



**Faculty of Engineering
and Information Technology**

DRAFT ONLY

ABSTRACTS

CAPSTONE PROJECT PRESENTATIONS

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Broadway Campus

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Modeling the Effectiveness of Software Project Creation Using System Dynamics (12cp)**James Allan - A11-003**

Supervisor: Xiaoying Kong

Assessor: Zenon Chaczko

Major: ICT Software Engineering

Historically, software projects have experienced a large volume of failure. Many of these projects fail upon project completion where the end product doesn't meet the needs of the customer, or during the development of the project due to poor planning or external influences. This has helped to drive the development of new software development methodologies such as the agile and iterative approaches. These approaches aim to minimise administrative overhead, while remaining in constant communication with the customer.

This project aims to model how effective the current process of software project development is, by using system dynamics as the analysis method of choice. The primary focus of this analysis is on the initial concept and design phases, as changes made in these phases have the greatest impact on the overall project. A literature review was conducted, along with six industry interviews to gather an understanding of the current effectiveness of software project creation and the issues that are faced.

Due to the soft systems nature of this issue, system dynamics was used to analyse these issues. This project explores the issues that software project manager's face, focusing on industry best practices, development approaches and the impact of failure. The findings of this analysis is presented as a cause and effect model, where each element is analysed in detail.

Using the cause and effect model as a base, this project also provides a workable tool that calculates the likelihood of software project success as a percentage. This tool uses each of the variables highlighted in the cause and effect model as inputs to help ensure that a realistic output is presented. This tool can then be used to help project managers and their organisations reduce the number of software project failures.

Fatigue Testing and Analysis of Race Car Driveline Component (12cp)

Felipe Angulo Chow - A11-006

Supervisor: Terry Brown

Assessor: TBA

Major: Mechanical Engineering

Sprocket hanger is one of the components in the driveline in UTS Motorsport Formula SAE race car and it failed with very low life cycle in the running track. Similar components have been used widely in many mechanical devices such as the derailleur hanger in bicycles, break hanger in motorcycles and other transmission components. The investigation is performed to find out the reasons of failure by doing fatigue testing and finite element analysis (Solidworks Simulation).

By observation, the broken sprocket hanger is a fatigue failure with very low cycle. Since it was installed next to the sprocket with bolts, single shear stress is generated in the bolts and unbalance force generate moment to the sprocket hanger. Moment twist the sprocket hanger and the driving force pull sprocket hang simultaneously while the driveline is operating. The fatigue testing and FEA result also proved that there was a significant higher stress in the single shear joint comparing with double shear joint in the hanger.

This report will describe how a single shear and double shear fatigue testing are approached including surface finish measurement, the set up of testing and fixture design for the sprocket hanger. The failure will be explain and analysis by experimental result and FEA. The outcome of the analysis will also help the UTS SAE team to improve the driveline component design in term of weight and strength in the future.

Mobile Rowing Tracker (6cp)**Thomas Ansart - A11-007**

Supervisor: Xiaoying Kong

Assessor: Zenon Chaczko

Major: Software Engineering

With the release of the iOS5, and the announcement of the 4th major release of the Android operating system, smartphones are becoming less of a novelty for businessmen, but rather, a widely available device to the masses. Recent studies shows that in 2010, 35% of the Australian population had a smartphone, and only 5% had no mobile phones at all (Nielsen 2011). Smartphones are getting more affordable while they keep on packing more processing power, larger memories and adding various sensors. Nowadays, most smartphones have an accelerometer, a GPS, and a gyroscope, while more recent mobiles come with even more sensors, such as barometers, magnetometer, and proximity sensors.

The main objective of this Capstone project was to create an application for mobile phones, which could accurately track a rower's speed, and the stroke rates. Though simple in theory, in practice various variables must be accounted for due to the often less-than-ideal environments. Moreover the data from the various sensors must be handled and analyzed in real-time while being constrained by the many limitations imposed by mobile phones.

While rowing applications exist on the Android, many rowers have been complaining about the unstable nature of these. As such, various approaches were taken and tested to try and accurately track these data in real-time. This report documents the engineering processes that were used to complete this application. Furthermore, the various design decisions that were taken are documented, and explained in the document.

Investigations and Preliminary Design Options, for a Bicycle Facility for Rangers Avenue Mosman, to Cater for South Mosman Residents Commuting to the Sydney CBD (12cp)
Thomas Bentley - A11-012

Supervisor: Ken Halstead
Assessor: Rob Shipton
Major: Civil Engineering

Mosman council area has a higher proportion of persons commuting to and from work on bicycle than the Sydney Statistical Division. Mosman Municipal Council aims to increase the number of local cycling trips for transport through improving the overall connectivity of their bicycle network. Cycling is increasing in popularity in Australia, both as a recreational activity and as a legitimate form of transportation. For the past ten consecutive years, the number of new bicycles sales has eclipsed new car sales. With the growth in cycling, there is a greater need to provide supporting infrastructure in an effective way to promote cycling not only for its health benefits, but as an attractive form of transport to alleviate transport congestion.

The aims of this Capstone Project include investigations to evaluate the appropriateness of Rangers Avenue as an important link for the overall connectivity of the Mosman bicycle network, and the development of preliminary solutions to facilitate the construction of a cycling facility. It would cater for South and East Mosman residents wishing to commute to the Sydney CBD. An assessment has been made of the existing conditions of Rangers Avenue and surrounding streets accounting for bicycle sensitive topics: topography; topology; traffic and existing bicycle movements; as well as environmental and heritage concerns.

The project confirms the appropriateness of choosing Rangers Avenue as the preferred location for a cycling facility. In developing a safe and appealing solution to fix the break in facility from the East to the West, a link has been created increasing the effectiveness of the rest of the network. A solution has been designed that meets all design standards and addresses stakeholder concerns. By increasing facilities and encouraging cycling the pressure of growing transport demands can be alleviated using a cost effective and environmentally sound method.

Design and Development of Pico Hydro Turbine Generator (12cp)**Benjamin Boland - S10-181**

Supervisor: John Dartnall, Greg Gibbs

Assessor: Robert Jarman

Major: Mechanical Engineering

The following report will outline the steps taken, the issues found and the engineering solutions that were used to continue the design and development of a Pico Hydro Generator, a project that has been initiated by Greg Gibbs (PHD candidate at the University of Technology Sydney).

The aim of the project is to provide an economical means of generating electricity for the people within areas of the world such as Papua, Indonesia. In Papua, there are currently over half a million people who live in small towns and villages that have no access to electricity, which also means that schools and medical practices operate without the basic necessities, such as lighting and refrigeration. The geographical landscape, being predominately undulating mountain ranges and with abundant water flow lends itself to the implementation of hydro-electric power generation. Whilst there are a small number of alternatives available, the cost, installation, maintenance and ownership of the product are the major obstacles for their implementation.

The project has involved reviewing the design of the generator, designing and producing a prototype in order to be able to conduct initial laboratory testing with the potential of a field trial in Papua. The design and development of the project has been focussing on the following design criteria:

- Low cost economical solution.
- Simple manufacture.
- Modular design allowing for transporting and scheduled maintenance.
- Simple installation into these remote parts of the world.
- Safety in operation.
- Maximise its efficiency in generating electricity.
- Developing “Buy In” into the project by the people of Papua.

This report outlines the design process that has been undertaken, the manufacturing techniques that have been used to develop a prototype for testing, the testing results and the design changes that have been implemented or are recommended in order to take the project to the next stage of mass production, marketing and sale of the product.

Experimental Investigation of Timber Connections Using Screws (6cp)

Mustafa Bondigo - S11-007

Supervisor: Rijun Shrestha

Assessor: Christopher Gerber

Major: Civil Engineering

Current engineering practices in the construction industry show a dependence on the use of unsustainable materials such as steel and concrete. Productions of these materials require the consumption of limited resources and results in green house gas emissions. Steel and concrete are however favored material because there is a wealth of knowledge on their structural behavior and design aid which results in greater use by engineers due to confidence in the materials.

Sustainability is now a major factor in engineering, with a push to increase the use of products made of timber - a material which is environmentally sustainability when sourced from properly managed plantation. This experimental investigation seeks to develop a greater understanding of the behavior of timber screw connections under structural load, hence providing engineers with knowledge and understanding to encourage the use of timber as a structural product.

This experimental Capstone will aim to show correlations between results provided by the experiment to theoretical values determined from the Euro Code 5 and the American Timber code.

The experiments was conducted as a push out test with two specimen types, the first consisting of three pieces of 45mmx100mmx410mm laminated veneer lumber (LVL) connected using two screw, the second with identical dimensions but utilizes four screws in the connection, ten specimens of each were tested.

The tests have shown that connection type two has a greater capacity, twice that of type one (confirming with multiple fastener effect specified in AS1720.1-2010), as well as increased stiffness of the connection as expected. All specimens show similar failure patters to those specified in the Johansen model for a ductile screw failure. Testing of both specimen types resulted in the formation of plastic hinges in the screws at the timber joint interface, with localized compressive failure in the timber around the deformed screws.

A Study on the Reduction of Congestion at Intersections on Urban Arterial Roads – Case Study of the King Georges Road and Canterbury Road Intersection (6cp)

Taylor Burns - S11-013

Supervisor: Ken Halstead

Assessor: TBA

Major: Civil Engineering

Traditionally in Australia congested urban intersections are improved either by adding lanes or by building a grade separation. However, the drastically increasing congestion on our roadways coupled by restricted road reserves and limited funding means that innovative methods of reducing congestion are required. Quadrant roadway and continuous flow intersections are two types of unconventional intersection designs, which have proven to be effective in many cases at increasing the effective intersection capacity and level of service in mid to high traffic volume conditions.

A case study on the King Georges Road and Canterbury Road intersection has been conducted to assess eight intersection designs including the existing intersection, the two unconventional designs previously mentioned, two half continuous flow intersections with displaced right turns on either King Georges Road or Canterbury Road, and three conventional intersection designs. The three conventional intersection designs include two at grade intersections; one containing dual right turns and auxiliary left turn lanes on all legs, another containing dual rights, auxiliary lefts and additional through lanes. The third conventional design is a Fly-over (Grade Separation) with King Georges Road passing over Canterbury Road.

The eight intersection design options have been modelled using SIDRA intersection software to determine the performance of each intersection. The cost of each intersection design was estimated and the benefit to cost ratio were also calculated. This study has shown that the unconventional intersection designs provided considerably higher benefit to cost ratios than the conventional intersection designs. In this case study the Quadrant roadway intersection and Full Continuous Flow intersection have both provided a level of service of B which was equivalent to the level of service provided by the grade separation design but can be constructed for approximately half the cost.

Risk Management in NSW High School Sports Programs (6cp)**Kathryn Cabrera - S11-014**

Supervisor: David Eager

Assessor: Chris Chapman

Major: Civil Engineering

This capstone project was an investigation into the risk management process involved in the implementation of a sports program as part of the high school curriculum in New South Wales (NSW). According to AS/NZS ISO 31000 risk is the result and potential events of uncertainty on objectives; risk is a reality of life and its sources are unlimited. Risks are of particular concern in sport, especially in school sport, and therefore the main purpose of this project is to undertake a comprehensive study and delve into a suitable procedure for mitigating such risks, with specific respect to NSW High School students and staff.

The main case study used for gaining primary source information included members of the St Andrews College High School, located in Marayong NSW. A number of different people were interviewed, such as high school students, staff, sports coordinators and first aid administrators; experts in the field of risk and sport; and sports equipment manufacturers. It was intended to gain a relatively decent micro representation of the community that are most affected by the application of a High School sports program in NSW. Nonetheless the data set was small and it cannot be concluded that a true depiction of the entire NSW community was achieved, due to demographic elements of the majority of people surveyed.

Secondary source information, obtained through a comprehensive literature review was compared with the primary source data to identify and discuss similarities and differences. After thorough analysis of information gained, a recommended risk management process for implementing a sports program in a typical NSW High School was developed for the use of and benefit for the wider schooling and sporting communities.

Emergency Diesel Generator Protection Upgrade (12cp)

Victor Catchpoole - A11-019

Supervisor: David Dorrell

Assessor: Li Li

Major: Electrical Engineering

The aim of this project was to complete an upgrade of the protection scheme for the 30 year old Unit 8 Emergency Diesel Generator at Wallerawang Power Station. This project was necessary to improve the level of generator protection, by taking advantage of recent developments in the field.

This project included a review of the existing protection scheme, a literature review of developments in the field of protection and a review of the protection relays available on the market. There are several administrative steps required by Delta Electricity before any project can proceed. Once these prerequisites have been met, it was necessary to define the project scope before preparing the contract documents.

There are inherent risks associated with this project and these were identified along with suitable control measures.

To calculate fault currents, the complex magnet circuit of the generator can be represented on a simplified per-phase basis along two planes, being the direct axis and a quadrature axis. The complexity of these fault calculations increases when interconnected generators, transformers and busbars are included in the calculations. To simplify the complex fault calculations, computer software (PowerFactory) has been used to determine the fault levels.

Having reviewed many of the protection relays available using a Tender Evaluation Matrix, a decision was made to purchase a SEL (Schweitzer Engineering Laboratories) SEL-700G1 Generator Protection Relay and as back-up protection, a SEL-501-2 Dual Overcurrent Relay. The relay settings were calculated and modelled using PowerFactory to confirm correct grading and discrimination with the existing system.

The installation work was done by contracting staff and then the relay program was transferred into the protection relays. Commissioning tests were completed before the equipment was made available for service. At the conclusion of the project all site documentation was upgraded to match the new installation.

Zabbix Mobile Application for Apple Mobile Devices (12cp)**Michael Chan - A11-023**

Supervisor: Zenon Chaczko

Assessor: Xioying Kong

Major: ICT (Computer Systems) Engineering

Network monitoring systems such as Zabbix is used to monitor critical IT infrastructure hardware and is a vital requirement for each and every IT/Telecommunications company in the world. Existing systems are reliable and use both the cellular network and Internet to notify network administrators of problems. However the continual use of the short message service (SMS) to notify network administrators of problems have been beneficial and convenient, has lead to a substantial number of SMSs being sent that poses a financial burden toward the company. Furthermore the notification by themselves are independent and uninformative to the bigger problem. Network administrators also want readily access to the Zabbix web portal, that is optimise for use on a mobile devices.

This capstone project aims to develop a network monitoring app for the Zabbix technology, which can be deployed on the Apple iOS devices.

The iOS device will have the ability to receive alert push-notifications from the Zabbix server. When the user receives the push-notification, they can tap the notification, which then launches an application to display the full alert details.

The app may also present information subsets of the Zabbix web portal optimised for display and interaction on the iOS device.

The implementation of a dedicated Zabbix application with push-notifications enables network administrators to access common subsets of the Zabbix web portal optimised for the mobile device. Furthermore push-notifications received from the Zabbix server may be delivered via the Internet rather than the cellular network, thus in turn reducing the financial burden attributed by notifications delivered over the cellular network.

Control of a Robotic Upper Limb Exoskeleton for Use in Muscular Strength Augmentation and Rehabilitation (12 cp)

Gerard Chetcuti - A11-031

Supervisor: Dikai Liu

Assessor: TBA

Major: Mechanical & Mechatronics

A robotic exoskeleton is a wearable external support frame with joints and links similar to those of human beings. Exoskeletons are becoming increasingly popular in their application for muscular rehabilitation. The robotic platform developed at UTS was originally 2-DOF and intended for industrial use in providing strength augmentation to sandblasting apparatus operators. The purpose of the exoskeleton has developed to serve as a testing platform for muscular rehabilitation. The exoskeleton is intended to provide targeted assistance to muscle groups which are weakened from their normal capacity, but not to provide assistance to muscles which are already healthy. Research was completed on developing an appropriate and robust control system particular to this application. The exoskeleton had several limitations to its performance including signal noise, motor controller limitations and backlash. The exoskeleton was modified to reduce the effect of these imperfections and thus increase the capabilities of the developed control systems. A cable-driven elbow joint was added to increase the degrees of freedom to 3, significantly increasing the workspace of the exoskeleton. Several control systems were developed and tested (position, force and admittance control) and were assessed in terms of performance and suitability to the intended applications of the exoskeleton. For the particular application of targeted strength augmentation, admittance control was found to be the most effective control solution. Recommendations to improve the performance of the exoskeleton and its control system were made including adding additional degrees of freedom to increase the user workspace, incorporating harmonic drive motors to reduce backlash, utilising rotary encoders for higher precision of joint velocity measurement, and further refinement of the control system.

Asset Management in Urban Water Supply and Pipeline Maintenance (Ice Pigging)**(12cp)****Wan-Ling Chu - A11-034**

Supervisor: Huu Hao Ngo

Assessor: TBA

Major: Innovation Engineering Civil Stream

Advanced methods for strategic asset management are implemented across the industry locally, nationally and globally. A comprehensive asset management model can help service providers to manage assets in order to continually improve operational and planning aspects of infrastructure, performance improvement and upgrades. The International Infrastructure Manual provides a framework for asset management in urban water supply. The guideline provides valuable information for the industry and is referenced throughout this project.

Ageing of water infrastructure in Australia causes a new challenge on service providers and local governments. It is important to maintain and rehabilitate the system in the most efficient and effective way in order to increase the reliability, availability, safety and efficiency of the service. Over time residues from the treatment can become problematic to the supply system and cause capacity reduction, discolouration, odour and a bad taste in water. It is therefore important to have a well defined asset management model in order to mitigate such problems.

Ageing pipelines impose risks of system failure. The effect of this can be a significant impact on service performance and public health. Maintenance and rehabilitation are methods used in proactive management to prolong the asset life cycle. There are many pipeline scouring methods commercially available in the industry and they are examined in this report.

Ice-pigging is one possible method of effective pipeline maintenance. It is a cleaning technique using ice-slurry to create friction on the lining, aiding in the removal of debris. It is promoted as a state of the art technology in urban water supply. Trial results of ice-pigging are presented in this project to demonstrate its effectiveness and feasibility in Australia. Regular maintenance and water quality monitoring is necessary to sustain a robust system that delivers a high standard of drinking water in compliance with Australian Drinking Water Guidelines.

A Control System for Zoned, Central Air Conditioners (12cp)

William Cruz - A11-039

Supervisor: Peter McLean

Assessor: Steven Su

Major: Electrical Engineering

The aim of this project was to design and build a working prototype of a residential heating-ventilating-air-conditioning (HVAC) control system that can interface with an existing centrally-ducted HVAC system in an American home and convert it into a zoned system. The goal of this control system is to control the existing HVAC system in a more energy efficient manner, and use less materials and equipment than alternative zoning systems that are available commercially.

In the United States, ducted air conditioners, also referred to as split-systems, are common in homes. This style of split HVAC system delivers conditioned air to the rooms in a house through ducts; however they are incapable of dynamically controlling the airflow to individual rooms. When the system is on, the entire house is air conditioned regardless of the heating/cooling needs of specific rooms.

The deliverable of this project was a system that could dynamically control the compressor, fan, and flow of air to each room in the house separately. This was done by designing an electronic control system that included three main components: an Automated Vent, a Thermostat, and a Main Controller. The development of these components involved the design of an embedded system including power, digital, and analog electronic circuits, as well as software for the control algorithms, user interface, and serial data networking. The prototypes of these components were developed through several stages including proofs-of-concept, through-hole circuit boards, and surface-mounted printed circuit board assemblies.

The final phase of this project included shipping the developed prototype components to the United States to be installed and tested with an actual residential HVAC system. Following the installation, an experiment was performed and relevant data was collected to determine how well the prototype control system compared to the pre-existing system in terms of energy efficiency and usability.

Feasibility, Design and Analysis of Advanced Cogeneration Systems for the University of Technology, Sydney (12cp)

Pinar Dagci - A11-042

Supervisor: Jafar Madadnia

Assessor: John Dartnall

Major: Mechanical Engineering

The environmental impact of intensified usage of exhaustible energy has promoted adaptation of conservative solutions. Cogeneration is the process where heat and power (electrical & mechanical) is simultaneously generated from a single source of energy. The source of energy has been conventionally gas and now replaced with solar energy. Conventional cogeneration systems have used gas since the early 1970s but it is predicted that solar energy and photovoltaic will be more widely used in the 21st century as the environmental costs and carbon-foot prints are considered more seriously.

The University of Technology, Sydney has relied on the purchase of electricity to provide energy and gas for heating (air conditioning and domestic hot water). Like all environmental friendly institutions, UTS has been influenced by technological, environmental, social and economic factors to adopt more renewable-based cogeneration systems. Test Data from a BIPV was collected and used for estimation of both thermal and electrical efficiencies of the BIPV-Cogen.

This abstract presents five potential co-gen-systems which are developed and compared with a Building-Integrated-Photovoltaic (BIPV) system for heat and power generation at the university. These five systems include Internal combustion (IC) engines, External combustion engines including Stirling engine, Organic Rankine cycle (ORC), Kalina cycle, and Fuel-cells. After comparison both BIPV and the Organic Rankine Module (ORM) were found reasonable. The selected cogeneration systems offer shorter payback period, lower IRR and net-energy savings, lower Co₂ emissions, and higher electric-power generation capacity than the benchmark system developed by the engineers at the UTS, Facility Management Unit (FMU).

Following this, a preliminary design of the selected option was developed and a heat exchanger was designed to be used within this system.

The project recommends a variety of cogen systems for UTS building based on the emphasis on low-carbon-footprint or energy efficiency of the system.

Comparison of Conventionally Reinforced Concrete and Pre-Stressed Concrete Structures with Respect to CO₂ Emissions (6cp)

Andrew D'Ambrosio - S11-024

Supervisor : Anne Gardner

Assessor : Chris Gerber

Major: Civil Engineering

The choice between adopting conventionally reinforced concrete and pre-stressed concrete in a project has traditionally been based on cost and ease of construction. Today, society is placing increasing emphasis on sustainable developments. The notion of sustainable development is a more recent concept which seeks to integrate environmental, social and economic factors into one issue. Sustainable development is the meeting of today's needs without compromising the needs of people in the future (Dovers, 2005).

There has been much debate regarding the sustainability of pre-stressed designs compared to conventionally reinforced designs. Pre-stressed slabs and beams are generally thinner and use less steel than their equivalent conventionally reinforced counterparts. However, for a typical concrete mix of 32MPa to be used in conventionally reinforced concrete, 128 to 160kg of cement is used per cubic metre of concrete. This is half of the 264 to 330kg of cement per cubic metre of concrete used for 40MPa concrete used in pre-stressed designs. As a general rule of thumb, pre-stressed designs use less material, but the materials they use are much more carbon intensive to produce.

To encourage the application of sustainability in the construction industry, a government body known as *The Green Building Council of Australia* has developed a set of guidelines to assess the sustainability of a given construction project. This rating system, known as the *GreenStar Rating*, currently focuses on the use of recycled materials and cement substitutes. However, it fails to provide guidance on assessing which structural system provides the most sustainable solution by examining both the type of material and the quantity of material used. This report offers suggestions to *The Green Building Council of Australia* to incorporate additional assessments based on a systems analysis of various pre-stressed and conventionally reinforced designs.

Human Robot Interaction (HRI) Using Verbal Communication (12cp)**Leigh Dearden - A11-044**

Supervisor: Chris Stanton

Assessor: Benjamin Johnston

Major: ICT Engineering (Software)

Human Robot Interaction (HRI) is the study of how humans and robots can naturally interact. One aspect of HRI is computer speech recognition - that is, enabling a robot to understand human speech through the use of sensors such as microphones. The Aldebaran Nao humanoid robot is a fully programmable autonomous robot, and is the current robot of choice in the RoboCup Standard Platform League. Currently, the Aldebaran RoboCup edition Nao lacks any speech recognition capabilities, and most interaction with this type of robot occurs through button presses and keyboards. For example, to start or stop the robot a button located on the robot's chest must be pressed. This chest button can be difficult to access if the robot is walking. A more natural way to interact with the robot would be through the use of speech.

This thesis describes a software system developed to allow the Aldebaran Nao humanoid robot the ability to recognise and respond to a variety of speech commands. The performance of the speech recognition system is evaluated empirically, and the system is compared to other existing approaches that allow robots to recognise speech.

Gesture Recognition and Control System Using Xbox Kinect™ (12cp)**Karlo Diamante - A11-182**

Supervisor: Steve Murray

Assessor: Zenon Chaczko

Major: ICT Engineering

Human-computer interaction has rapidly evolved from the use of keyboard, mouse and joystick, to the use of touch interfaces and voice recognition. Limitations such as costs, technology and complexity have previously impeded the advancements in this field. However, with the advent of affordable and portable controller-free gaming devices such as the XBOX Kinect™, vision-based dynamic gesture recognition has gained traction in becoming a feasible alternative to static human-computer interaction.

The aim of this project is to showcase the potential of the vision-based gesture recognition technology to control a portable and configurable embedded system (Lego® RCX). The system utilises the depth-mapping algorithm embedded in the XBOX Kinect™ to map a 3D visual profile of the user. The XBOX Kinect™ software library and driver provided by OpenNI™ is utilised to map a skeletal framework of the user. Furthermore, the 3D coordinates of the joints is obtained and used for the gesture recognition algorithm.

The gesture recognition algorithm references a gesture vocabulary that contains a mapping of basic navigational controls for the embedded system. The algorithm outputs control commands to the Lego® RCX through its infrared USB tower.

The Lego® RCX microcontroller is programmed using the leJOS firmware. The embedded software is designed and developed to accommodate for basic controls mapped to the gesture vocabulary and utilise the motors accordingly.

This project aims to pave a way for future development in the area of vision based human-computer interaction. Future developments shall include a middleware in the software architecture to allow for other gesture recognition devices to be used as input for the control of an embedded system.

Investigation and Implementation of a Federated Remote Laboratory Architecture Using the Open Source SAHARA Labs System (12cp)

Michael Diponio - A11-045

Supervisor: David Lowe

Assessor: Steve Murray

Major: Software Engineering

Developing a remote laboratory is an expensive investment but by their remote nature allows the ability to share them. Providing this access ameliorates the cost over many uses by users that need not be resident to the remote laboratory or even the institution that provides the remote laboratory. The Labshare Institute (TLI) is an organisation that takes this premise as its *raison d'être*. SAHARA Labs, sponsored by TLI, is an open source software suite that enables remote access to physical, computer controlled apparatuses (called rigs) over the Internet. It provides the software building blocks to implement a remote laboratory site (called a provider) and is currently used by multiple universities, including the University of Technology, Sydney to build their remote laboratories.

However, going to a SAHARA Labs website allows the use of rigs hosted within that provider but not rigs hosted at other providers and currently has no support for sharing. This capstone explores architectures such as centralised, distributed and peer-to-peer architectures that allow the creation of a federation of remote laboratories with the end goal of logging into a SAHARA Labs website to use rigs hosted at other providers. Using a lens of contextual (existing and legacy laboratories, inclusiveness), operational (ownership, access negotiation, user perception) and technical (performance, scalability, security) factors an architecture has been chosen which best suits the key actors in a remote laboratory federation, TLI, the providers and the end users. This architecture is then developed, designed and implemented as an prototype system from the existing basis of SAHARA Labs. It is validated to ensure suitability of the base architecture with the future goal of a new SAHARA Labs release utilising this architecture and the capstone developed prototype.

ENTREACT Online: Product/Service Promotion (6cp)**Jordan Drenth - S11-032**

Supervisor: Peter PASTARS

Assessor: David Eager

Major: Civil Engineering

The Entreact Program is designed to cover all the business fundamentals required to run and build a successful organisation. Peter Pastars is currently developing the online component of Entreact. This online component includes a business planning tool to guide users whilst writing their business plan. Currently, this business planning tool needs several business related topics to be completed. My capstone will add the topic of “Product/Service Promotion” to the Entreact business planning tool.

I used content from the Entreact Program to develop my understanding on the topic promotion. VBA and Excel were used to write my program in accordance with the Entreact notes.

The success of my project provides Entreact users guidance to selecting the appropriate mix of promotional solutions for their product/service.

The significance of my program is its systematic and automated approach to developing promotional strategies. This is a significant step in the area of promotion that is for the most part fuzzy logic. Academics in the field of engineering will appreciate the logical approach my program takes to determine the best promotion mix for their product/service.

Learning Repetitive Gestures by Demonstration Using Nonlinear Oscillators (12cp)**Daniel Egan-Wyer - A11-048**

Supervisor: Alen Alempijevic

Assessor: Nathan Kirchner

Major: Mechanical and Mechatronic

The world of technology is expanding at a rapid pace, thus, the robotics community is looking to have robots be a common occurrence in everyday life.

The RobotAssist project is an initiative by UTS to explore human robot interaction that has produced a robotic platform with the intention of assisting people in their homes. A number of essential fundamental skills such as navigating around a room have already been implemented. Expanding these skills to complete more complex tasks is the future direction of the project. One such expansion is the use of repetitive gestures which can be used to interact with humans or to perform a task, for example waving goodbye or wiping a table.

This capstone will focus on developing a method that allows for repeating previously learned cyclic gestures in order to interact with humans or perform tasks. The method uses a Microsoft Kinect to sense the environment as well as a gesture made by a human. Locations of objects and surfaces are extracted and a system of adaptive oscillators is used to learn a signature profile of the gesture. Subsequent analysis using a kinematic model of the robot arm to compute the inverse kinematic joint positions enables repetition of the learned gesture in the current environment. Online modifications allow the repeated gesture to be performed at different speeds and at different locations in space.

The capture of gestures is currently done offline and the repetition of gestures has been modelled in simulation. The kinematic model, inverse kinematic calculations and execution of trajectories have been successfully implemented on the robot. Further work is required to implement the entire system in real time on the platform.

An Intelligent Remote Control Utilising Modern Electronics Technologies (12cp)**Tom Elliot - A11-051**

Supervisor: Peter McLean

Assessor: Ben Rodanski

Major: Electrical Engineering

In this Capstone project a universal remote control is developed as a slim, credit card sized touch pad device. Simple and generic touch based “gestures” are interpreted using a neural network to provide an intuitive interface for the user.

This Capstone project exploits the understanding that the modern home holds a variety of remote controls, and each remote control is cluttered with functionality that regularly goes unused. The remote control designed in this Capstone project is intended to be a single interface for all of the devices in the home that utilise a remote control. The focus of this project is the hardware and firmware design for the remote control, rather than the implementation as a universal remote control.

A number of modern electronics technologies have been utilised to implement this intelligent remote control, including inductive charging, capacitive touch, a supercapacitor as well as low power wireless communications. Inductive charging allows the remote control to be charged by simply placing it on an inductive charging surface – potentially a coffee table or couch armrest. A supercapacitor is used as the primary energy storage device, which results in a short charge time. This allows the user to recharge the device in minutes rather than hours. Low power wireless communications are implemented to enable the device to easily network with a modern “automated home” and allow the user to move freely with the remote control.

Sustainable Chippendale – Diagnosis and Determination of a Plan for a Sustainable Chippendale (6cp)

Matthew Faint - S11-141

Supervisor: Ken Halstead; Michael Mobbs

Assessor: TBA

Major: Civil & Environmental Engineering

Cities around the world are only now starting to come to terms with the ways in which their day to day operation is impacting the environment. There are a number of ingrained operational systems that make cities both environmentally and economically unsustainable. Inhabitants of urban centres require resources that are currently transported from far and wide to satisfy their concentrated demand. The urban environment has been separated from its electricity sources, its water sources, its food sources, and its material sources, and its demand for these sources is unnecessarily high.

This report concentrates on the inner-city Sydney suburb of Chippendale and focuses on the issues of energy, food, water, waste, the urban heat island effect, and transport. These issues are the elements of urban life that regulate the impact of the urban setting on the environment. By diagnosing the problems surrounding these systems we can go some way to determining solutions to make urban living more sustainable.

These solutions come in three forms: engineering interventions, financial interventions, and legislative interventions.

Engineering interventions include altering current infrastructure to conserve more of the natural resources that are afforded to urban environments such as rainfall and sunshine for water and food. And they include the installation of infrastructure that will ameliorate the effect of the urban heat island and its impact on energy demand.

Financial interventions include suggesting financial incentives to encourage behavior that minimises the impact of urban life. These may take the form of reduced council rates for residents who don't own cars, or residents who collect their stormwater.

And legislative interventions include looking at the legislative tools that currently govern development in the City of Sydney and determining which clauses are resulting in poor outcomes for the environment and suggesting ways in which they can be adjusted.

**Residential Slabs and Footings Code Calibration (As2870-2011) for Western Sydney –
Based on Performance of Existing Floor Slabs (6cp)****Christopher Fernandez - S11-037**

Supervisor: Hadi Khabbaz

Assessor: Behzad Fatahi

Major: Civil Engineering

The recently released revision of the Australian Standard (AS2870 – 2011) has changed the rules governing the design of residential floor slabs. Notwithstanding this, the Standard still states that a non-standard design may be accepted if it is designed using engineering principles or where there is other evidence that it meets the requirements of the Standard. Engineering principles is defined as “principles that are commonly accepted by qualified engineers.

This study assessed the performance of a floor slab design that has been used in the construction of Western Sydney homes by Beechwood Homes in the past 7 to 15 years. Beechwood Homes has built over 22000 houses in last 25 years and 1060 of which are relevant to this study. Because this slab was only constructed by Beechwood Homes it could not be described as a design that was commonly accepted by qualified engineers. The assessment looked at the slabs performance, on soils with varying reactivity in Western Sydney to show that these slabs perform satisfactorily when compared with the Standard expectations.

The assessment involved the inspection of 30 randomly selected houses and their cracking was compared with the classification system for cracking provided in Appendix C of AS2870 – 2011. To determine if the cracking displayed in the houses was the worst that it is likely to experience during its life time, the soil moisture condition, quantified using Thornwaite Moisture Index (TMI), throughout the lifetime was assessed. TMI was calculated based on rainfall and temperature data from a nearby weather station. The TMI data suggested that extreme wet and dry soil conditions have occurred since 2005 for all calculated stations suggesting that the inspected houses have experienced their worst likely cracking condition.

Based on this analysis it is concluded that the Beechwood Homes slab design works satisfactorily when compared with the Standard.

Sydney's Bicycle Transport Network – a Sustainable Transport Study for the Roads and Traffic Authority (6cp)

Timothy Fletcher - S11-038

Supervisor: Ken Halstead

Assessor: TBA

Major: Civil Engineering

In modern society, current global conditions have been reshaping the way we view human transport. A variety of factors including global environmental issues, the finite lifespan of fossil fuels, rising levels of traffic congestion and the increasing need to improve sustainability have shifted a large focus onto the investigation and development of sustainable transport. Various government bodies and private organizations have recognized these issues and have identified cycling as a very effective solution to many of these problems.

Currently, bicycle transport within Sydney is well behind many other domestic and global cities. As a result, this form of sustainable transport is becoming a more prominent issue and has seen an increase in initiatives, resources and infrastructure in an effort to make Sydney a more bicycle friendly city. This thesis contains an in-depth study of Sydney's current bicycle network and is made up of a comprehensive literature review and comparative study between the networks within Copenhagen, Melbourne and Sydney. This report will provide the Roads and Traffic Authority's Sustainable Transport Section with a comprehensive range of actions and recommendations to help improve cycling and the bicycle network within Sydney. This document also provides a range of stakeholders with valuable statistics and cycling information for the city of Sydney.

This thesis will also discuss, analyze and present the results collected from a large scale public survey regarding cycling transport within Sydney. This survey was developed for this thesis and was completed by members of the public on the Roads and Traffic Authority's live website. In addition, this report will present the ideas, concepts and summaries of interviews undertaken with four high ranking professionals within the cycling transport industry in Sydney and Australia. These components of this thesis will also contribute to the actions and recommendations presented to the Roads and Traffic Authority and will help provide a framework for future development and a vision for this mode of transport within Sydney.

The Development of a Technique for Quantifying Reliability in Behavior Tree Models

(12cp)

Jessica Formica - A11-058

Supervisor: Ravindra Bagia

Assessor: Mary Walmsley

Major: Mechanical and Mechatronic Engineering

The reliability of engineered systems has become a fundamental design consideration as a result of society's increasing dependence on the correct functioning of increasingly complex systems. Even though system safety, costs and quality may be optimized through the consideration of reliability in system design, current mainstream reliability engineering processes struggle to adequately manage reliability requirements in large-scale system design. Consequently, a methodology that facilitates both scalable and comprehensive reliability management would be highly valued.

Traditionally, reliability requirements and constraints are apportioned to sub-systems partitioned based on system behaviors. System reliability is then ascertained from the integration of such sub-systems using tools such as reliability block diagrams. This may fare feasible for smaller scale systems, however as the scale of a system increases, the complexity in managing the system's requirements becomes an increasingly challenging task.

The current Behavior Engineering methodology provides a foundation for the direct translation of requirements into Behavior Trees representing the system design. In further developing this approach, a scalable methodology for reliability assessment was devised. This was achieved through the integration of algorithms derived from the mapping of reliability block diagrams to Behavior Trees. The validity of the reliability methodology developed was shown through its application to a case study.

Investigation of Timber-Lightweight Concrete Composites (6cp)

Christopher Garven - S11-040

Supervisor: Christophe Gerber

Assessor: Anne Gardner

Major: Civil Engineering

Timber-concrete composites (TCCs) are being used increasingly in flooring systems, with timber beams supporting concrete slabs. Connection is typically in the form of screws, nails or metal bars, and an interlayer between the timber beams and concrete slab may be present, taking the form of formwork or an existing timber floor in the case of rehabilitation works.

TCCs have several advantages over full timber construction, including improved strength, stiffness, vibration control, fire performance and thermal and sound insulation. TCCs also have advantages compared to full concrete construction, including significantly reduced dead load. In line with this, and considering the relatively lower strength of timber beams, investigation of further means of weight reduction is desirable.

This research aims to improve understanding of the behaviour and failure mechanisms of timber-lightweight concrete composites, using locally available materials to evaluate their potential for use in Australia. In addition to normal concrete (NC), two different density lightweight concrete (LWC) mixes were prepared using expanded polystyrene beads in place of some coarse aggregate. Each mix was tested both with and without an interlayer. The connection mechanism was constant, via crossed ($\pm 45^\circ$) SFS screws. Push-out tests were undertaken to test the connection in shear, as a representative behaviour of the composite.

As expected, the strength of the samples decreased with density. Strength also decreased by approximately 10-15% where an interlayer was present. Behaviour and failure modes differed between mixes. Slip, both overall and between the concrete and interlayer, increased as strength decreased. In LWC samples with interlayers this led to a dual peak load behaviour, with a peak before interlayer failure, then a second peak at screw failure. Further, while higher strength samples failed at the tensile connector, lower strength samples exhibited failure of the compression connector after localised concrete crushing led to buckling and eventual shear. The failure of lower strength samples also tended to be more ductile.

This research suggests that there is strong potential for moderate lightweight concrete to be used in TCC systems, with limited effect on strength or behaviour. While their low compressive strength may limit applications for very lightweight concretes, they may still be suitable for use in TCCs and provide advantages over full timber construction.

Remotely Accessible Wind Tunnel (12cp)**Alexander Gibson - S10-040**

Supervisor: Matthew Gaston , Steve Murray

Assessor: David Davis

Major: ICT Computer Systems Engineering

Over the last decade remote laboratories have matured in capabilities and have developed from ad hoc one off implementations to become true systems to allow for stability, scalability, reliability and ease of development.

This has allowed the types of experiments (rigs) to diversify and to expand the pedagogical aspects especially as tools to help students to visualise basic scientific and engineering concepts. Getting students to combine theoretical knowledge with a practical application in a lesson or assignment so they have to explain differences between theoretical calculated results and practical results a long with uncertainties in measurement can help them to a better understanding of real world problems can assist in keeping students focused and motivated and make theoretical concepts more interesting.

This project seeks to develop a remotely accessible wind tunnel experiment for use by students at university and high school as a tool to assist with learning basic aerodynamic principles and additionally be used as a tool to attract or interest high school students to continue studying science and engineering at university.

It involves automating a desktop wind tunnel and developing a control system to allow for batch mode interaction by users. Most remote laboratory experiments in use and development today are interactive in nature with users having direct control over the experiment. Having a batch mode experiment allows the experiment(rig) to be run without needing the user to be present (locally or remotely) , allows sharing of the resource, faster experiment runtimes and allowing the system load and maintenance to be better managed and scheduled.

The system development included the prototyping and development of the control system including, electronics (low voltage) for the control and sensor systems, systems software and the user interface (web).

The main system software was developed using python and the sensor software was written in c and runs on avr and arm microcontrollers.

Customer-focused Concept Refinement and Business Case of a 4-post Test-rig System

(12cp)

Brett Granger - A11-062

Supervisor: Nong Zhang

Assessor: Jin Ji

Major: Innovation Engineering

Due to limited funding, small research groups need low-cost laboratory equipment. 4-post test-rigs are one such example. They are used within the automotive industry for such things as Noise, Vibration and Harshness (NVH) testing and durability testing. They comprise of four hydraulic actuators, one under each wheel of the vehicle, and produce vertical movement.

The opportunity – A niche market has been identified that desires a significantly cheaper version of the product. Currently there are no products readily available that satisfies their needs. Such a system would enable a greater number of smaller research groups, both private and government, to perform more effective vehicle dynamics testing.

The aim of this project was twofold; firstly, to perform the front end innovation process work required to refine the concept and provide the initial business plan for commercialisation purposes. Secondly, based on this innovation work a specific need was to be identified and selected for design and manufacture.

A Customer Needs Analysis was conducted and the Voice of Customer was established. The Quality Function Deployment (QFD) method was implementing using House of Quality (HOQ). The HOQ revealed the need for a vehicle stand and consequently this component was selected for design and manufacture.

The market size of 4-post test-rig systems that are currently available was determined to be \$300 million in annual sales revenue. That market has reached maturity and is currently declining by \$20 million annually. The Strategic Analysis suggests a slightly unfavorable commercialisation environment, and a small likelihood of a new entrant achieving commercial success. This paper provides a foundation for future objective decision making regarding the development and commercialisation of a 4-post test-rig system that best meet the needs of the identified niche market. Further analysis is required on the vehicle stand design and once performed it will be ready for manufacture and delivery to the customer.

Controller-Area Network (CAN) Analyser (12cp)**Dimitrije Grasar - A11-063**

Supervisor: Peter McLean

Assessor: Adel Al-Jumaily

Major: Electrical Engineering

Controller-Area Network (CAN) is an international serial communication protocol standard. CAN is able to operate through a single or dual wire configuration, it does not require a master unit for correct operation and guarantees maximum allowable speeds with up to thirty connected units. This makes the protocol favourable over others in terms of wiring complexity, network stability and robustness as well as overall efficiency. CAN is most commonly used in cars but has seen wide expansion in the industrial, aerospace and naval industries.

The aim of this project is to design and manufacture a working CAN Analyser. A prototype was made as a proof-of-concept and together with CAN capability it incorporates technologies such as Bluetooth, capacitive touch sensing, lithium-ion battery, an innovative and powerful microcontroller and a large display. The project also aimed to create a competitive unit in today's market so costing and physical design aspects were also taken into consideration.

The CAN Analyser is controlled with four capacitive touch sensing pads. It connects to the vehicle's internal network via the available On-Board Diagnostics-2 (OBD-II) connector and can query the on-board computer. The analysed data is stored locally and displayed on the graphical liquid crystal display (LCD). Stored information is capable of being accessed via the Universal Serial Bus (USB) or Bluetooth, through either a personal computer (PC) or an Android phone. While connected to a vehicle, the power is drawn directly from the car battery; otherwise a rechargeable battery will keep the system running. Recharging is controlled by the MCU and can be accomplished while connected to a vehicle or through a standard DC plug pack.

Next-Generation Software Management Framework: Integrating contemporary and Future Practices in Education and Corporations (6cp)

Anik Gupta - A11-064

Supervisor: Priyadarsi Nanda

Assessor: TBA

Major: Software Engineering

Software Project Management has been becoming an essential part of modern life practices in software development. It is well understood and applied in various areas of Project Management. In Australia, it has achieved a high reputation and will remain number 1 choice in future practices amongst Software companies, technical college trainings and Universities offering courses in software engineering. The history of project chaos repeated itself since 1994 where number of software projects was abandoned due to significant cost and time overruns. With increased rate of project failures, Software companies faced 54% in result of abandoned and cancelled projects. For this consequence, cancellation of projects resulted major lost in revenues and could not be recouped. Within next 5 years, it is predicted (based on survey results) that Australia is likely to face 30-40% range increase in average error estimation of software budgets and will spark many levels of software companies and Engineering institutions. Another survey was conducted which indicates, 85% error in Software requirements change throughout a project, dealing project complexity or wicked problems and the system's life cycle in the public sector of Australia. This approach will be carried out to blaze the way in the direction of the next generation of Software Management practice.

This project investigates practices in software project management through systematic methodology and provides sophisticated techniques and tools to be applied and tested in Software companies and other management enterprises. Associating business project management with software cost estimation and software economics are major factors to develop successful business integration. COCOMO II methodology will present usefulness solutions to integrate software cost estimation and metrics issues. The interviews have been conducted in Sydney with various Software companies on the basis of wicked problems in project complexity. System Dynamics is defined and investigated to understand the behaviour of complex projects and can optimize and overcome limitations of project practices. The importance of COCOMO II tool is demonstrated to improve the process of project budgets and scheduling and other financial planning. Overall, it measures incompleteness, uncertainty and weak size of developed software products. It is predicted that 32% encountered project risks associated with poor planning and time constraint that strains project deliverable. The study have been sourced from different Universities and software companies with medium to large size all over Australia demonstrated an accuracy of within 20% of actual 68% of the time for effort, and within 20% of actual 58% of the time for a non-incremental development schedule.

Investigation of Buckling Failure Mode of Spirally Wound Poly Vinyl Chloride (PVC) Liners in Trenchless Sewer Rehabilitation (6cp)

James Haisman - S11-045

Supervisor: Emre Erkmen

Assessor: Hamid Valipour

Major: Civil Engineering

In developed nations worldwide there are millions of kilometres of pipe work underground that is used for carrying wastewater and storm water. Over time these pipes degrade and become damaged to a point where they need to be rehabilitated. The most popular methods of rehabilitation worldwide for these degraded pipes are trenchless rehabilitation methods. Trenchless rehabilitation methods utilise the existing maintenance holes to gain access to the deteriorated pipe and apply the rehabilitation techniques via these maintenance holes. One such rehabilitation technique, which is widely used in Australia, is to spirally wind a poly vinyl chloride (PVC) profile pipe into the deteriorated host pipe.

Prior to the installation of these liners they must be designed to comply with the relevant standards for deflection, strength and buckling limits. In the instance where the condition of the host pipe is adequate enough to carry soil loads the liner is subjected to hydrostatic pressure only and at a critical depth below the ground water table the liner could buckle under this loading.

This project investigates the buckling failure mode of these types of PVC liners through numerical and experimental analysis. Due to time and monetary constraints only five (5) diameters have been tested. However, future testing will continue after the completion of this project to further investigate buckling failure mode in larger diameter pipes. The numerical analysis will be compared with experimental results and then used to predict the buckling loads of pipes with different diameters that have not been tested.

Improving Steam Turbine Efficiency through Refined Processes of Reducing Turbine Nozzle Diaphragm Surface Roughness (12cp)

Brett Ikin - A11-077

Supervisor: Phuoc Huynh

Assessor: Terry Brown

Major: Mechanical and Mechatronic Engineering

Steam turbine efficiency can be affected by many factors. One such factor is the surface roughness of the stationary turbine blade sets, known as nozzle diaphragms. Over the service life of a steam turbine, the surface finish of the nozzle material can degrade, increasing the losses in steam flow and reducing stage efficiency of the turbine. These losses occur when microscopic peaks in surface material disturb the laminar flow of the steam over the blades. These losses are directly related to the Reynolds number of the blade row and have a greater impact in higher pressure stages of the turbine where Reynolds number is high.

Toshiba, a world leader in power generation, have developed a robotic grit blasting machine, known as the Soft Polishing plant. This machine is used to carry out optional remedial work on the nozzle diaphragms of a steam turbine. This additional work is performed during planned maintenance outages, with minimal impact to the project schedule. The automated plant polishes each nozzle diaphragm to reduce its nozzle surface roughness. After working with this machine during a turbine outage, areas for improvement were identified, both in the equipment and the processes used during the remedial work.

This Capstone project presents three new design proposals for the Soft Polishing plant and its processes, to improve performance and reduce project costs. Each design proposal is based on available resources for the proposed improvements, offering low, medium and high cost solutions for the new design. Research on the effect of surface roughness forms part of this project, as well as field testing carried out on previously polished nozzle diaphragms. These new designs, along with the field research and testing, are supported by a business plan and design drawings to form a project proposal for Toshiba to consider in the future.

Feasibility Studies and Experimental Investigation on Influence of Integration of Vaportec Heat Pump in Performance of Domestic Water Heaters (12cp)

Jarrold Ison - A11-079

Supervisor: Jafar Madadnia

Assessor: John Dartnall; Brendan Bourke

Major: Mechanical Engineering

Air Sourced Heat Pump Water Heaters (ASHPWH) are a type of energy efficient water heater as they allow heat to be moved from the air into the water using a typical vapour compression refrigeration cycle. In the “vapour compression” cycle, heat is pumped from a low temperature medium (air) to another fluid (water in the water heater), rather than heating water directly. Based on relative positions of the condenser of the heat pump and water heater tank, heat transfer could be enhanced by different techniques including stratification, buoyancy or several passes. Experiments included use of psychrometric test lab, controlling water flow rate, measuring temperatures of refrigeration and water, enthalpy of refrigeration components and heat capacity.

This project details the investigation into an alternate concept of condenser, a type of heat exchanger, used in a current Rheem heat pump water heater. Currently heat pump models transfer about 3kW energy into the water tank for every 1kW electricity the compressor draws. Effectiveness and energy efficiency of the water heater are affected by the integration of heat pump, the type of heat exchanger core used (shell and tube, concentric, etc.), subcooling of liquid refrigerant before the expansion valve and superheating of gaseous refrigerant before the compressor.

It is believed by Vaportec, the company which designed the heat exchanger, that due to the design of the condenser and refrigeration circuit, the water heater efficiency can be increased; therefore reducing the power consumption to heat the same amount of water.

This concept has been tested using a prototype constructed by Vaportec, using a method equivalent to current Rheem test methods and AS/NZS 5125. Several tests were conducted to ensure consistency within results. These tests were analysed and compared with results of previous testing of current Rheem heat pump designs. Testing was performed to determine coefficient of performance of the heat pump to confirm claims made by the prototype manufacturer. Our experiments results have concluded that in certain conditions, economic benefits of operating heat-pump with water-heaters exceeded its costs, and recommendations are made to use heat pump for heating in those conditions.

Evaluation of Unsaturated properties of Cement related Sandy Clay (12cp)

Pil Yong Kang - A11-082

Supervisor: Hadi Khabbaz

Assessor: Behzad Fatahi

Major: Civil Engineering

Geotechnical engineers have been faced with numerical restrictions in normal construction site. When it comes to soft clays considered as problematic soils that have a high shrink-swell potential and cracking, it often presents difficulties for geotechnical structures. However, using cement can enhance for behavior soft clay soil. In addition, as mixing with fine dry sands, the characteristic of soft clay soil is improved in terms of compressibility and deformability, thereby producing improved construction ground properties results in making appropriate ground for foundations.

In this project, it is demonstrated that how unsaturated clay-cement mixtures are influenced by fine dry sands in terms of water contents. For the investigation of this, the concept of the soil-water characteristic curve (SWCC) is adopted to understand for its behavior by utilizing the pressure plate apparatus provided for the capillary-moisture properties described the retained moisture in the soil at certain suction pressures.

It is designed for the project to develop SWCC by conducting the test following the procedure called as 'Capillary moisture relationships for fine-textured soils by pressure membrane apparatus' according to an American National Standard. Using 15 bar pressure plate, the SWCCs are figured out to determine the relationship between the water content of the soil and the matric suction as the soil imbibes water.

In this experimental project, prepared total 12 with different proportions of kaolinite-cements with sand mixtures are inspected such as 40 per cent of sand with 10, 20 and 30 per cent of cement and discussed from the results obtained. It is plotted by using moisture contents or the degree of saturations for the materials at each applied pressure to observe unsaturated soil behavior. This SWCC can be made use of determining the characteristic of unsaturated clay-cement mixtures with fine dry sand and it can assist geotechnical engineers to design the deep soils mixing columns.

An Investigation into the Implementation of Building Information Modeling (Bim) within the Civil and Structural Engineering Industry (12cp)

Jun Seok Kim - S11-163

Supervisor: Chris Wilkinson

Assessor: Anne Gardner

Major: Civil Engineering

The implementation of Building Information Modelling (BIM) within the civil and structural engineering industry is in its early stages. Internationally, BIM's implementation is a decision that is still being deliberated. However, as the civil industry is soon to undergo a shift in paradigm from the 'Agricultural society' to the 'Knowledge and Information society'. This will include the systematic management of collected data and assets for documentation in historical records. This process that is integral for the civil industry to prepare if we wish to successfully pass on the accumulated knowledge from one generation to the next including stakeholders. Further, as the twenty-first century continues to welcome rapid developments in engineering technology, the civil and structural engineering industry must learn to accommodate more complex and larger scale projects.

The fundamental aim of this report is to explore and discuss the effects of implementing BIM within civil and structural engineering projects, a system that uses 3-D modelling to carry out data management processes. Potentially most current applications in the industry use BIM for the design & construction phase. This project highlights the usefulness of BIM for the maintenance phase of the infrastructure's lifecycle. This includes issues such as facility asset management, risk management, return on investment (ROI), Geospatial Information Systems (GIS) and quality control etc.

An analysis of published literature, including with staff at organisations involved in infrastructure design, construction and maintenance, reveals benefits and weakness of implementing BIM based on both current theoretical assumptions and life trials.

This project finds that the implementation of BIM in the Civil and Structural Industry is looked at positively upon. The BIM system efficiently and effectively improves the quality, efficiency, productivity and performance of a project, during all three phases of a construction project, Design, Operation and Maintenance.

Motion-based Controls for Menu Picks in the Xbox Kinect System (6cp)**Susannah Lai - A11-088**

Supervisor: Lian Loke

Assessor: TBA

Major: ICT (Software)

Natural User Interfaces (NUIs), where the user interacts with a computer, free of any artificial control devices, and the interface becomes invisible to the user, have recently become a focus of intense development. The development of technology that enables the use of the motion detection and analysis systems behind NUIs for use in home entertainment systems has allowed this revolution and the possibility of NUIs becoming a standard feature in future computer systems. This has implications on the design of these interfaces; they must be user-friendly and intuitive and they must be ergonomic and not tiring or harmful to the user.

This project is focusing on the gesture detection part of an NUI, in particular on creating a gesture set that users can relate to easily without having to use actions that are unnatural to them or tiring. The platform that will be used to develop this will be the Xbox Kinect, using the official Kinect for Windows SDK. There are some inherent difficulties and hardware limitations involved in this as well as user considerations. The methodology employed in the development of this project attempts to strike a balance between user consideration, hardware limitations and the usefulness of the software in the creation of menus in a NUI. User surveys were conducted to inform the set of implementable gestures to be recognized by the computer. These gestures are also analyzed and advice taken from expert sources, in particular, a Tai-Chi master to ensure their suitability for repeated, extended use for interaction with a computer. A gesture set and a demo tracking program has been developed, and the gestures compiled into a library that can be reused with other applications or further developed to improve and extend it.

Design and Implementation of a Roll Controlling Electro-Hydraulic Demand Dependent Active Suspension System (12cp)

Michael Lee - A11-094

Supervisor: Nong Zhang

Assessor: Paul Walker

Major: Mechanical and Mechatronic Engineering

The increasing popularity of the SUV (Sports Utility Vehicle) as a passenger vehicle in recent years has sparked the increase of the risk of rollover accidents to vehicle users. Studies have shown that the SUV is approximately 8 times more susceptible to rollover accidents occurring from vehicle to traffic barrier collisions than passenger vehicles even surpassing the risk of rollover from large pickup trucks (Gabauer and Gabler, 2009).

To target vehicular rollover safety without sacrificing the qualities of handling and comfort unnecessarily, Zhang et.al (2009) has developed the Demand Dependent Active Suspension (DDAS) system concept to address this issue. In this concept a novel application of a H-infinity control topology combined with hydraulic actuation is applied to produce a robust vehicle roll control system.

In order to realise this concept, the author presents the complete mechatronic synthesis of an electro-hydraulic control package to realise the DDAS concept. The results of the verification of both the performance of the individual elements of the system as well as the combined system implementation are presented.

Investigation into the applicability of the proposed H-infinity control system to low cost embedded microprocessors is conducted. Mathematical methods are applied to the proposed control system to reduce the complexity and increase the numerical stability of the controller, enabling feasible implementation of the controller system into low cost microcontroller hardware.

Modelling of the system is performed with respect to prior test data to produce an appropriate design for implementation. A design was then created to allow the installation of the hydraulic system to a Ford Territory test-bed for further evaluation.

Declarative Dependency Engine (12cp)**Stephen Lee - S11-071**

Supervisor: Chris Stanton

Assessor: Benjamin Johnston

Major: Software Engineering

In the context of the Toshiba range of Multifunction Printers (MFPs) there is often a need to describe interactions and constraints between various options. These are collectively referred to as dependencies. A particular example is Toshiba's Windows® printer driver user interface which provides a graphical interface that allows a user to select various printing options such as paper size, stapling, or hole-punch. Several of these options constrain selection of other options. For example, the MFP is not capable of performing hole-punch and stapling together unless both are on the same edge of the paper.

The currently proposed design for the driver describes these dependencies using a simple imperative language supporting the if-then-else construct. As the driver grows to support more features and multiple MFP models, it is anticipated that this approach may prove difficult to maintain and test due to combinatorial explosion.

To avoid these issues, this thesis proposes an alternate design approach: using a declarative language. A pre processor analyses the high-level language describing the dependencies and performs Boolean logic simplification to produce a low-level description of the dependencies as a kind of finite state machine. This description is then evaluated by a runtime system. Both the pre-processor and runtime system have been implemented and integrated into the driver.

In this thesis the academic basis of the declarative approach is outlined, similar techniques used by open source projects are discussed and the operational semantics of the declarative language are presented. Finally, appropriate metrics are used to demonstrate that the alternate design has reduced maintenance and testing effort compared to the currently proposed design.

Effects of Guide Vanes in Transition Flow from a Round Pipe to a Rectangular Chamber**(12cp)****Dingjie Lin - A11-099**

Supervisor: Phuoc Huynh

Assessor: Terry Brown

Major: Mechanical Engineering

This project aims to design a rectangular-box chamber for model testing and flow visualization, to be fitted into an existing horizontal axial-flow pump circuit. A computational study has been conducted into the flow of water as it expands from a 400-mm-diameter round pipe into a 3-D-rectangular-box configuration. The geometry is asymmetric; the pipe's bottom is aligned with the chamber's bottom, but its top is expanded into the chamber's top.

A uniform flow pattern in the test chamber is extremely desirable, since with a uniform flow, test results from the chamber will be more robust. However, as the flow expands from the round pipe to the rectangular chamber, a non-uniform flow will appear across the transit region and would take a long distance to settle to a uniform flow, if at all. Since there is also a limitation on the combined length of the transit region and test chamber, guide vanes are introduced to reduce the transition length.

Therefore, more specifically, the research is concerned with a computational study of the influence of guide vanes on reducing the transition region's length and producing a uniform flow in the rectangular test chamber. Influence of the guide vanes will be assessed by comparing the flow patterns resulting from different designs with and without the vanes.

A commercial Computational Fluid Dynamics (CFD) software package is used to simulate the isothermal turbulent water flow, using the standard K-epsilon turbulence model.

The result of this study is that the transition region's length can be reduce to about 1 m by 4 guide vanes which are set at attack angles of 1° , 4° , 7° and 11° respectively for the vanes from bottom to the top.

This study can be a reference regarding internal fluid control. It is also useful for student who wants to pick up a research about the free surface in the rectangular test chamber.

Progressive Collapse Assessment of a Reinforced Concrete Frame (6cp)

William Mason - S11-081

Supervisor: Hamid Valipour

Assessor: TBA

Major: Civil (Structures) Engineering

Progressive collapse is defined as the spread of an initial local failure from element to element, eventually resulting in the collapse of an entire structure or a disproportionately large part of it. The phenomenon of progressive collapse is caused by the loss of key members (i.e. columns), triggered by an accident or attack of low frequency but of extraordinary consequence.

The progressive collapse scenario has been selected for a three-dimensional reinforced concrete frame within Sydney designed according to AS3600-2009 and AS1170. The alternate load path (ALP) method is the adopted approach referenced in the U.S General Service Administration (GSA) Guidelines on “Progressive Collapse Analysis and Design Guidelines for New federal Office Buildings and Major Modernization Projects”. The ALP method assumes one or more columns have failed and are removed from the structural model and the remaining structure is analysed to determine whether other members or the entire structure will fail or not. The ALP Method is utilized to limit the amount of total damage by providing ways for the structure to redistribute loads and prevent propagation of failure when a local failure has occurred.

The commercial structural analysis software Staad.Pro was used to model the reinforced concrete frame and to perform a Linear Static Analysis and Linear Dynamic Analysis to assess the phenomenon of progressive collapse. The Linear Static Analysis assumes that a column has failed and is removed from the frame before undertaking the analysis. The frame is then analysed and the acting force in the structural element is determined and compared with the expected ultimate force obtaining a demand capacity ratio (DCR). The Linear Dynamic Analysis is conducted by removing the column instantaneously over a time period. The displacement caused by the removal of the element (i.e. column) is then compared with the displacement of a Linear Static Analysis obtaining a Dynamic Load Factor (DLF).

The assessment has compared the static response through the DCR and dynamic response through DLF values associated with individual elements with the current GSA guidelines. The assessment has also identified the behaviour associated with beams with the sudden change from negative to positive moment in the region of local failure and has provided practical recommendations to allow for an alternate load path to develop.

ISSA - Intelligent Sentiment-based Stock Advisor Identifying Financial Market Sentiment in Real-time Using Social Media Streams (12cp)

Nathan McCarthy - A11-107

Supervisor: Paul Kennedy

Assessor: John Debenham

Major: ICT (Computer Systems) Engineering

International financial markets are a cornerstone of the world's economies. In recent years algorithmic and automated trading systems have grown in complexity in-line with advancements in trading technology. Simultaneously, internet technologies have grown rapidly, and microblogging has become popular in exchanging financial opinions.

The Intelligent Sentiment-based Stock Advisor (ISSA) project focuses on two popular microblogging platforms, Twitter and StockTwits. ISSA leverages market data and social media to predict market and stock trends using sentiment analysis which estimates whether messages are positive or negative.

ISSA uniquely adds a human element to investment decision making. Traditional automated trading relies on real-time market data and news to make buy/sell decisions. ISSA collects investment related messages in real-time from social media streams to produce a profile of current market sentiment which, in-turn, can be used in investment decision making systems to aid in the determination of trading strategies.

This project presents a novel solution using computational linguistics to analyze financial sentiment in 1.2 million messages posted between March and October 2011. The system, developed in Java, provides a distributed, horizontally scalable text classification framework to run multiple classifiers, allowing the system to classify thousands of messages per minute.

It was found that the sentiment of these messages could be used in a simple trading strategy to generate positive returns in both the Australian and American stock markets over 6 months in 2011, outperforming both markets over the same period. The sentiment signal was also used to train a neural network to predict the direction of the Dow Jones Industrial Average two days in advance. Evaluating the neural network over three weeks confirmed that it could predict the direction with 80% accuracy.

Finally, a web interface and API are presented to provide investors and trading systems with access to ISSA to help them lower trading risk and improve returns.

Exhaust Heat Energy Recovery by Absorption Cooling of a Car Engine's Intake Air (6cp)**Travis McCarthy - S11-138**

Supervisor: Jafar Madadnia

Assessor: TBA

Major: Mechanical Engineering

This paper covers a unique and innovative way of improving performance and efficiency of internal combustion engines for use in motor vehicles.

Less than one third of the total energy in a given amount of fuel is transferred into the rotational motion that drives vehicles forward. The remainder is either used to overcome friction and drive auxiliaries such as the alternator and water pump or is wasted as heat through engine cooling and exhausted gas. The two forms of waste heat each account for approximately a third of the available energy.

Harnessing the thermal waste energy in the exhaust can be achieved through integration of a heat exchanger in order to power a vapour compression absorption cycle for the purpose of cooling intake air. This cooler, denser charge improves both volumetric and mechanical efficiency of engines with the outcome being improved performance, better fuel economy and lower emissions.

Recommendations for future work and other applications will be provided based on the analysed results contained in the body of this paper.

Application of Haptic Interfaces to Tele-operation of Delta Parallel Robots (12cp)

Rodney Morrison - A11-114

Supervisor: Zenon Chaczko

Assessor: Xiaoying Kong

Major: ICT (Software)

Recent years have led to great advancements in Human Computer Interaction (HCI), including touchscreens in tablets and phones, and haptic interfaces that allow tactile immersion in a virtual environment. With this came the concept of the Natural User Interface (NUI), and the ability to interact with computers through gestures. Microsoft's Kinect sensor extends this concept to allow users to interact in three dimensions. Soon after its release, many libraries surfaced to allow independent developers to access the information provided by the Kinect. Developers have used these libraries to enhance many aspects of HCI, most notably body gesture recognition; however one aspect that has been overlooked is hand gesture recognition.

This project outlines the development of a non-tactile user interface for the control of a Delta Parallel Robot, with a focus on extensibility to other technologies (both as input and output). The main source of input for the system will be a Kinect sensor. The Kinect sensor has facilities for producing a colour image and a 'depth image', as well as a microphone array for audio input. The system will extract an image of the user's hand, recognise the gesture being performed, and execute the command with the parallel robot.

The goals of the system are to be extensible to other technologies, as well as more affordable than previous technological solutions. Extensibility is achieved through a modular, loosely-coupled design, and user configurability. Low cost can be achieved by using components, such as the Kinect sensor, that are far less expensive than their higher-quality equivalents.

Using lower-quality sensors will unavoidably result in lower-quality results; this limits the complexity of the gestures that can be recognised. In a similar vein, designing the system's output to be completely interchangeable limits the specificity of output commands that can be executed; this has been overcome by allowing gestures to be mapped directly to configurable commands that are sent directly to the output module. This allows the commands to be specific to the output device being used, without the otherwise necessary command abstraction. Because both ends of the system are configurable, there is increased potential for more complex interaction and operations.

Development of an Audience Entertainment System for Gameshows Australia (12cp)**James Neilson - A11-120**

Supervisor: ZenonChazcko

Assessor: Xiaoying Kong

Major: ICT (Computer Systems)

Gameshows Australia is a small family-run business currently offering a bingo system in venues around Australia using proprietary software. The original software was developed over 10 years ago and now it is becoming a barrier to new market opportunities. Recently, competitors have started to offer visually appealing and high-tech solutions for venues. Gameshows Australia dominated the market for many years and at present, needs for the existing software to be redesigned to remain competitive.

This capstone can be categorised into two main areas:

- An investigation into new and existing technologies in relation to audience/system interaction
- The design and development of a suitable replacement solution that will allow for the integration these enhancing technologies.

The design requirements of this project are a combination of capturing the legacy system functionality and new requirements through consultations with Gameshows Australia in order to emulate and extend the original design.

The final system implementation is both scalable and adaptable to new technologies and integrates android devices to enable the operator to directly interact with audiences. The system has been completely redesigned and developed leveraging Windows Presentation Foundation (WPF) for rendering the user interface, consequently the system is visually pleasing. Usability has also been increased through the ability to have multiple input/output devices to meet the changing needs of Gameshows Australia.

Experimental Investigation for a Better Way to Use Ethanol Fuel in Internal Combustion Engines (12cp)

Gim Lim Ong - A11-126

Supervisor: Guang Hong
Assessor: Peter Tawadros
Major: Mechanical Engineering

Two very important issues in today's modern society are energy resources and environment conservation. Using alternative fuel sources is one of the ways to address them. Ethanol fuel has the potential to offer a reduction in exhaust emissions, suppression of engine knock and a contribution to the conservation of the depleting fossil fuels but at a cost of engine performance, financial implications and other considerations. This project aims to investigate a new method to use ethanol fuel more efficiently and effectively in terms of engine power output, fuel consumption and engine emissions.

An engine testing rig has been set up in the Engine Laboratory at UTS. Experiments have been undertaken using gasoline and ethanol fuel mixed at various ratios to investigate its effect on engine performance including fuel consumption and emissions.

In addition to that, effect of operation parameters on the performance of this dual fuel engine has been investigated. This includes variation of spark ignition timing, fuel injection timing as well as the use of different spark plugs. Results showed a peak improvement in power output and a fuel consumption reduction by up to 20% when 300o crank angle (CA) is used for fuel injection timing and 70o CA direct fuel injection timing. Results from the use of various spark plugs were also useful by showing the effect of different head lengths of the individual spark plug.

Preliminary experimental results have shown that the new engine test rig would provide a solid foundation for further research regarding ethanol fuel usage.

Locomotion for Humanoid Robots (12cp)

Edward Ratanasena - S10-127

Supervisor : Mary-Anne Williams

Assessor : Benjamin Johnston

Major: Mechanical and Mechatronic Engineering

RoboCup is an international robotics competition designed to stimulate research and development. This thesis focuses on the Standard Platform League (SPL) within the RoboCup domain where teams program a robot to play soccer using the same hardware. The standard platform is now the Aldebaran Nao - a small humanoid robot 53cm tall.

This Capstone project arises from the software intelligence and control requirements of the robot body. The developmental work has been very broad and can be broken up into three main sections:

1. **Locomotion** - A pre-existing walk engine was used as a base and framework. This project involved the integration and optimisation of this locomotion engine. Optimisation involved a combination of both manual tuning and Particle Swarm Optimisation (PSO). Our locomotion engine was one of the top 5 in the competition, obtaining speeds of up to 25cm/s using the Zero-Moment-Point (ZMP) criterion.
2. **Special Motions** - These are motions such as kicking and getting up off the ground. This thesis describes the use of Key-Frame-Motions (KFM) to develop these actions.
3. **Collision Detection** - A system was developed whereby we can reliably infer collision by only reading motor command and sensor values. Purely using the difference between command and sensor values was found to be insensitive. Our approach involved training neural networks to predict sensor values. Comparison of predictions and actual values has proven to be an effective method to detect collisions or joint-malfunction.

All aspects of this project were used at the RoboCup 2011 competition. In particular, the collision detection system was showcased for the open challenge section of the competition which achieved a top 10 ranking globally.

An Energy Harvesting System for Biomedical Sensors (12cp)**Daniel Roxby - A11-138**

Supervisor: Steven Su

Assessor: Hung Nguyen

Major: Electrical Engineering

Low power electronics and energy harvesting techniques have evolved in the past 10 years, such that it is now possible to create systems which can be independent of large scale power supply. Many integrated circuit chips can operate on as little as microwatts of power which is perfect for recent energy harvesting systems which have been able to store between microwatts to several watts of power (Donelan, 2008). This energy is often harvested from the human body, so the focus has often been minimizing the effort expended by the user.

An interesting way in which this could be done involves the temperature difference between the human body and its environment. Whether a person is active or inactive, body heat is produced. A way of harvesting thermal energy comes with peltier cells, where with a temperature difference across their surfaces, will convert a proportion of the thermal energy flowing into electricity. The system is intended to power biomedical sensors, since the system will already operate with the body.

The focus of this capstone project then is to provide preliminary tests of a system to demonstrate this idea. What is presented is an overall thermal energy harvesting system design and simple sensing application, along with the various items documenting the stages of its development. A big part of the development involved the building of a basic system to test peltier cells.

The final design uses a low powered sensor, instrumentation amplifier and microprocessor for sampling body temperature which is powered by a low cost highly integrated energy harvesting chip and peltier cell. The vest like design is for environments where the temperature is lower than the human body temperature. Sensing data is taken on a duty cycle basis and stored such that it can be downloaded via USB and later analysed.

Assessment of Influence of the Initial Stress State and Interface Parameters on the Performance of Laterally Loaded Piles (6cp)

Patrick Ryan - S11-096

Supervisor: Behzad Fatahi

Assessor: Hadi Khabbaz

Major: Civil Engineering

Deep foundations, or piles, are a crucial component of many substantial structures that exist today, such as bridges, high-rise buildings, towers and offshore platforms/structures. One of the key attributes of piles that such structures require is the ability to resist lateral loads, such as wind loads, wave loads, impact loads and earthquake loads. This requirement to resist substantial lateral loads presents geotechnical engineers with the challenge of analysing the lateral behaviour of such piles. Laterally-loaded piles require an investigation into the likely soil reaction, lateral displacement and soil-pile interaction of the pile system. This behaviour is complex due to the elastic-plastic, non-linear properties of soils, three-dimensional factors and the modelling of the soil-pile interface.

This project explores the evolution of various significant methods used by researchers and engineers to analyse the behaviour of laterally loaded piles, including limit-state, load-transfer (p-y) and finite-element based methods. A case-study of laterally-loaded piles is also explored and modelled using an existing, commercial finite-element modelling program. The results of the model have been verified against known field measurements from the case-study. Such results include depth-displacement, depth-bending moment and p-y curves.

Additionally, a parametric study has been conducted to investigate the influence of the coefficient of lateral earth pressure at rest (K_0) and the interface strength reduction factor (R_{inter}) on the results of the model. The results of this study can be used by the practicing geotechnical engineers and researchers to better understand the significance of such parameters on finite-element-based, laterally-loaded pile models. In turn, more accurate finite-element models can be created and utilized to assist in pile-design and foundation engineering.

Generational Changes of Risk Perception Involving Children (6cp)**Charles Sawley - S11-100**

Supervisor: David Eager

Assessor: Christopher Chapman

Major: Civil Engineering

Appropriate management of risk is of great importance to the individual as well as to society as a whole. If risk perception skills are not developed adequately during childhood the ability to identify and manage risk will be impeded and may result in an individual having an inadequate level of risk awareness and perception later in adult life.

The purpose of this study was to determine whether there has been an inter-generational shift in the amount of risks that children between the ages of 7-10 are exposed to. The end goal of this study was to identify a trend of increased protectionism within society as well as to provide potential causes of this change in the approach to child safety and learning.

The research conducted within this study comprised a theoretical explanation about the base concepts which underpin any inter-generational shifts with respect to risk. Primary research was conducted through the use of a survey instrument to gather opinions from adults on their own experiences as a child and the experiences of their own children. A comparison was then undertaken. Children were also given a visual survey that consisted of a number of pairs of photographs which were used to illicit their perceptions on activities that they prefer and what risks they perceive within those activities.

The results of this study show a reduction in the level of risk that children today are exposed to. It is hypothesized that this is lowering the opportunities that children have to develop their risk management skills. Engineering implications of this identification of reduced levels of risk could include the development of children's activities and toys which do not eliminate inherent risks, thereby allowing children to develop and enhance their risk management skills.

Energy Consumption Monitoring for Building Management Systems

Daniel Schrader - A11-143

Supervisor: Steven Su

Assessor: Li Li

Major: Electrical Engineering

Power/energy measurement is integral for the management of energy being consumed. Building management systems generally need to improve the transparency of the energy consumption profile. A device that can connect to a building's main control network in order to monitor the energy consumption would be invaluable. Existing devices on the market are expensive and usually are made and designed overseas. It is important for the future to have a simple, local and cost effective way of managing our energy consumption.

This project is a proof of concept design for such a device.

This project will be the design and manufacturing of a product to measure real-time information about the energy consumption of equipment used in large buildings for the management of that buildings energy (eg. Heaters, Chillers, Fans). This will in turn allow for the profiling of energy consumption of this chiller for future improvements implemented through new control techniques. The current and voltage values will be read in real time sampling and the data will be analysed for the appropriate readings (eg. power consumption, pf, reactive power etc). These values are saved to an SD card, displayed on an LCD screen and communicated to the network using the ModBus /BACnet protocol. A simple graphical user interface has also been developed in VB.NET which communicates with the device and displays information.

The product to be developed will include the design of a standalone device supported by the functionality of PIC microcontrollers. The set-up will need a current transformers to step down the signal for the device.

This project will make contributions to the innovative culture of Australian engineering, with the production of an Australian made product which can be catered to the exact needs of such a product integrated into industrial building management systems.

Electronic Tutorials for Structural Analysis Technical Instruction (12cp)**Jordan Scott - A11-144**

Supervisor: Ali Saleh

Assessor: Anne Gardner

Major: Civil Engineering

Teaching and learning is optimized when flexibility is promoted in regards to location, teaching modes as well as maximization of learning resources. The University of Technology, Sydney (UTS) currently compliments in-class teaching methods with online teaching and learning resources to provide this flexibility. These resources are of varying formats (such as animations and e-tasks) and are available in different locations. This project focuses on centralizing the available remote learning resources as well as providing additional resources to compliment learning.

One resource (called e-tutorials) will be provided to students undertaking the subject 48349 Structural Analysis at UTS. It will be available outside the classroom, at University and at home. The e-tutorials contain a number of instructional animations, interactive pages, quizzes and links to web sites focused on teaching the basic concepts and prerequisite knowledge vital for understanding more complex principles of structural analysis.

The e-tutorials will be of particular interest to students who wish to bridge prerequisite knowledge gaps. They are designed to be a central, easy-access resource for student to increase their understanding at any time and in many locations outside the classroom. The e-tutorials may also prove to be a valuable resource for students undertaking 48321 Engineering Mechanics, 48331 Mechanics of Solids and 16206 Structures.

Steel Portal Frame Design Application (6cp)

David Shutte - S11-106

Supervisor: Ali Saleh; Hamid Valipour

Assessor: TBA

Major: Civil Engineering (Structures)

The thesis comprises of software created in Excel and Visual Basic Application for Excel to assist in the design of portal frames. Portal frame design is a very common process in the structural engineering field, though there are few manuals and design guides dealing with the processes involved. Portal frames are the most common type of industrial structure as they allow for large areas that are un-interrupted by columns. The process of design is often tedious and requires the use of various software, Australian Standards and calculation processes. The aim of the software is to reduce the time and resources that a structural engineer requires to design a common portal frame.

The design procedures are based on first-order elastic analysis described in the Australian design provisions of the Steel Structures Code, AS 4100. The loading conditions adopted were a combination of vertical, lateral, gravity and point loads taken from the Australian design provisions, AS1170 (Parts 0, 1 and 2) and for simplicity restricts the structures roofing pitch to <10 degrees.

The software analyses members and member data gathered from the Onesteel Hot-Rolled Structural Sections Catalogue and applies the data as well as the loads from AS1170 to a matrix analysis called Direct Stiffness Method. This analysis produces the forces and deflections in the structure both locally and globally. For each member a matrix analysis and design procedures from AS 4100 are completed to allow a user quick and efficient design of the structure.

The design of this software on completion of this project will contribute significantly to further development of software for portal frames, to later include design procedures for:

- Purlins and Girts
- Haunches
- Portal Frame Connections and Base Plates.
- Cad Outputs

Examining Passive Methods of Mitigating the Effects of Wind Loads on Tall Structures and the Selection Criteria Adopted for these Different Approaches (6cp)

Timothy Small - S11-111

Supervisor: Bijan Samali

Assessor: Ali Saleh

Major: Civil Engineering

With the increase in the accuracy of structural modelling and greater prevalence of lightweight materials and construction techniques, buildings are being constructed which are significantly lighter and taller than at any time in the past. Due to these advances, wind loading has become a major concern for structural designers both in the ultimate and serviceability limit states. There is presently a need for a concise overview of the main methods of passive mitigation of the effects of wind loading. This paper fills that gap in the current literature.

Each of the different approaches to wind loading are described and analysed in terms of the underlying physical principles which allow them to function, conditions under which they should be used and their advantages and disadvantages. Case studies of each of the approaches are given as a means of demonstrating successful implementations. Secondary sources are used to gather the information needed.

This thesis is designed to act as a reference for students or professional engineers, allowing them to gain an overall understanding of each approach to reducing the wind induced response of tall buildings. This understanding will allow them to decide which damping system is most appropriate for their particular situation and to understand some of their design requirements.

Design & Development of Low Yield, High Efficiency Water Pump – (12cp)**Abdul Baset Taheer - S10-185**

Supervisor: John Dartnall

Assessor: Garry Marks

Major: Mechanical Engineering

A high efficiency, bore water positive displacement pump for low yield wells was detail designed in this project; it is an enhanced version of a previously developed design by John Dartnall which he has a thesis on “Innovative Mechanical Design with a Case Study of Pumping Systems for Low Yield Tube Wells” (Dartnall, 2003). Bore water usage is facilitated using low yield well pump but it is still in the developing stages. Manufacturing, assembly and maintenance have been the keystone of all designs completed in this project. The ideal product would be manufactured and used easily whilst being affordable. The success of this project will benefit many communities that rely heavily on ground water sources and especially those communities that are based in less developed areas.

The thesis will elaborate on the key areas for improvement some of which include technical efficiency of the product and its manufacturing. Alternative design ideas and adjustments made to increase the performance and to minimize cost issues will be discussed in this thesis. It is important for the bore pump to be manufactured in an low technology and standardized manner therefore, precise designs and models are to be made. The consumer’s need and accessibility is the main concern when creating a product and thus the assembly, maintenance and the process of use for this pump is reviewed.

This project will describe all the design phases and conceptual designs for the improvement of the bore pump. The designs will then be the basis of manufacturing a fully functional pump and will later be critically analyzed for any further modifications

Sample Capstone Project Title – Investigating Soil Consolidation Using Rowe Cell (6cp)**Jean Taouk - S11-117**

Supervisor: Behzad Fatahi

Assessor: Hadi Khabbaz

Major: Structural Engineering

As the social and economical development of the world keep advancing along with the increase in the population, the availability of appropriate sites with proper soil for construction becomes increasingly meager. Soft soils are more predominant around coastal areas or river sides where demand for construction is usually higher. One of the design challenges of construction on soft soils is prediction of the ground consolidation settlement which may be excessive for deep soft clays. Consolidation settlement is the rate of volume change under an applied load over a period of time, while immediate settlement is the instant volume change under an applied load. Such change occurs rapidly due to the good drainage properties of cohesionless soil.

This capstone briefly summarises the basic characteristics of soils while primarily focusing on soil consolidation. It compares two of the currently available methods to measure soil consolidation properties namely Rowe cell consolidation apparatus and the conventional oedometer. It examines the theoretical differences between the two methods summarising comprehensive list of advantages and disadvantages for each. The laboratory experiment is conducted using a small Rowe cell available at UTS, where the clay sample is loaded hydraulically by water pressure. The experiment then continuously measures the pore water pressure and the axial displacement of the sample. Results of the Rowe cell consolidation test are used to predict consolidation properties. Practicing Geotechnical Engineers can use results of this capstone thesis to conduct laboratory consolidation test using Rowe Cell step by step, and interpret the results to calculate the design parameters.

The Experimental Investigation of Noise Produced by Building Integrated Horizontal-Axis Wind Turbines (6cp)

Kaushik Tilwa - S11-137

Supervisor: Jafar Madadnia

Assessor:

Major: Mechanical

There is increase in demand and research of renewable source of energy around the world. Wind power is considered to be the most efficient one. But the wind turbines also have a problem associated with them. The noise produced from these turbines is low frequency and high amplitude noise. These can be heard from longer distances. This is one of the reasons why they are installed in remote areas.

The objective of this project is to investigate experimentally the sources of noise from different shaped wind turbines and test different method and ideas on how to eliminate or reduce them below audible sound level. The experiment will record data on sound pressure level, frequency of sound and RPM of rotating shaft. The experiment will also include twin shaft wind turbines and its effect on noise. The experimental results may assist in determining the sources of noise and determining possible methods to reduce noise.

The project will require research on different methods currently being used to reduce noise and provide recommendations for improvement and new method for experiment. The focus of project will be on value addition for next semester students by summarizing experimental data and research materials.

Use of Segway Robotic Mobility Platform (RMP) for Health Care Applications (12cp)**Martin Tirzins - A11-153**

Supervisor: Hung Nguyen

Assessor: Steven Su

Major: Electrical Engineering

The Segway Robotic Mobility Platform (RMP) is a commercially available robotics platform based on the concept of a wheeled inverted pendulum, utilizing the experience the firm has had in the past with their variations of the Segway technologies in the area of personal transportation. While the platform has seen heavy use in the field of mobile robotics in the past, little consideration has been put into its use in health care applications.

Initial plans for the RMP in the UTS Health Technologies Centre revolved around the concept of the RMP as a base for the mechatronic hospital bed currently under development at UTS, with the possibility of additional uses as a robotic aid to assist with the movement of supplies in hospitals. Based on these desired uses, a series of possible tasks were decided on for initial development and testing. These included the development of a system to allow the RMP to follow a person utilizing a laser range finder, the development of an android interface to control the movement of the RMP, and the development of an improved balance controller.

LabVIEW was selected as the initial development platform for the system due to the ease of use when dealing with multiple sensors and systems for modeling and control, and the relative speed with which test programs could be developed.

This report will focus on the work carried out with the RMP in regards to person following, mobile application development, and the work on improved controller designs. It will give detailed information about the success of each task, the potential for future development, and the suitability of the technology in a hospital environment.

Optimisation of Chemical Stabilisers for the Stabilisation of Organic Soils – Experimental Study (6cp)

Nugroho Tjahjono - S11-121

Supervisor: Hadi Khabbaz

Assessor: Behzad Fatahi

Major: Civil Engineering

Soil is a fundamental component in civil engineering projects. It acts the foundation of the majority of civil structures such as buildings and roads. In some cases, soils possess undesirable properties that often do not meet the requirements in civil projects. In other cases, it can also impose environmental risks to many structures such as erosion. Furthermore soils are known to degrade overtime and therefore maintaining its properties is crucial in ensuring the structure integrity. Stabilisation of soils has become one of the prominent methods in solving many geotechnical problems. This method promotes alterations to the soils' properties in order to improve its capabilities.

Fly ash is a residue produced in combustion process, at the present it is commonly generated as a by-product from coal power stations. This material is widely abundant and it is identified as a pozzolan. When it is mixed with lime, it would trigger pozzolanic reaction which causes a pozzolan to develop cementitious properties. In the context of soil stabilisation, these chemical materials are used as binding agents within to the soils to improve its properties.

This experiment investigates the viability of chemical stabilisation on organic soils for the improvement of its characteristics. The experiment attempts to measure the impact of the chemical stabilisers such as fly ash and lime on the soils' compressive strength and permeability. Various samples will be made based on stabilisers ratios, mass percentages of the materials and curing periods. The experiment aims to discover the most optimum results which are able to provide the best outcomes from stabilisation method.

Optimisations of Fly Ash and Lime to Stabilise Soft Soil (6cp)**Terence Tjandra - S11-122**

Supervisor: Hadi Khabbaz

Assessor: Behzad Fatahi

Major: Civil Engineering

Fly ash is the residual waste from coal power station. Due to relatively cheap price of coal compare to the other energy source, coal power stations remain the majority of power stations around the world. The disposal of large amount of fly ash contributes to major land environmental problem around the world. Fly ash mainly used in concrete industry in order to reduce the quantity of cement mixture, thus saving cost. But the disposal of the fly ash from coal power stations is far outweighing the amount used in concrete industry. Lime is one of building material used as sticking agent. Lime is extracted from mineral containing calcium such as limestone. Due to fly ash pozzolanic characteristic, Lime is used to stabilise weak fly ash.

This project will investigate the effect of adding fly ash and lime to soil's unconfined compressive strength. The aim is to give additional strength to the soil so it can be used for construction of embankment, dams, retaining walls, etc. The stabilisation of soft soil using only lime has already been used for quite some time but this practice require a lot of lime, thus it is a very costly method. By adding fly ash, we can significantly reduce the amount of lime in the mixture to save cost and at the same time reducing environmental waste from fly ash itself.

The optimum combination of fly ash and lime will be determined by soil's unconfined compressive strength. This project will produce 48 soil samples each with different composition of the fly ash and lime and also different curing time. There are 4 ratios for fly ash and lime, and each ratio will have 4 different compositions and each composition will have 3 samples for different curing time.

A Compressed Natural Gas Nozzle for Global Automotive Applications (12cp)

Michael Treloar - A11-157

Supervisor: Phuoc Huynh

Assessor: Terry Brown

Major: Mechanical Engineering

This present Capstone aims to evaluate the current global environment surrounding the Compressed Natural Gas (CNG) industry, with a particular focus on CNG refuelling technology, concluding with the design of a CNG nozzle. Attention will be directed at the following CNG nozzle elements: Connection system, Lever actuator and Valving system, then to be compared to the current market leading product. To achieve this outcome a variety of methods, such as literature reviews, patent searches, research into the properties and manipulation of Methane, a breakdown of the refuelling process and an investigation into the CNG nozzle market were used. The testing and analysis of existing nozzles and the flow resistance paths of the proposed designs and also that of a leading competitor were employed to distinguish the potential operational characteristics in the proposed design.

The push for the use of alternative fuel sources to power the world's motor vehicles has increased dramatically as global populations witness the effects of the reliance on heavy fossil fuels such as gasoline and diesel and their detrimental environmental impact and finite supply. The challenges of overcoming the dependency on fossil fuels is exposed and opportunities in utilising Methane as a primary energy source are analysed, along with the initiatives international governments are employing to combat pollution in the transport sector.

A specific emphasis on the refuelling nozzles directly involved in supporting natural gas vehicles (NGV) identifies the importance of growing customer acceptance throughout all NGV markets. To achieve sufficient knowledge and understanding of CNG nozzles, an investigation into three current Class A refuelling nozzles is conducted. Comprehension of the refuelling process and the breakdown and analysis of these products assisted the proposed design. Particular focus is put on the release of wasted gas during the unavoidable venting process at the final stage of refuelling. Complexity of current nozzle designs discourages growth in the CNG refuelling market, the proposed design aims to remove this intricacy while maintaining safety and function while also achieving a respectable dead space volume release upon disconnection.

An Investigation Into Bolted Timber Connections (6CP)

Danielle Turrin - S11-124

Supervisor: Christophe Gerber

Assessor: TBA

Major: Civil Engineering

Engineered wood products are increasingly being used in substitute of traditional sawn timber in a range of structural building applications. This can be attributed to engineered wood products generally possessing higher characteristic stiffness and strength than sawn members of the same wood species.

Laminated veneer lumber (LVL) is considered to be an engineered wood product as it is formed by joining thin veneers together with adhesive. The drive to advance the engineered wood product industry has led to the development of cross-band laminated veneer lumber (LVL-C), which is formed similarly to LVL, but the two veneers located directly beneath the outermost veneers of the member are orientated perpendicular to the others.

The primary project aim was to compare the characteristic strength and stiffness of three member bolt fastened timber connections made of LVL and LVL-C. Fifteen test specimens of LVL were tested, ten of which were reinforced with timber screws and five of which were left unreinforced. Two different screw arrangements were tested. Five test specimens of LVL-C were tested to enable a comparison.

The additional aims of the investigation were to enable the provision of comments upon whether LVL-C functions comparably to LVL in its unreinforced and reinforced state. Comment is made upon the suitability of the current Australian Timber Design Code AS1720.1 for the use of connections made from LVL and LVL-C, and an analysis of the results was performed in accordance with the contents of Eurocode 5:Design of timber structures 2004. As an outcome of this investigation I anticipate that I will be able to quantify the benefits of reinforcing LVL or using LVL-C as a substitute for LVL.

Investigation of the Corrosion Protection Performance of CC and DAS Anode Sacrificial Cathodic Protection Systems Installed on Reinforced Concrete Bridge Structures Located within Marine Environments (12 cp)

Daniel Weber - A11-163

Supervisor: Kirk Vessalas

Assessor: Robert McLaughlan

Major: Civil Engineering

Corrosion of steel reinforcing within reinforced concrete bridge structures located within marine environments is a major concern to infrastructure asset managers. Reinforcement corrosion causes physical damage to engineered structures, which can result in order of severity in structural failure, early decommissioning or at the least the need for expensive repairs. In addition, corrosion of reinforced infrastructure is of major economic concern worldwide. Within Australia, an estimated \$13 billion is spent each year to monitor, mitigate and inhibit corrosion. Due to the substantive overall cost of corrosion, solutions to mitigate the extent of corrosion must be found.

Once corrosion has initiated, several technologies can be employed to reduce the rate of corrosion to an extent that in turn inhibits further deterioration. Such options include the use of protective coatings, migratory corrosion inhibitors, patch repair systems, re-alkalisation, chloride extraction and cathodic protection. Of these technologies, only cathodic protection has proven to provide long-term corrosion protection in existing reinforced concrete structures.

This project investigates the use of a form of cathodic protection known as Sacrificial Cathodic Protection (SCP). Two different SCP systems have been trialled: Vector™ Galvanode® CC; and, Vector™ Galvanode® DAS anode systems. These systems have been installed on three reinforced concrete bridges located in marine environments within Sydney, New South Wales (NSW), Australia. The performance of these systems in providing corrosion protection has been assessed throughout the project based on the potential shift and potential decay criterion specified in Australian Standard (AS) 2832.5–2008 Clause 2.3. The results of testing demonstrate that both CC and DAS anode systems are capable of providing full cathodic protection as defined in AS 2832.5 criteria; however, the level of protection was found to vary depending on the severity of the environmental exposure to the reinforcing (i. e., corrosive state of reinforcement). Relative trends in the performance of the systems as a function of time have also been investigated, revealing a decrease in performance due to decreased current outputs of the systems with increasing time; however, results indicate SCP systems can provide significant corrosion protection for a period of at least 10 years.

Neptune Necklace: Providing Clean, Renewable Electricity through Harnessing Energy from Ocean Swells at the Point of Consumption, with Minimal Environmental Impact (12cp)

Jack Wild - A11-166

Supervisor: Catherine Killen

Assessor: Peter Brady

Major: Innovation Engineering

Global energy demands from rising populations and increasing per capita consumption will not be able to be met from the finite supply of traditional fossil fuels. Alternative, renewable clean energy derived from a resource that covers 70% of the Earth's surface is therefore a tantalising prospect

The 'Neptune Necklace' is an innovative renewable wave energy harvesting system that I have conceived, designed, tested and evaluated for engineering functionality and commercial viability. The design is intended to act as a local base and/or peak load renewable power source near the point of consumption, therefore possible implementation sites have also been assessed.

The system I propose involves an array of modular fluid compressing pumps that capture the kinetic and gravitational potential energy of passing deep ocean waves. The compressed fluid shall be stored in an underwater holding unit before being piped to an onshore electricity generation plant which utilises a fluid driven turbine system as needed, so as to match local energy demands.

The energy harvesting sub system is the focus of my Capstone project and is the inventive leap. The system involves the high pressure compression of small volumes of fluid which then trickle charge the storage system. As a consequence each module is significantly smaller and more simple than existing wave energy technologies and therefore less expensive. The upshot is that being modular, it can be initially installed and then capacity can be added as resources permit. The modular construction also means maintenance can be carried out in situ without the entire system being taken offline.

Proof of concept prototypes have proved the validity of my design and bench tests have provided valuable data which will be used in the final product. Initial discussions are underway with venture capital providers with a view to commercialisation of the Neptune Necklace.

The Design and Development of an Intelligent Power Outlet Controller and Data Logger For the Home Utilising the Zigbee™ Communication Framework (12 Cp)

Barry Winata - A11-167

Supervisor: Peter McLean

Assessor: Steven Murray

Major: Electrical Engineering

The boom in energy demand observed in recent decades, attributed by population growth (especially developing nations), advances in science and technology and the increasing standards of living for society, have been forecasted to grow indefinitely for the foreseeable future. Threats of fossil fuel depletion and climate change has seen a social outcry for greater global environmental friendliness. Consequently, initiatives in renewable energy sources i.e. solar, wind etc. are being undertaken with the hope of supporting our future demand. However lack of action and an inherent time lag is placing constraints on renewable development.

Given this dilemma, we are now faced with the issue of managing this demand in the short to medium term. One potential solution is smart metering. Smart or intelligent metering is the process of analysing and informing the user in real-time of their power usage. Currently, smart meters are of limited functionality either due to their cost, size or robustness and for this reason does little in influencing the consumption behaviour of society.

Therefore the aim of this project was to develop a low-cost, light-weight, portable wireless meter utilising the ZigBee™ framework capable of providing feedback to consumers around the home. This project encapsulated an embedded system that entailed the design of hardware and software components. Both devices utilised low-power electronics and software algorithms where possible.

One device (master) represented the hub of a given network and communicated with its counterparts (slave). The slave was capable of sequentially monitoring a given load's consumption, by either storing or transmitting it back to the master for analysis. Testing showed, range was reasonable and robust in a typical household where line of sight exists. Although a peer-to-peer network was not developed for proof-of-concept, utilisation of such a network can overcome such barriers of sight thus allowing full global communication given multiple devices.

Artificial Intelligence Data Analysis and Prediction (12cp)**Steven Wong - A11-168**

Supervisor: Zenon Chaczko

Assessor: Xiaoying Kong

Major: ICT (Software)

There is no doubt that information in modern society is critical to the success of any, if not all, established institutions. Information is no longer regarded as merely the transfer of knowledge but as a valuable commodity. The importance and value that society hold for information can be clearly observed through the myriad of legislative rulings which govern how information may be obtained and used.

Accelerating society's reliance on information largely depends on the integration of ICT technology into the daily operation of virtually all institutions within developing and developed countries. The Internet, in combination with modern technological devices, have propelled the ease at which information can be accessed and produced. However, as the amount of information available expands the problem is no longer the speed at which information is accessed, but the ease of cognitive comprehension.

The 'Artificial Intelligence Data Analysis and Prediction' software attempts to alleviate the issue of information overload by utilising theories developed in the field of artificial intelligence and 3D graphics to develop a software which will facilitate modern decision making processes. The software allow users to develop a model whereby actions may be executed depending on the content of information and utility of outcomes. The software will also allow users to define 3D graphical elements to assist in immediate information cognition which deviates from the tradition of using graphs to represent the state of information being modelled.

The Construction of an Experimental Test Rig to Simulate the Forces Experienced in John Dartnall's Low Yield Water Pump Transmission(12cp)

Lawson Yu - A11-174

Supervisor: John Dartnall

Assessor: TBA

Major: Innovation (Mechanical)

Currently John Dartnall is in the process of redesigning his low yield water pump. In this process he has taken many design considerations as to components that can be redesigned and manufactured in a better manner for the end user. He created an original design for the power transmission of the pump which involves the use of rods and bushes. The rods and bushes are designed to deflect under compression and tension, essentially this method is more efficient than having one long rod that is traditionally used in the industry. Along with this he has also formulated an equation that complements his original design.

The objective has been to create and construct a physical experiment rig that simulates that forces experienced in the power transmission of the low yield water pump. Apart from simulating an analysis will be completed detailing how the theoretical results compare with real world results with conclusions and recommendations.

Entailed in reaching the objective, the task involves designing all the components that are to fit into the experiment rig. A detailed analysis on the different design configurations that were created will be included with consideration of cost and benefits of them.

These design configurations, considerations and conclusions will be used by John for further implementations to his final designs for his low yield water pump.

Comparison of Conventionally Reinforced Concrete and Pre-Stressed Concrete Structures with Respect to CO₂ Emissions (6cp)

Andrew D'Ambrosio - S11-024

Supervisor: Anne Gardner

Assessor: Chris Gerber

Major: Civil Engineering

The choice between adopting conventionally reinforced concrete and pre-stressed concrete in a project has traditionally been based on cost and ease of construction. Today, society is placing increasing emphasis on sustainable developments. The notion of sustainable development is a more recent concept which seeks to integrate environmental, social and economic factors into

one issue. Sustainable development is the meeting of today's needs without compromising the needs of people in the future (Dovers, 2005).

There has been much debate regarding the sustainability of pre-stressed designs compared to conventionally reinforced designs. Pre-stressed slabs and beams are generally thinner and use less steel than their equivalent conventionally reinforced counterparts. However, for a typical concrete mix of 32MPa to be used in conventionally reinforced concrete, 128 to 160kg of cement is used per cubic metre of concrete. This is half of the 264 to 330kg of cement per cubic metre of concrete used for 40MPa concrete used in pre-stressed designs. As a general rule of thumb, pre-stressed designs use less material, but the materials they use are much more carbon intensive to produce.

To encourage the application of sustainability in the construction industry, a government body known as *The Green Building Council of Australia* has developed a set of guidelines to assess the sustainability of a given construction project. This rating system, known as the *GreenStar Rating*, currently focuses on the use of recycled materials and cement substitutes. However, it fails to provide guidance on assessing which structural system provides the most sustainable solution by examining both the type of material and the quantity of material used. This report offers suggestions to *The Green Building Council of Australia* to incorporate additional assessments based on a systems analysis of various pre-stressed and conventionally reinforced designs.