the Terzaghi's, 1936 model. This thesis presents the results of an investigation into soil-reinforcement interactions under saturated and unsaturated conditions by means of pullout tests. Especially for this purpose, an apparatus able to contain 2 cubic meter sample of backfill material was designed by the author in order to perform real scale tests. The pullout tests were conducted on granular material, silica sand. The properties related to this backfill material, including gradation curve, proctor curve and specific gravity are presented in this thesis. An anchor block attached to steel rod act as reinforcement were used in conjunction with the silica sand. The testing program has been designed to evaluate the soil-reinforcement interlock capacity by means of pullout testing. A few series of pullout tests were conducted on various water content of backfill material under various vertical pressures. Once the vertical load was applied, a second hydraulic actuator was started to pull the anchored rod out from the box at a rate of 1 mm/min. The test was continued until constant or decreasing pullout force was obtained and a maximum of about 200 mm travel was recorded. The test data, including the vertical load, the pullout force and displacement, were collected. The applied vertical pressure were 50, 100, 200 and 300 kPa and the backfill material were varies from dry, 1%, 2%, 6%, 12% of water content as well as under the saturated condition. Prior to the pullout tests, the soil water characteristic curve were developed by the pressure plate extractor apparatus which gave a result of residual suction of 10 kPa. The variations of shear strength with relate to suction for saturated and unsaturated tested sand was developed in this study. The shear strength variation with respect to suction was found to be non-linear for the entire test which in accordance to the curved-surface envelope soil shear strength model (CSESSM) of Md. Noor and Anderson, 2006. Consolidated drained triaxial test were conducted on the soil specimens, both under saturated and unsaturated conditions with different moisture content of 1%, 2%, 6% and 12% which were adopted according the soil-water characteristics curve done in this study.

There have been many cases of wall failure by bulging. The potential causes of this type of wall failure are might due to the over-estimate the shear strength at the lower part of wall, the influence of a hydrostatic pressure at lower part of the retaining wall and the soil in the retaining wall transformed from unsaturated to saturated condition. This is anticipated to be the cause of wall bulging. This illustrates the importance of applying the right shear strength which can be achieved through the curved surface envelope shear strength model.

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**Name :** Noraishah Shamsuddin, PhD  
**Title :** Heart Sound Diagnosis Using Nonlinear Arx Model  
**Faculty:** Electrical Engineering  
**Supervisor :** Prof. Dr. Hj. Mohd Nasir Bin Taib (MS)

This thesis presents a research work on a diagnosis system for heart sound based on nonlinear ARX (NARX) model. The system uses neural network for model estimation and classification of several heart diseases. Six NARX models which represent Normal and other five categories of heart diseases such as Atrial Septal Defect (ASD), Pulmonary Stenosis (PS), Patent Ductus Arteriosus (PDA), Ventricular Septal Defect (VSD) and Mitral Regurgitation (MR) are estimated. A Lipschitz method and Levenberg Marquardt algorithm is used to determine the model order number and train the network respectively. The R-square value of the OSA prediction of the signal is above 99% for all heart sound signals. The best network architecture for modeling the heart sounds is 2-4-1. As for

classification, the features are extracted and selected from the modeled signals and their distinctive patterns are used as inputs to the classifier. To make the system more robust, the background SNR ranging from 3dB to 20dB is injected to the modeled signal. The Resilient Backpropagation (RPROP) algorithm is used to train the network. The optimized learning parameter used is 0.07 and the network has best performance when hidden neurons equal to 220. The architecture of the network is 32-220-6. The accuracy of the network when validated with the diagnostic test is found to be above 97% which suggests that the network performs well and is doing as 'gold standard'. The classification result is further improved to 100% when overall testing is performed. This result has surpassed the result of heart sound classification based on linear model. The accuracy of the linear approach to analyse certain heart diseases varies from 88.5 to 91.6%. The nonlinear approach has successfully estimated the sounds from the heart such that the heart diseases are classified accordingly.

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**Name :** Shahril Irwan Bin Sulaiman, PhD  
**Title :** Intelligent Sizing And Output Prediction Techniques For Grid-Connected Photovoltaic System  
**Faculty:** Electrical Engineering  
**Supervisor :** Prof. Dr. Titik Khawa Binti Abdul Rahman (MS)

This thesis presents new intelligent-based techniques for sizing and output prediction in grid-connected photovoltaic (GCPV) system. Initially, two intuitive-based sizing algorithms for GCPV system design, termed as Conventional Sizing Algorithm (CSA), were developed based on two design goals. The design goal 1 (DG1) was formulated with the aim to design a system based on a specific solar electricity requirement while the design goal 2 (DG2) dealt with the sizing of the system such that maximum solar electricity can be generated using the available roof space. In addition, each CSA incorporated both technical and economic sizing procedures to provide comprehensive design using a pre-selected set of photovoltaic (PV) module and inverter. It was found that the maximum solar electricity requirement from CSA with DG1 was actually capped to the maximum solar electricity that can be generated from CSA with DG2. Apart from that, a novel Iterative Sizing Algorithm (ISA) was also developed to present an iterative approach towards sizing process when there were numerous sets of PV module and inverter need to be considered. At this stage, a database of PV module and a database of inverter were developed to form possible sizing solutions. It was discovered that the ISA based on DG2 had produced more feasible solutions compared to the ISA based on DG1 because DG2 was only limited to the available roof space whereas DG1 was limited to both the

solar electricity requirement and the available roof space. Later, a new intelligent-based sizing algorithm for single objective functions, known as Evolutionary Programming-based Sizing Algorithm (EPSA) was developed using Meta-Evolutionary Programming (Meta-EP). In addition, a Non-Linear Step Size Scaling Factor (NLSS) was also presented to improve the performance of EPSA. It was found that the Meta-EP without NLSS had yielded better optimal solutions compared to other EP models for every design case being presented despite producing worse optimal solutions compared to ISA. After the incorporation of NLSS in each EP model, the optimality of the solutions produced by each EP model had been improved. Nevertheless, only Meta-EP with NLSS had successfully produced similar optimal solution suggested in ISA for each design case. Next, using Meta-EP with NLSS, new intelligent-based sizing algorithms based on two objective functions had been presented, namely the Weighted Sum Method-based Sizing Algorithm (WSMSA) and the Multi-Objective Evolutionary Programming-based Sizing (MOEPSA). Based on six bi-objective design cases being investigated, MOEPSA had outperformed WSMSA in producing more Pareto optimal solutions and better approximation of the Pareto front. Besides that, a new intelligent technique was also presented to predict the energy output from GCPV systems. At this stage, a classical Multi-Layer Feedforward Neural Network (MLFNN) was developed using systematic training, testing and validation procedures. The results showed that the MLFNN performed better than Linear Regression (LR) in predicting the output of the systems. Finally, a novel Hybrid Multi-Layer Feedforward Neural Network (HMLFNN) using Meta-EP with NLSS was developed to improve the classical MLFNN. The results showed that the HMLFNN model had shown better prediction performance when compared to the classical MLFNN and HMLFNN using selected optimization methods.

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**Name :** Nina Korlina Binti Madzhi, PhD  
**Title :** Development And Fabrication Of Piezoresistive Microcantilever-Based Glucose Biosensor  
**Faculty:** Electrical Engineering  
**Supervisor :** Associate Prof. Dr. Lee Yooi Khuan (MS)  
 Prof. Dr. Anuar Bin Ahmad (MS)

This thesis is focused on the Development and Fabrication of the Piezoresistive Microcantilever-based Glucose Biosensor. The objective of this work is to design via simulation a piezoresistive microcantilever sensor suitable for glucose sensing. Then, the piezoresistive microcantilever is fabricated with CMOS micromachining technique. The fabricated piezoresistive microcantilever performed the fabrication process characterization to prove the viability of the design. Finally, the objective in this work is to identify suitable Glucose immobilization technique onto microcantilever surface. The methodology of this work starts with the designing of piezoresistive microcantilever. The microcantilever beam length is selected at 195µm and width, 70µm. On this microcantilever beam there are four different piezoresistor with the length of 80µm, 110µm, 140µm and 170µm. The sacrificial layer of BPSG material in the piezoresistive microcantilever have two different thickness of 0.9µm and 1.8µm. The proposed biosensor also includes the fabrication process design and the process characteristic study such as the resistivity testing and wet etching characteristic study

with wet etchant of Hydrofluoric (HF) acid, Pad Etchant and Buffered Oxide Etch (BOE) to observe the etching rate of the BPSG sacrificial layer. This investigation is important to observe the performance of the MEMS biosensor. Then, the signal conditioning circuit is developed to convert the physical behavior of the piezoresistive microcantilever to electrical signal. The signal conditioning circuit includes the wheatstone bridge, amplification, filtering and linearization circuitry. The next step is the investigation of several Glucose Oxidase (GOx) immobilization techniques on the fabricated microcantilever biosensor surface to find out the optimal enzyme immobilization. In this work there are two controlled conditions which is the glucose testing on the blank piezoresistive microcantilever and other is glucose testing on piezoresistive microcantilever immobilized without Glucose Oxidase (GOx). The proposed glucose-based MEMS biosensor has been developed and tested. The measurement obtained shows that at the testing of the glucose with blank microcantilever no resistance changes are observed indicates that no immobilization of receptor occurs with this technique. In the second method, the immobilization technique used normally is for the Au coated silicon microcantilever investigated previously by Jianhong et al. With this technique, GOx immobilized PZR microcantilever sensor found there is a resistance change caused by a change in surface stress in response to the microcantilever deflection. The measurement obtained shows the possibility use of piezoresistive microcantilever for glucose testing.

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**Name :** Asmadi Mohammed Ghazali, PhD  
**Title :** Development Of Competency Profile For Records Managers In The Malaysian Federal Ministries  
**Faculty:** Information Management  
**Supervisor :** Associate Prof. Dr. Rusnah Johare (MS)  
 Dr. Mohammad Noorman Masrek (MS)

This study was undertaken with the aim to explore the competency profile of the records manager in Malaysian federal ministries. Problem statements, identified from review, include: (a) the advancement of Information & Communication Technology, (b) incompetent records managers, and (c) unavailability of Malaysian records manager competency profiles. Knowledge, skills and attitudes define competence. As the exploratory sequential approach concerns research methodology, the first phase of data collection involves contents analysis technique and on-line focus group discussions. Four competencies manual from United Kingdom, United States, Canada and Australia; and qualitative data from on-line focus groups discussions were transcribed and categorized to identify themes and patterns by applying manifest and latent coding. In the second phase, the data collected from aforementioned methods has been used to develop a survey questionnaire which drew the response of 182 Departmental Records Officer from 25 federal ministries. The mean ranking and descriptive statistics were used to analyze quantitative data. As for content analysis, two approaches have been used: quantitative and qualitative content analysis. Quantitative content analysis is concerned with assigning unit into appropriate categories and providing counts for each category, while qualitative content analysis comprises the relationship and connection between concepts. In quantitative content analysis, the frequency of reference made to the 106 sub-themes analyzed on the four manuals, indicates some variation. 42 sub-themes were identified to be referred to in only one manual, 43 sub-themes in two manuals and 13 sub-themes in three manuals. Even so, similarities were found in the 106 referred sub-themes, which were used in all the manuals. In qualitative approach, the Australian Manual was found dominant in providing guidance and information in technical competencies such as records control, creation, disposition, maintenance, outsourcing, protection and IT capabilities. In contrast, the Canadian Manual was found to be outstanding in focusing on general competencies such as business management skills as well as interpersonal and personal skills, whereas the United States Manual was found to be the most frequently referred guide used in discussing records management. Findings from on-line focus group discussions (web blog) through the manifest approach revealed ten main themes and 39 sub-themes as follows: (a) competencies, (b) principles of records management, (c) problems

This study was undertaken with the aim to explore the competency profile of the records manager in Malaysian federal ministries. Problem statements, identified from review, include: (a) the advancement of Information & Communication Technology, (b) incompetent records managers, and (c) unavailability of Malaysian records manager competency profiles. Knowledge, skills and attitudes define competence. As the exploratory sequential approach concerns research methodology, the first phase

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in managing records, (d) training and education, (e) records management practices, (f) departmental records officers, (g) archives officers, (h) heads of departments, (i) the National Archives of Malaysia, and (j) electronic records. These elements support the main themes but only four main themes and 17 sub-themes were clearly associated with the question of competencies and the record manager's discharge of his roles and responsibilities. Findings from a survey questionnaire indicated that knowledge and skills required in the 'creation' stage were considered most vital. In the final stage of analysis, it was revealed that the competencies required by the surveyed Malaysian records managers matched only 12 main themes of the competencies elements of best practice manuals with their related sub-themes, leaving one unmatched element 'control'. Notwithstanding, the element 'control' should be incorporated in the Malaysian Records Managers Competencies Profile due to the existence of electronic records in Malaysian federal ministries.

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**Name :** Bulan Bin Abdullah, PhD  
**Title :** An Improvement of Mechanical Properties Of Ductile Iron And Niobium Alloyed Ductile Iron Through New Heat Treatment Cycles  
**Faculty:** Mechanical Engineering  
**Supervisor :** Prof. Ir. Dr. Ahmed Jaffar (MS)  
Associate Prof. Dr. Sunhaji Kiyai Abas (CS)

This research is focused on three different heat treatments and they are austempering, tempering and a new heat treatment cycle of ductile iron and niobium alloyed ductile iron. The selection of all heat treatment parameters were based on TTT and CCT diagram which were simulated by JMart Pro Software. The microstructures were observed after etching with 2% Nital using light microscopy and Scanning Electron Microscope (SEM). The structures were verified by XRD analyses. The physical and mechanical tests were then evaluated through density measurement, Rockwell

hardness (ASTM E18), Tensile (TS EN 10001-01) and Charpy impact (ASTM E23) tests. The fracture surfaces after tensile test and impact test samples were examined using Scanning Electron Microscope (SEM). The results showed improvement of 60% on tensile strength and 84% on impact toughness with addition of niobium into ductile iron. Superior mechanical properties were obtained after the new heat treatment cycle compared to austempering and tempering processes. This is due to the formation of fine ferrite platelets and lower bainitic structures and dimple rupture fractograph. It was also found that the tensile strength and impact toughness of austempered and tempered samples decreased with respect to longer holding times and higher heat treatment temperature. The development of the new heat treatment cycle in this research is successful in producing high strength materials. This treatment can easily be utilised in heat treatment industry compared with austempering process which required a special salt bath as quenching media.

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**Name :** Isa Bin Halim, PhD  
**Title :** Risk Factors Information And Analysis Of Muscle Activity In Prolonged Standing Job Relating To Decision Support System  
**Faculty:** Mechanical Engineering  
**Supervisor :** Prof. Ir. Dr. Hj. Abdul Rahman Bin Omar (MS)

establish information on risk factors relating discomfort and muscle fatigue. A surface Electromyography (sEMG) was used to analyze muscle activity while the workers are performing processes jobs in prolonged standing. Questionnaire surveys and sEMG analysis were conducted in a metal stamping industry. It involved 20 production workers from metal stamping process lines and handwork section. Meanwhile the decision support system was validated through a case study performed separately in two manufacturing companies. The questionnaire surveys reported that all production workers experienced discomfort and muscle fatigue due to performing processes jobs in prolonged standing. The sEMG quantified that the two groups of workers show significant difference in mean power frequency ( $P < 0.05$ ) in the right gastrocnemius muscle. Moreover, the right gastrocnemius muscle experienced fatigue earlier than other muscles throughout the workday. The findings of validation process showed that the developed decision support system has generated accurate results that are comparable to conventional method. In conclusion performing processes jobs in prolonged standing has contributed to discomfort and muscle fatigue. The developed decision support system provided semi-qualitative analysis and solutions in minimizing discomfort and muscle fatigue.

In industrial workplaces, many workers perform processes jobs in standing position for a long period of time. This working practice is a potential contributor to discomfort and muscle fatigue to workers. Analysis of discomfort and muscle fatigue associated with prolonged standing using conventional method has limitations such as individual assessment, pen and paper based, and time consuming. The objectives of this study are to establish information on risk factors pertaining to discomfort and muscle fatigue associated with prolonged standing, and analyze muscle activity of workers while performing processes jobs in prolonged standing. The outcome of the two objectives is the development of a decision support system that is specifically utilized to provide semi-qualitative analysis and solutions in minimizing discomfort and muscle fatigue associated with prolonged standing. Prolonged Standing Questionnaire was administered to production workers to

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**Name :** Hartini Saripan, *PhD*  
**Title :** *The Application Of The Digital Signature Laws In Governing Internet Banking Security In Malaysia : With Special Reference To The Eu Directive And The Uk Laws On Electronic Signature*  
**Faculty:** Law  
**Supervisor :** Associate Prof. Dr. Zaiton Hamin (MS)

Despite the recent trend in other jurisdictions such as the European Union and the State of Utah, USA in investigating into the issue relating to the application of the electronic signature laws, including a digital signature, such concern has never been methodically explored in Malaysia. This study aims at examining the application of the Digital Signature Act 1997 and its 1998 Regulations in governing the security of Internet banking. It underscores the extent to which the said laws were applied by the banks under study and the means in which governance was being exercised. The relationship between the adoption of a digital signature and its laws has somehow informed the application of the latter, which amplifies the debate concerning its under-utilization. A thesis statement of the study is the minimal application of the digital signature laws in securing Internet banking transactions in Malaysia has in turn informed the emergence of other governing modalities including technology, guidelines as soft law instrument, contractual terms and conditions, code of practice and security policy as well as netiquette and norms of Internet banking users. Employing a qualitative research, this study triangulates the case-study research approach and the doctrinal black letter approach, which focuses on the discrepancy between the "law in the books" and the "law in action". The empirical evidence from the eight multiple case studies in Malaysia is significantly reported in Chapter Five, showcasing the reality of

the issue within the realm of Internet banking. Whilst the doctrinal analysis provides emphasis on the 1997 Act and its 1998 Regulations in Chapter Four, the legal comparisons with the European Union Directive and the United Kingdom legislation on electronic signatures, which adopt a hybrid approach, are also examined in Chapter Three to compare and contrast between these jurisdictions. The central argument of this study is the negligible degree of the application of the digital signature laws, in particular, as the fall-back mechanisms, is greatly dependent, not only on the marginal adoption of the digital signature technology but also, various rationalities including law-related issues, lack of understanding of the laws, lack of legal expertise and inadequate enforcement. Whilst this issue is also shaped by the inconsequential adoption of a digital signature by the banks under study in managing the risks involved in Internet banking, there are technology-related, economy-related, security-related, business-related, user-related and societal-related issues on the criticisms of the technology, which can be precisely encapsulated under the notion of security versus cost versus convenience. At the theoretical level, the lack of the application of the laws has changed the ways in which security is being governed; from the central role of the formal laws to the fractions of governing modalities such as technology, contractual terms and etiquette of netizens. This could ultimately wither the role of nation-state as the primary guarantor of security. This study will not only contribute to the understanding of the role of the laws and other modalities in governing Internet banking security but also, to assist both the Malaysian Communications and Multimedia Commission (MCMC) and the Central Bank in promoting the application of the digital signature laws in Malaysia.

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**Name :** Mohammad Yaakob, *PhD*  
**Title :** *Moderation And Mediation Analyses Of Exposure To Television Violence Contents And Contextual Features And Its Influence On Adolescents' Aggressive Behaviours*  
**Faculty:** Communication & Media Studies  
**Supervisor :** Associate Prof. Dr. Mohd Adnan Hashim (MS)  
 Prof. Dr. Darussalam Abu Bakar (CS)

model for Television Violence Effects (TVE). Secondly, this study measured the influence of mediator and moderator variables on the relationship between exposure to Television Violence Contents (TVCN) and its effects on adolescents' aggressive behaviours. The respondents for this study were 514 students aged between 13 and 18 from 10 schools in

Previous studies on the effects of exposure to television violence on viewers' aggressive behaviours have produced mixed results. Some studies have found significant effect sizes while others have found low and non-significant effect sizes. Television effects scholars have postulated that these mixed results are caused by the inconsistencies of research methodology employed and the inability to control major mediator variables in the studies. The present study is designed with the objectives to overcome these shortcomings. This study firstly validated and proposed measurement models for the variables and a full structural

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the State of Perak. SPSS statistical software version 16 was utilized for preliminary data processing and AMOS version 5/16 was utilized for multivariate statistical data processing. The results provided evidence that the employed instruments achieved sound psychometric properties. All measurement models, TVE full structural model and all TVE nested path models achieved all standard model-fit indicators very well (Chi-Square/df < 3; GFI and AGFI > .09; and RMSEA < .05). Descriptive analyses of data showed that 53% of adolescents were exposed to television between three and four hours a day. Of 11 genres, adolescents ranked all television violence genres at number eight and above in their most favourite television programmes list. Hypotheses testing showed that exposure to TVCN did not have direct relationship with adolescents' aggressive behaviours; instead, Contextual Features of Television Violence (TVCX) totally mediated this relationship. Some other mediator variables then mediated totally and some mediated partially the relationship between TVCX and adolescents' aggressive behaviours. Hypotheses testing on the influence of moderator variables showed no significant differences in nested path models of TVE for different gender, place of residents, ethnic groups, levels of general television exposure and levels of academic achievements. To conclude, this study found that TVCX is the main factor beside other mediator factors such as adolescents' Television Viewing Self-Regulative Capabilities (SRGC), Personal Values (PV) and Aggressive Attitude (AGT) that determine the effects of exposure to television violence contents on adolescents' Aggressive Behaviours (AGB); regardless of their demographic backgrounds, the amount of television exposures and academic achievement levels. These findings are consistent with the predictions laid by theories guiding this study and with the findings from some previous studies. This study provides valuable information for parents, the television industry and the policy makers in recognizing pro-violent and anti-violent features of television violence programmes for Malaysian school adolescents. It also provides new perspective for future studies of television violence in Malaysia.

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**Name :** Hazwanie Binti Hashim, PhD  
**Title :** Integrating Pharmacogenomics-  
 Metabolomics Towards Realising  
 Personalised Medicine For Colorectal  
 Cancer Patients Treated With 5-Fluorouracil  
**Faculty:** Pharmacy  
**Supervisor :** Associate Prof. Dr. Teh Lay Kek (MS)  
 Prof. Dr. Mohd Zaki Bin Salleh (CS)

Colorectal cancer (CRC) is one of the most common cancers among men and women in Malaysia. 5-fluorouracil (5-FU)/leucovorin is the standard chemotherapy for colorectal cancer and various other types of cancer including breast, head and neck cancers. However, standard method for dosing 5-fluorouracil (5-FU) still lacks accuracy and reliability. In addition to the body surface area index (BSA) that is currently used in dosing regimen, other factors such as genotype, age, gender and drug-drug interaction needs to be accounted. We explore the value of pharmacogenomics and metabolomics in personalising medicine in patients treated with 5-FU. We intended to profile both the genetics and metabolomics markers that could be useful in the clinical monitoring of patients' responses towards 5-FU and its disease. Genetic polymorphism of DPYD and UGT1A1 show interethnic differences among the populations studied. The frequency of DPYD\*5, DPYD 1896 T>C, UGT1A1\*28 and UGT1A1\*6 was high in this study. Patients who experienced neutropenia had significantly higher serum concentration of 5-FU as compared to those who did not have it (Mann Whitney-U test, p-value= 0.031). Combined

regression analysis showed that the predictive power of DPYD\*5 and 1896 T>C for serum concentrations of 5-FU in the studied group is 36.6% (p-value= 0.04). However, many factors affecting the efficacy of 5-FU treatment remain to be investigated including optimal drug doses, treatment duration and the synergistic effect between combination of 5-FU with other cytotoxic agents. Current study also highlights the potential use of integrated genotyping and metabolomic tools in monitoring patients' responses towards 5-FU and to pave the way towards personalised medicine (PM). Seven classes of metabolites were found to be potential markers for prognosis of colorectal cancer as well as evaluating the efficacy and toxicity of 5-FU. These biomarkers include acylcarnitines, porphyrins, sphingolipids, eicosanoids, bile acid conjugates and nucleosides. The present data demonstrates the potential use of Quadrupole Time-of-Flight (Q-TOF) LC/MS in profiling serum metabolites which are useful markers for colorectal patients to help achieve better clinical management. Overall, integration of different approaches would enhance the identification of biomarkers which enable the characterization of prognosis as well as response towards chemotherapy. On-going effort to establish personalised medicine (PM) with the help of value added therapeutic drug monitoring using combination of metabolomics and pharmacogenomics approaches is required especially in Malaysia with multiracial community.

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**Name :** Wan Rosalina Binti Wan Rosli, PhD  
**Title :** Understanding Interpatient Variation Of Clinical Responses Among Acute Lymphoblastic Leukaemia (ALL) Patients Treated With 6-Mercaptopurine (6-Mp): A Pharmacogenomics-Metabolomics Perspective  
**Faculty:** Pharmacy  
**Supervisor :** Prof. Dr. Mohd Zaki Bin Salleh (MS)  
Associate Prof. Dr. Teh Lay Kek (CS)  
Dr. Rosmadi Mohd Yusoff (CS)

Leukaemia chemotherapy had advanced considerably, enabling higher rates of survival and cure. This success is largely attributable to optimization of the use of chemotherapeutic agents such as 6-mercaptopurine (6-MP). However challenges still remain in striking a delicate balance between therapeutic outcome and risk of toxicity due to the narrow therapeutic window of anticancer drugs. This is compounded by the variability in patient response even when given the standard dose. Identification of patients at risk of adverse events would be beneficial, thus pharmacogenomics could play a role in reducing the related adverse drug reaction and hospitalization by the development of diagnostic tools to tailor appropriate therapies for patients. The aim of

this study is to investigate the impact of pharmacogenomics in the clinical outcome of acute lymphoblastic leukaemia (ALL) patients that were on 6-MP. Therefore, 313 healthy Malaysian volunteers from each ethnic group (Malay, Chinese and Indians) and 63 ALL patients were recruited for the study and their blood sampled. The samples were then processed to obtain DNA, RNA and also metabolites. Investigations proceeded with the genotyping of TPMT common variants and ITPA 94C>A and the only TPMT common variant detected was heterozygous TPMT\*3C. Whereas for ITPA 94C>A was detected at a high frequency, in accordance with other studies on Asian populations. There is higher likelihood of developing fever, liver toxicity and risk for relapse for ALL patients bearing the variant ITPA 94A. Variability in patient response was still observed therefore the patient samples were also subjected to denaturing high performance liquid chromatography (DHPLC) analysis to navigate the entire exon regions of TPMT for any variants other than the common variants assayed in PCR. There were a total of 15 variant sites detected that include both reported and unreported variations. Even though there is low frequency of TPMT common variants, the genotyping of other detected polymorphisms and haplotypes may prove more useful. Measurement of TPMT gene expression by absolute quantification of mRNA in patients' blood utilizing quantitative PCR (qPCR) was done for patient samples and found that the expression level was not uniform and this suggest that although there were no common variants of TPMT detected in patients, there may be other variants in the gene that affect the mRNA expression. Analyses have shown that there exist relationship between the DHPLC-detected variants and the variable level of TPMT expression. Global metabolite profiling of patient samples reveal that there exist differential expression among patients and healthy subjects as well as among patients with different genotype groups. Some metabolites detected such as glycerophosphocholine, hypoxanthine, linoleic acid metabolites and prostaglandin 2F alpha were previously associated with clinical outcome of cancer patients. At the end of study there were a total of nine metabolites that were identified to have potential to be used as biomarker either for disease progression, onset of adverse reaction and relapse. However the use of these metabolites in the clinical setting has to be validated further. An initial understanding of the biochemical processes that affect clinical outcome could aid in tailoring therapies that suit individual patient needs and be a positive step toward personalized medicine. At the end of this study establishment of the correlation between genotype, metabolite levels and TPMT expression with treatment outcome is hoped to lead to more effective therapy for patients in the future.

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