

SMARTER PUBLIC WORKS ENGINEERS – A UNIQUE LOCAL SOLUTION TO A GLOBAL CHALLENGE

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Abstract

The labour market for professional engineers in Australia is facing unprecedented pressures due to a massive increase in infrastructure expenditure in the public and private sectors, and this is expected to continue for at least the next 10 years. The increasing global demand for engineers and an aging engineering workforce will *result in a decline in the availability of local technical skills*. Add to this a stagnant or declining interest from school leavers in undertaking engineering courses and the result is a potent mix which will make obtaining suitably qualified and skilled engineers for local government extremely difficult and increasingly expensive in the competitive environment. Well gone are the days when civil engineers were readily accepted in the highest levels of society professionals. For example, the City Engineer, once a pillar of society, well respected, powerful, and with great standing is no more, often “replaced” as a Works Manager, Asset Manager or similar. The status once enjoyed no longer exists to “champion” future engineers into local government. Changes to society and governance has led to this outcome but other *professions* have suffered the same fate, witness the fall of such past luminaries as bank managers and religious leaders.

With a global society and the lessening of employee “loyalty” to one employer, more rapid turnover of staff occurs both within and external to the local government sector . This is being increasingly driven by the younger generation who have a desire to “move up” or “move on” in their employment.

Standing still, or doing as we have done in the past, is in reality going backwards.

One key aspect that is often largely overlooked in organisations is that of *the underlying desire of existing employees for self improvement and standing* . As a result one of our most valuable resources, our people often receive the least attention. Hence there is a need for appropriate incentives to not only retain existing engineers and para-professionals , but to enhance their knowledge and standing , and simultaneously provide incentives for the take-up of a career in local government by graduates.

Key Words: Infrastructure Assets, Public Works, Distance Learning, Technical Qualifications, Road Engineering, Pavement Management, Skills Enhancement, Higher Education, Local Government

Background

Employees as Valuable Commodities

By and large, throughout the world, employees have become “valuable commodities” thanks to the dramatically increased focus on their health and safety often brought about by Government legislation that imposed fines and penalties for non-compliance with health and safety regulations. However in our world, the world of the public works engineer the people have yet to be elevated to “valuable commodities” in respect of their technical and skill value

status. We might say we have, and many are trying, but little impact has been made to turn around the position with respect to the diminishing resource of technically competent and skilled people vital to local government and public works.

We should be very concerned, about the slow pace in reversing not only the availability of *competent* personnel, but *also* the desire of those personnel to establish a career, and become long term employees in the public works sector. For the large part we are already into a “catch up” scenario and if an individual entity or industry sector thinks it

has its training, education and staff development systems well up to speed, then a check against best practice is strongly recommended.

The “domino effect” is alive and well. When an individual organisation or company needs a certain type of employee, due to expansion or replacement, it will go to the open market at some point for a person either for that specific position, or to replace an in house promoted person.

The “new employee” is most likely to have come from another similar entity or a government agency in the proximity to the work location. If needed, other sources will be explored such as consultants, and, where higher education is required, possibly university graduates, may be sourced. More frequently, these days, people are being sourced from other countries in a bid to find the right skill set to minimise corporate training commitment and “learning” time.

Supply and Demand Imbalance

The current scarcity of capable technical personnel is a very real concern, when a predicted strong growth in public works will result in the demand for skilled staff exceeding the ready supply of appropriate persons. The recent significant “stimulus funding” by the Australian Federal and State Governments is likely to place further pressure on the already struggling skilled engineer employed in the public works industry.

At the last Public Works Conference in Australia, Keith Reester, Public Works Director of the City of Loveland, Colorado, USA, opened his presentation by stating “*the United States, like most nations, is facing a looming crisis in the workforce; “baby boomers” are retiring while the numbers of potential workers set to replace them is dwindling. This failing is especially acute in the technical and trade professions which impact delivering public works services.*”

Whilst initially many thought the world recession would provide via a construction downturn, an opportunity to “catch up”, the reverse has actually happened due to the use of massive spending on infrastructure as one of the main actions to stimulate national economies, including the local Australian economy.

Critically Australia faces this dilemma now, but what will the situation be like when the next buoyant economic period joins the current infrastructure boom period?

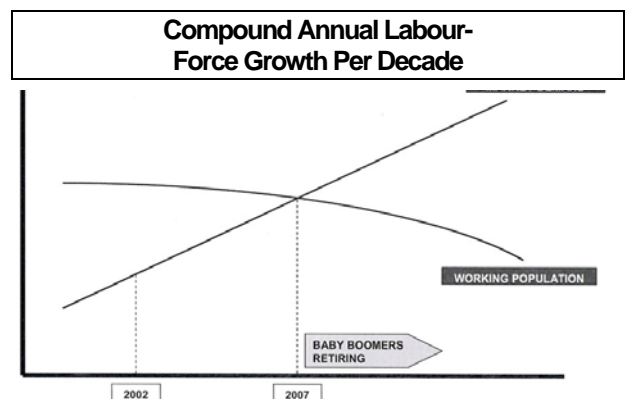
Even though it has involved some pain, we have been able to cope with demand/supply fluctuations until now, but the danger is that these changes will become more extreme in the years ahead and are unlikely to be manageable as in the past.

The global skilled labour shortages that have been impacting on us has merely softened thanks to the world-wide recession, but this will only be temporary.

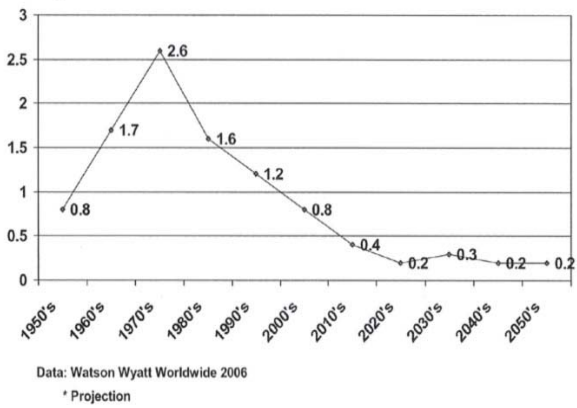
Unemployment Rates for some Key Economies	
Countries	Rate
Australia	5.7
New Zealand	5.0
Japan	4.80
USA	8.9
Canada	8.0
Austria	4.5
France	8.8
Germany	9.0
Netherlands	4.4
Sweden	8.0
UK	7.1
Brazil	8.9
Portugal	8.9

Source: Wikipedia 03/06/09 Quickseek (July/August 2007) approx. values

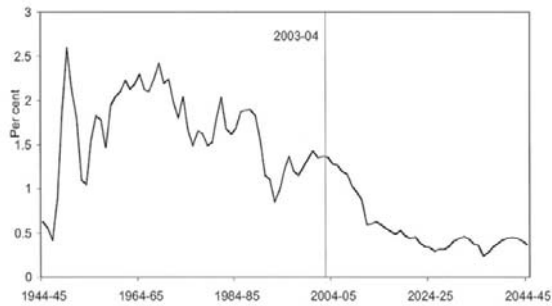
When one looks at past and projected labour force growth, we are rapidly declining to a level well below even replacement levels especially when combined with the declining availability of working age personnel.



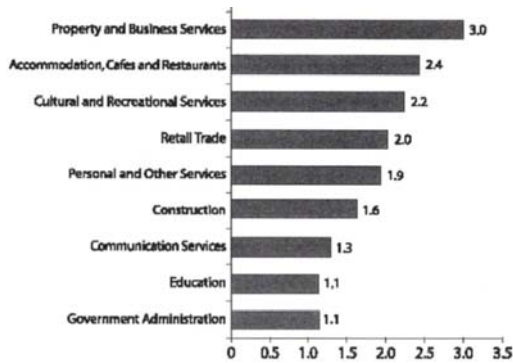
Compound Annual Labour-Force Growth Per Decade



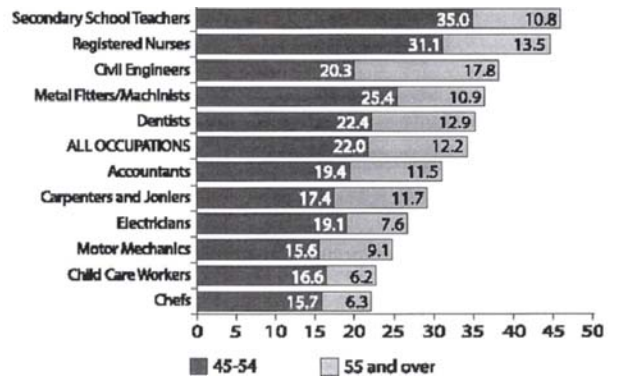
Looking Forward: Growth in population of working age



Strongest Projected Employment Growth by Industry to 2010-11 (%pa)



% of the workforce aged 45 years and over by selected occupation



The labour market for professional engineers in Australia is facing unprecedented pressures due to a massive increase in infrastructure expenditure in the public and private sectors, which is expected to continue for at least the next 10 years. An increasing global demand for engineers and an aging engineering work force, at the same time as a stagnant or declining interest from school leavers in undertaking engineering courses, will result in a potent mix which will only serve to drive up remuneration for professional engineers in Australia.

Infrastructure “Boom” Will Only Increase Pressure

However the situation in Australia is not unique. Globally there has been and will continue to be some form of major infrastructure boom as developed countries seek to rejuvenate their economy via far greater than normal expenditures on infrastructure. Then there are the emerging economies such as China, India, and Eastern Europe and South America beginning to build infrastructure. In this global context, Australian engineers are highly regarded for their “hands-on” and “can do” approach and significant numbers have been enticed to work overseas.

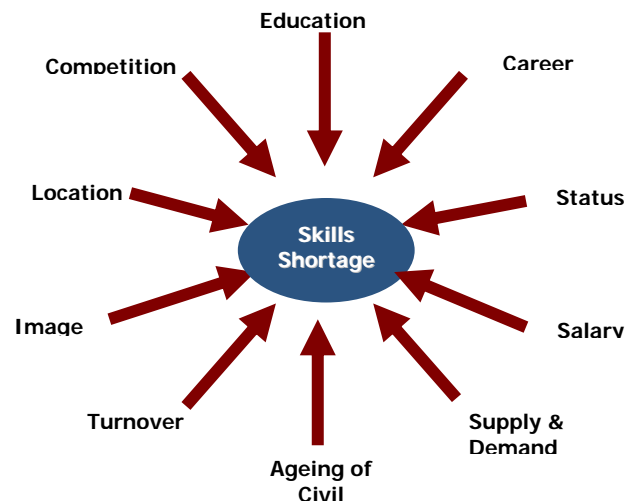
With a global society well established and the lessening of employee “loyalty” to one employer, more rapid turnover of staff occurs both within and external to our industry. This is being increasingly driven by the younger generation who have a desire to move overseas, or “move up” or “move on” in their employment.

and many of these challenges have the potential to reduce the appeal of a career in local government in particular and the public works sector in general.

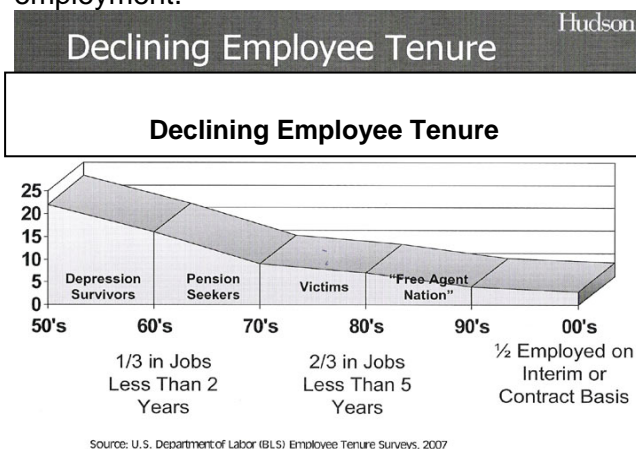
It’s too simplistic to say demand for skilled personnel has outstripped supply and that by getting more engineers through the university system, or more apprentices, or more training overall, will solve the problem. Certainly it will help but it won’t fix it, in fact it won’t go even close to fixing the real problem we are facing.

But what is the “real” problem? The problem is not a clearly defined single issue as such, but the culmination of many issues being faced.

Issues Impacting on Skills Shortage



There are various issues that have the potential to impact negatively on our industry.



Standing still, or just doing as we have done in the past, is in reality going backwards. On many fronts our sector is being challenged

Some Specific Issues Impacting On Employment Levels

Status

Well gone are the days when civil engineers were readily accepted in the highest levels of society professionals. For example, the City Engineer, once a pillar of society, well respected, powerful, and with great standing is no more, often “replaced” as a Works Manager, Asset Manager or similar. The status once enjoyed no longer exists to “champion” future engineers into local government. Changes to society and governance has led to this outcome but we are not alone, for the same fate has fallen on such past luminaries as bank managers and religious leaders.

Competition

Changing trends can be deadly to products, activities and career paths. The civil engineering profession has taken a battering since the 90's with IT (Information Technology) the popular draw card, itself falling over in the early 2000's with mining and mining engineers and now construction engineers being the new “competitor” for an engineering career in local government / public works.

Economics

Combination of low status and high competition for engineers in booming economic times and / or infrastructure demand driven periods brings with it an economic impact or penalty as a result of supply and demand pressures with salaries being pressured upward by external forces. The thriving mining industry in Australia particularly over the past five years has been a major cause for extraordinary financial carrots being offered to young mobile engineers.

In Australia, the demand for engineers overall is expected to remain strong for at least the next 3-5 years as demand exceeds supply, and this will have an impact on remuneration. In the private sector, salaries are expected to increase well above the norm, with areas of acute shortage seeing increases averaging 10 % or more. In addition, in recent years engineers with high demand skills have been in a strong position to negotiate “sign-on” payments of up to 20 percent of the first

year's remuneration and/or qualify for completion bonuses.

In the public sector, which is generally subject to more rigid salary budgets, employers have begun to realise they will not be able to attract and retain quality candidates to complete vital infrastructure projects without offering better than market rates of remuneration. In 2006, the Queensland government approved a retention payment of up to 30% for government employed engineers in Queensland public sector authorities.

Location

Whilst we hear of young or mobile engineers relocating away from their home base (overseas or regional areas), this is often on the basis of “contract period” of 12 months or 2 or 3 year terms, and this is generally acceptable to the engineer as the high income provides compensation for the sacrifice involved. However the number of engineers prepared to readily relocate is diminishing and this has a two-fold impact. A shortage develops in non capital city locations, and remunerations are increased to provide extra attraction ultimately having a flow-on effect on salary levels of all engineering jobs.

Career

In the “good old days” the local government engineer “apprentice” or cadet engineer was given a vision and career path to aspire through the ranks, to scale the “Everest” and become the City or Shire Engineer. Whether this was his home town or suburb, it was what dreams were made of and was what often happened in reality. For a variety of reasons, this dream is in today's terms unlikely. Positions of such standing now rarely exist, and hold little incentive for today's younger engineers who have a very different attitude to those of yesterday.

And today long term employment of the “young guns” is regarded as 2-3 years and they tend to think nothing of moving from one employer to another. Whilst much of this attitude resulted from the good economic climate that has persisted for decades now and employers, as much as employees, have encouraged the turnover mentality. However this does not help local government / public

works and the roads sector where in reality it can be detrimental overall, for the work is as much an art as it is a science. Being a part of the history of projects and seeing outcomes 10 -15 years later, can be fundamentally important to ongoing decision making.

Another risk with the short tenure mentality is that with each change of employment comes the risk of an employees flight to a more inviting career path away from the perceived mundane.

Advancement

Another change to impact on traditional advancement modes, is the lessening of the possibilities to gain further education targeted to ones chosen profession by undertaking further studies or post graduate courses with subjects directly related to the engineering role. Most capital cities and the big rural cities had a tertiary college or university offering such courses, but today , whilst the education facilities may remain their relevant educational offerings have virtually all but disappeared.

The Master of Business Administration (MBA) has become the qualification of advancement, further impacting on the skills shortage as *the more* progressive engineers choose to learn about being managers. Their desired role has become that of a senior manager as distinct from a senior engineer. With the reduced capability of government State Road Authorities (SRAs) to train, as a result of their downsizing and corporatisation process which occurred in the eighties, much of the "feed stock" of younger engineers for consultants and industry, extracted from the road authorities is no longer. Fortunately this situation is now reversing as state road authorities crank up their recruitment process to meet their own demands but it will be some time before the void of the past 20 years has been replenished and the flow-on effect felt.

Innovation

In respect of the above, there is no quick fix, and especially in respect of the status and the career issues, it is likely to take many, many years of considerable effort and initiatives to turn the negative position into a positive.

However exacerbation of the problems are happening now , as today's experienced

Civil engineers age and early retirements *reduce the chance of transfer to young engineers* of hard earned experience and knowledge. With employment demand exceeding supply, more frequently we are seeing engineers being forced into roles and decision making they are often not ready for, and for which they lack mentors to help them cope adequately. We are therefore inheriting a workforce that is less experienced, not more experienced as each year passes. Innovation is one aspect that has been overlooked. We regularly hear that we need to innovate to advance and in a rapidly developing, technologically driven society, it is vital for any industry sector to keep up with the pace of change

However innovation is therefore only worthwhile if implementation follows.

Acceptance of new or modified technology is paramount and with the considerable time, effort and expense incurred in its development by companies, and often the industry at large, the question has to be asked as to whether much of this "investment" is being wasted by lack of timely adoption and market place acceptance of innovation, new technology and new products and methods.

That is to say, if our people aren't knowledgeable and aware of the latest developments, and understand them, great opportunities to have better outcomes are being lost.

Skills Enhancement and Recognition

Surveys and reports consistently show that there are other issues that rate more highly than pay (contrary to the often held employers' view) and at, or near the top of the employees' list of the issues that most impact is that of career development and training. If you look at the evidence about why people leave an organisation, the most popular reason given is that they do not feel their career enhancement is being provided for in their current position. Reason number five is money.

Yet many employers still regard spending money on training staff as discretionary. These are likely to be the same ones that believe the market place will simply provide the replacement for a lost employee. Companies and authorities that operate on

these principles will continue to loose ground in a competitive environment.

For many organisations, the workplace has now to become a point of competitive difference, and they will have to invest in it. So more and more are engaging in retention strategies as they realise that if they do not retain employees, it costs them.

Improving Knowledge, Skills, Career and Standing – Centre For Pavement Engineering Education (CPEE) As a Model Filling a Learning Void

Well prior to the emergence in more recent years of the widespread elevation of skills and training concerns, an area of concern for the roads and pavements industry, was the availability of technically competent engineers and technicians to meet future demands in the flexible pavements sector. Identified in the early 90s by AAPA (the Australian Asphalt Pavement Association) representing industry was the lack of appropriate education for engineers who were already in, or entering, the roads sector,. AAPA was then joined by the government “Association”, Austroads, (representing Government-State Road Authorities) to form the Centre for Pavement Engineering Education (CPEE). At that time road agencies were largely abandoning their training role and the universities were unable to respond to the highly technical courses sought by young pavement engineers preparing their career paths, industry was keen to ensure their existing (and future) engineers and technicians were well informed and possessed the skills necessary to operate effectively in a competitive and innovative environment and sought a solution.

Commencing in 1994, CPEE with SRA (government State Road Agencies) and industry support, developed higher education units focussed on the immediate needs of the industry (private and Government sectors) and the pavement engineers and technicians employed by industry. Rapid and effective education/technology transfer was achieved by carefully designed university level accredited Distance Learning programs, making on-going education possible in every part of Australia, reaching even the remotest locations.

In the context of this paper, CPEE is offered as a model for assisting with many of the issues that we are concerned about with respect of the skills shortage challenge. CPEE’s unique and targeted Graduate Certificate, Master of Technology and Master of Engineering post graduate programs allow engineering professionals to enhance their specialist industry specific knowledge and technical skills, which in itself is a fundamental need. However, by creating these specialist courses, recognising and targeting a select group of engineering professionals, it elevates the awareness and standing of the roads and pavements engineers and technicians and provides a specialist qualification that enhances the standing of the profession.

Federal and State Government Road Authorities, with local government and industry continually struggling to find and retain suitably qualified and experience engineers, with the poor awareness of the role and status of the roads/pavements engineer providing little incentive for young graduate engineers to make this industry a career choice. CPEE qualifications have raised the bar and provide unique recognition and elevated status to those who successfully complete a qualification. With the ability to further ones specialist knowledge, with university level credit, a career path is unfolding.

A major incentive for “students” and employers alike is that the undertaking of a CPEE course is a guarantee that the “student” will have studied up-to-date industry nominated and developed material (Government and Industry approved) with access to tutors who have significant standing in the industry itself.

The units of study have been developed by industry experts, the tutors are industry experts and the unit contents are regularly revised by industry experts. CPEE has therefore trapped the knowledge and expertise that we face loosing as retirements rob us of the ability to adequately foster and develop those entering the road construction sector.

Across the board, industry and road authorities through retirement of acknowledged experts are loosing expertise and experience. There is a very significant question mark over the knowledge

enhancement programs of individual organisations for existing personnel concerning the delivery of desired outcomes. Anecdotal evidence indicates the retention of the “knowledge and wisdom” from these retiring experts is not occurring, or being appropriately passed on, in both the government and private sector. CPEE units are collecting and professionally holding (via units of study) much of the knowledge and hard earned experiences which the new/inexperienced engineers can learn from. Importantly, this knowledge is being updated regularly to ensure its currency and students are able to apply their newly gained knowledge and skills immediately. In this way, there is little lag between learning and application.

Unique and Targeted Tertiary Qualifications

Working for some time primarily through Latrobe University in Melbourne , and additionally this year with the University of Tasmania , (and also with other selected individual universities and institutions), CPEE provides a logistically superior solution to the problems of time and distance facing many students. It’s unique Graduate Certificate and Masters programs are innovative since they tie the qualifications specifically to an industry or sector as distinct from an open, often unrelated, mix of subjects.

The CPEE/Latrobe University qualifications of Master of Technology and Master of Engineering and the CPEE / University of Tasmania Graduate Certificate qualification are unique because they are practical and heavily industry-oriented and they can be studied from any location in the world. The qualifications are gained via postgraduate distance learning study “units”. Initially they were designed to enhance engineering outcomes in the roads and pavement design, construction and maintenance area. This focus however continues to broaden to include related units in asset management, business administration and environment aspects. There has also been the inclusion of units within “road engineering” such as “Fundamentals of Road Construction” and “Road Drainage”. The latest enhancement now encompasses “Infrastructure Asset Management”.

Infrastructure Asset Management Graduate Certificate Created

This year a major extension has occurred as in response to a growing demand , the Institute of Public Works Engineering Australia (IPWEA) have combined with the Centre for Pavement Engineering Education to create a new targeted qualification in the discipline of Infrastructure Asset Management. This new 4 unit Graduate Certificate in Infrastructure Asset Management has been developed specifically not only for engineering and science graduates, but other suitably qualified professionals working in asset management and is particularly aimed at local government and public works authorities asset managers who manage major infrastructure networks such as roads, water supply, drainage and sewerage.

CPEE with the support of IPWEA is offering this new qualification in conjunction with the University of Tasmania with commencement in second semester this year. IPWEA surveyed its membership and was overwhelmed with the response, calling for a University accredited qualification such as this.

The growing recognition of the long-term lifecycle costs associated with the operation, maintenance and renewal of physical assets has created the need for more specialist skills and qualifications in the management of infrastructure networks.

With State governments now requiring local authorities to create and implement asset management plans for infrastructure, this is adding to the demand for qualified specialists in the area of infrastructure asset management. This is increasing the career opportunities for new infrastructure asset managers as well as requiring existing manager to continue to develop their skills.

The four unit course consists of two compulsory core units (based on the International Infrastructure Management Manual), and two units selected from a list of relevant elective units and can be studied entirely by distance. Importantly the course will provide graduates with the knowledge and skills to fill senior positions in this specialist field. Even for those currently working in the field, the course will provide

relevant information to continue to be at the forefront of the increasingly important area of infrastructure management.

Applicants for the course must hold a Bachelor degree in Engineering or Science (in an appropriate discipline) or an equivalent qualification. An applicant holding a three year Bachelor degree will be required to have had at least three years relevant work experience. Special entry requirements can also apply for para-professional staff who do not have an undergraduate degree but have acceptable qualifications and prior experience.

This exciting new course will greatly enhance capability and recognition in this rapidly growing sector. See Appendix A for details.

For those not able to commit to the four unit course, there is also the option of undertaking a single unit to provide targeted learning on a specific topic to meet your immediate needs.

Unique Local Learning Model Has Global Application

These uniquely specialised, highly relevant technical programs are producing, well beyond past outcomes, professional engineers with expertise in the roads and pavements sector, and now the public works engineering sector in respect of the targeting of infrastructure asset management.

Already many Australian students who have been in remote Australian locations (distances equal to the spanning of several European countries), and many Australian and International students have resided in locations such as Ireland, Belize, Kazakhstan, Asia, Africa, Canada and USA, etc

The model is robust and operationally sound and viable for global use, and with unit content highly regarded, and leading to a recognised University post graduate level qualification, it is a model that will grow globally to satisfy not only a "student" need, but for employers of all types.

Fundamentally the enhanced take-up of improved technology and innovations will result from this unique and world class learning model.

Conclusion

The loss of technical skills has occurred in organisations linked to the construction industry and in particular infrastructure development. Attractive salary packages in the mining sector have enticed civil engineers from their traditional roles in public works. This trend may reverse temporarily during the current financial crisis but opportunities in mining are likely to increase when the world economy improves.

With a global society and the lessening of employee "loyalty" to one employer, more rapid turnover of staff occurs both within and external to the local government sector. This is being increasingly driven by the younger generation who have a desire to "move up" or "move on" in their employment.

Standing still, or doing as we have done in the past, is in reality going backwards for the public works sector.

The one key aspect that is often largely overlooked in organisations is that of *the underlying desire of existing employees for self improvement and standing*. As a result one of our most valuable resources, our people often receive the least attention. Hence there is a need for appropriate incentives to not only retain existing engineers and para-professionals, but to enhance their knowledge and standing, and simultaneously provide incentives for the take-up of a career in local government by graduates.

Acceptance that training and education expense is not a cost, but an investment is growing, although sadly many organisations make their training budget the first to be pruned when costs have to be reduced. The commercial benefits of having a highly skilled, knowledgeable and educated workforce are becoming more accepted as each year passes.

Where education and knowledge enhancement transfers to the client (a key need) then technical innovation, with acceptance of new, or modified technology, will provide further commercial benefits for all involved.

For one industry to be better able than another in attracting and retaining personnel at all levels, it needs to be innovative and co-ordinated. Knowledge and skills enhancement strategies must be a vital component of any initiative, and progress on

development and adoption cannot be prolonged.

Appendix A - About CPEE

The Centre for Pavement Engineering Education (CPEE) is an accredited private provider of Tertiary education specialising in road infrastructure, pavement technology and engineering and public works infrastructure asset management. CPEE provides practical and industry supported learning for enhanced capability and improved worth. CPEE distance learning programs have been operating since 1996 during which time there has been over 2000 unit enrolments. CPEE is quality accredited to ISO 9001:2008 and is an accredited private provider of higher education under the Tertiary Education Act 1993 (Victoria), (Provider registration No. VO1332), awarding specialist Graduate Certificate and Masters programs. CPEE is supported by its Foundation Members, AUSTRROADS and the Australian Asphalt Pavement Association (AAPA), in providing specialist distance education and short course offerings designed to enhance capabilities. CPEE education is utilised by state road authorities, public works and local government entities, consultants and industry seeking up-to-date, practical learning and skills enhancement solutions. Over the past 13 years employees within the roads and public works sectors have been able to further their studies and career prospects through the convenience of postgraduate Distance Education studies and/or specialised short courses.

CPEE activities include:

- Learning resources
- Short Courses
- Industry links
- Distance learning
- Technology transfer
- Undergraduate projects

Appendix B - About CPEE Unit and Short Courses Range

Distance Learning Units

- 650 Introduction to Pavements
- 601 Pavement Design
- 602 Flexible Pavement Construction
- 603 Pavement Wearing Surfaces
- 604 Asphalt Mix Design
- 605 Pavement Maintenance & Rehabilitation
- 606 Industrial & Heavy Duty Pavements
- 607 Pavement Management
- 608 Insitu Stabilisation
- 609 Road Asset Management
- 610 Rigid Pavement Construction
- 612 Managing the Road Environment
- 613 Fundamentals of Road Construction
- 614 Road Drainage
- 615 Project Evaluation
- 616 Asset Management Fundamentals
- 617 Asset Management Practices

Short Courses/Workshops

Pavement Design - 2 Day

CIRCLY Workshop - 1 Day

HIPAVE Workshop - 1 Day

Pavement Surfacing Fundamentals & Evaluation - 2 Day

Pavement Maintenance & Rehabilitation - 2 Day

Lightly Trafficked Streets Pavement Design - 2 Day

Pavement Management - 2 Day

Managing the Road Environment - 2 Day

Road & Public Space Lighting Workshop - 3 Day

Appendix C - Structure of Four Unit - Graduate Certificate In Infrastructure Asset Management

Core Units

Unit 616 - Asset Management Fundamentals*

Unit 617 - Asset Management Practices*

Electives A

Unit 607 - Pavement Management

Unit 605 - Pavement Maintenance & Rehabilitation

Unit 615 - Project Evaluation (CPEE)

Electives B

Unit 101 - Financial Management

Unit 415 - Engineering Risk Management

Unit 403 - Managing Information Systems

NOTES:

* these units are based on “*International Infrastructure Management Manual*” 2006 Edition INGENIUM & IPWEA

b) Minimum requirements are:

- the completion of the 2 Core Units
- the completion of one Elective A Unit
- the completion of one Elective B Unit

616 - Asset Management Fundamentals

Overview

The unit presents the principles and procedures involved in the introduction of an asset management system. It discusses the establishment of an asset management framework, the assessment of resources required, the preparation of asset management plans, the implementation of those plans, the links with other elements of the organisation and the monitoring of plans once implemented. The focus is on corporate direction, team or whole of organisation approach, the basic asset management plan template, preparation steps, continuous improvement and implementation. Other issues dealt with in this unit include levels of service, condition assessment and risk management.

Topics

Topic 1: Introduction to Infrastructure Asset Management

The first topic outlines the importance of asset management in the overall context of infrastructure service provision.

It defines some of the key terms that will be used throughout the course and provides an explanation of what is meant by infrastructure assets. The topic continues with a description of the basic process of infrastructure asset management and the continuous journey towards improving the way infrastructure assets must be managed.

Topic 2: Asset Management Planning

Topic 2 provides an outline of how asset management planning fits in with other organisational strategic planning processes. It describes what is meant by the Total Asset Management Process or Total Asset Management Plan (TAMP).

It then gives an introduction to the concepts of “core” and “advanced” asset management before addressing the question of lifecycle asset management.

Topic 3: Planning for Asset Management Improvement

This topic focuses firstly on the establishment of an organisation team that will be necessary to co-ordinate and integrate the asset management planning process with the overall strategic objectives of the organisation. It then turns to the asset management planning journey of how to achieve continuous improvement as we firstly understand what our current practices are and then look to identify gaps between that and where we want to be in terms of most appropriate asset management practice for a particular organisation or particular asset class. From there it is a logical step to identify what improvement projects might be best implemented to start closing some of those gaps, how to commence implementing those improvement steps and then monitoring and reviewing progress along the “journey”.

Topic 4, Preparing & Revising Asset Management Plans

Topic 4 focuses on the steps that should be followed in initiating that first basic “core” level asset management plan. This approach can be worthwhile even for an organisation that has previously commenced asset management planning but for a variety of reasons, the process has stalled or needs commencing afresh. This topic sets out the framework that is recommended for the formatting of an asset management plan. The

importance of promoting consistency in how these frameworks are applied can provide benefits in flow on issues such as benchmarking or collating data across an industry wide sector.

Topic 5, Implementing the Asset Management Plan

In this topic issues such as who is best placed to undertake various service delivery actions and who is best placed to take responsibility for the many activities that are part and parcel of the ongoing asset management process are considered. It takes a look at which activities are seen as being of prime concern or interest to the asset owner and should be retained as in-house functions for the owner. The remaining functions can then be carried out by in-house resources or contracted out. Allied to this issue is much management literature over recent decades that has considered what should be the prime role of governments as “steerers” – setting policy and strategic direction versus other entities performing the “rowing” and doing the actual grunt work on the ground in operation, maintenance and the like.

Topic 6, Levels of Service

This topic proceeds from the framework established in the earlier topics to explore the various tools and techniques necessary to assist organisations in actually developing their asset management plans. It addresses service levels which can be seen as the link between satisfying community needs and the costs of providing the service. The topic also discusses consulting with customers and stakeholders to establish desired levels of service and cost variations associated with changes to level of service. The monitoring of levels of service provided and reporting on actual performance against the set objectives is important.

Topic 7, Demand Forecasting & Management

This topic moves on from the issues addressed in the previous topic on levels of service, recognising that involving customers in reviewing of levels of service will almost certainly lead to some demands for changes in the level of service currently being provided by various asset classes. These changes arising from customer expectations,

coupled with a number of other drivers like population growth, new technology, changing legislation on issues like environmental protection and general societal changes, all impact on changes in demand for infrastructure services. This leads to the obvious question- How do we best manage these demand changes?

Topic 8, Risk Assessment & Management

In this topic the issue of risk assessment/management is addressed specifically with various asset classes in mind. Accordingly, recommended actions will differ depending upon asset types. The following risk management process steps are addressed: risk management context: risk identification: risk analysis: risk treatment: and finally monitor and review: the ongoing process for ensuring risk levels remain acceptable even if risks change.

617 - Asset Management Practices

Overview

The unit provides information on the tools and techniques used in asset management. Relevant theories are explained and the unit provides useful case studies presenting the application to practical asset management problems. The content of this unit is an extension of the material presented in unit 681 and introduces specific enabling process for asset management.

Topics

Topic 1: Demand Forecasting and Management describes the factors which have an influence on the demand for an asset and how to detect trends. It explains how to forecast demands and then prepare a response to demand changes.

Topic 2: Optimised Decision Making explains the trade-offs which must be considered when assessing the worth of a proposal. The process to formally identify and prioritise possible options is described.

Topic 3: Maintenance Management Planning outlines the procedures used to make sure that an asset can perform at the required level of service over the duration of its life. Issues such as setting maintenance objectives, defining the scope of maintenance planning, the maintenance analysis process and the elements of a maintenance plan are

discussed.

Topic 4: Financial Planning and Reporting provides a description of processes including lifecycle costing, asset valuation and financial forecasts. Case studies are provided to illustrate specific processes.

Topic 5 Information Systems and Data Management deals with issues such as the requirements of an asset information system, the interface with other business systems, spatial information systems, data structures, data collection programs and data management procedures.

Topic 6: Completion of the Asset Management Plan includes the preparation of long-term financial forecasts based on information relating to asset creation, maintenance, renewal/rehabilitation and disposal.

607 - Pavement Management

Overview

The unit provides an outline of the requirements and application of a formalised system for the total management of a road network, from the current situation through to defining the actions required to most effectively manage the network, based on the available financial resources. The unit gives a detailed description of a road network database with present condition, construction and maintenance history and traffic loading. It also contains coverage of topics such as future use prediction, future maintenance requirements, predicted treatment costs, formal management systems and asset management fundamentals.

Topics

Topic 1: The Pavement Management Process introduces the concept of PMS and explains the history of its development. The topic also considers the current limitations and the likely future of PMS. It continues with a look at practice versus theory and the links with asset management and maintenance management. Topic 1 concludes with the structure and components of PMS and lists and defines some common terms.

Topic 2: The Asset Register explains the need for an inventory and describes the type of data to collect. This topic discusses methods of data collection, data quality and

the frequency of data collection. Finally, it addresses the question of data management.

Topic 3: Pavement Condition Monitoring examines the relevant condition parameters and considers how they are measured. The application of these parameters to the main pavement types is then addressed. The final issue is condition monitoring surveys both at the network and project levels.

Topic 4: Pavement Performance begins by discussing deterioration models and their application to road pavements. Different types of treatment are compared and the effect of maintenance strategies on performance are explained. This topic also covers condition monitoring as an indicator of performance, long term condition targets, life cycle costing and the analysis of performance data.

Topic 5: Implementing a PMS includes the calibration of both deterministic and probabilistic deterioration models. It also considers the issues of credibility of PMS outputs and the use of PMS for short/long term planning. The topic concludes with a discussion on reporting and PMS.

Topic 6: Case Studies provides a number of examples of PMS from state and local authorities. Examples are also drawn from private industry.

Topic 7: Future Directions takes a look at current and possible future issues which will impact on PMS. These issues include trends from overseas countries, benchmarking, developments with GIS and laser technology.

605 - Pavement Maintenance & Rehabilitation

Overview

This unit examines the different ways a pavement shows distress both structural and non-structural. Modes of distress including disintegration, distortion, cracking and fracture are described together with problems relating to safety and damage caused by external factors. Evaluation techniques are presented which can be used to assess the condition of a pavement with respect to serviceability, structural capacity and safety.

The unit considers restoration using granular materials, full depth asphalt and concrete. Structural overlays are described along with details of stress absorbing layers. Corrective maintenance treatments are discussed at length and the unit concludes with the economic evaluation of alternative maintenance strategies.

Topics

Topic 1: Introduction to Road Pavements provides some road statistics outlining the extent and cost of road maintenance activities. It also contains important definitions relating to pavement maintenance.

Topic 2: Modes and Mechanisms of Pavement Distress describes the way pavements deteriorate and why distress occurs. The topic covers disintegration, cracking and fracture, distortion, safety issues and other forms of miscellaneous distress.

Topic 3: Pavement Evaluation Techniques discusses the use of condition surveys to assess the capacity of an existing pavement and to help predict its future performance. Evaluation techniques are employed to measure serviceability, structural capacity and safety.

Topic 4: Pavement Repair Techniques – Preventive Maintenance is the first of three topics giving technical details of physical treatments for pavements. This topic promotes proactive measures in response to early signs of distress. Preventive maintenance, though mostly minor, low-cost work, is potentially extremely beneficial in retarding deterioration rates and deferring the need for major expenditure.

Topic 5: Pavement Repair Techniques – Periodic Maintenance addresses the materials and processes for resurfacing unsealed and sealed pavements including crack sealing and bitumen rejuvenation.

Topic 6: Pavement Repair Techniques – Rehabilitation covers the investigation, design and operational aspects of pavement rehabilitation including granular, bound and rigid structural overlays.

Topic 7: Maintenance Management covers the philosophy of maintenance management,

its relationship with broader issues including pavement management and asset management, and suggests a range of strategies. The main features of maintenance management systems are described.

Topic 8: Evaluation of Alternative Maintenance Approaches describes analysis of economic and other criteria for alternative maintenance and rehabilitation approaches, and outlines how to estimate the benefits, costs and risks of competing proposals.

Topic 9: Maintenance Planning and Budgeting covers the issues in short-term budgeting and longer-term planning for pavement maintenance and rehabilitation in the context of a road network.

615 - Project Evaluation

Overview

This unit presents a basic understanding of the economic principles in which cost benefit analysis is founded and the relative merits of cost benefit analysis as a project evaluation tool.

It provides understanding of how a cost benefit analysis of a capital project such as a road upgrade is scoped including cases to be analysed, relationships between those cases and the degree of analytical effort required in a cost benefit analysis.

An understanding of the concept of discounting, the time value of money and the concept of net present value are covered, with differences between real and nominal values and discount rates explained. The determining of discount rates for the purpose of project evaluation, and the sensitivity of project evaluation outcome to changes in the discount rate are also covered.

What is included in benefits and costs and how benefits and costs are calculated follows.

The decision making process is introduced and covers the concept of economic project selection, how cost benefit analysis can be complemented by other forms of analysis and how regional and national impacts are considered in project evaluation.

Models and processes for carrying out cost benefit analyses. Pavement lifecycle costing and maintenance optimisation are

discussed with important concepts in maintenance evaluation provided.

Content:

- provides a basic outline of the economic principles in which cost benefit analysis is founded and the relative merits of cost benefit analysis as a project evaluation tool.
- describes how a cost benefit analysis of a capital project such as a road upgrade is scoped including cases to be analysed, relationships between those cases and the degree of analytical effort required in a cost benefit analysis.
- discusses the influence of time in cost benefit analysis and why temporal effects are central to cost benefit analysis.
- addresses practical aspects of estimation including the composition of costs and benefits, methods of estimation, some classification issues and data sources. It focuses specifically on the main costs in road applications (typically construction and related costs) and the main benefits (agency operations and maintenance costs, user travel time and vehicle operating cost savings, safety and environment).
- describes when analyses to estimate regional and national impacts should be carried out as part of project evaluation. It also looks at post-completion project evaluation, a form of 'looking back' analysis that can be used to answer questions such as: did our project perform as well as expected?; and, if not, why not?
- outlines the various modelling tools available (including spreadsheets) for carrying out cost-benefit analyses.
- Topic 7 introduces the economic evaluation of maintenance initiatives. Although both capital and maintenance initiatives use scarce resources and result in considerable costs for road agencies, approaches to evaluation differ in important respects.

101- Financial Management

Overview

This unit is concerned with the management of the financial functions of an organisation and is directed towards making you competent in financial decision making and the control of financial operations. It will also enable you to understand the professional advice and help that accountants and other finance professionals can give you towards that endeavour.

Aims

After studying this unit you should be able to:

- identify the different types of business organisations
- explain the basic principles of financial accounting and management accounting
- explain the role and content of each of the four main financial statements and describe the methods and principles used to prepare each
- discuss the issues involved in developing a funding structure for an organisation
- discuss the importance of corporate governance in both private and public organisations
- analyse financial statements using common techniques
- demonstrate the use of a range of costing systems and cost control methods
- prepare budgets and evaluate long-term capital investment proposals
- discuss the issues involved in selecting an appropriate approach to managerial performance measurement
- use accounting information for managerial decision making.

Topics

- Financial management - an overview
- Fundamental financial accounting concepts
- Financial statements
- Funding and corporate governance issues
- Analysis and interpretation of financial statements
- Fundamental management accounting concepts
- Costing systems and cost control
- Budgeting and capital investment
- Performance measurement considerations
- Managerial decision making .

415 - Engineering Risk Management

Overview

This unit is intended to provide you with an overview of engineering risk management techniques. It introduces the concept of the two-dimensional nature of risk and emphasises the need for assessment of both dimensions (severity and likelihood) for ascribing priorities in directing the risk dollar. Systematic and structured hazard identification techniques are introduced with a number of illustrative examples. The focus is on low likelihood–high consequence risk events, as these cannot be assessed by using epidemiological studies or actuarial techniques.

Aims

After studying this unit you should be able to:

- identify the key issues that have a significant impact on the risks associated with engineering activities
- understand the fundamentals of risk identification, measurement and control
- use hazard identification and risk management tools to propose and analyse realistic risk scenarios and develop risk management strategies
- explain the usefulness, applicability and limitations of risk assessment as a decision-making tool
- discuss the applicability of safety and environmental management systems
- participate in corporate engineering risk management programs
- explain the issues involved in risk perception and risk communication, and develop risk communication skills.

Topics

- The concept of risk
- Risk management overview
- Identifying hazards and potential loss events
- Estimating the severity of consequences
- Estimating event likelihood and measuring and ranking risk
- Decision making under uncertainty
- Risk management tools
- Emergency management and recovery
- Risk perception and acceptability
- Risk communication

403 - Managing Information Systems

Overview

This unit deals with the planning and management of effective information systems. It discusses the design, structure and evaluation of information systems to meet specific needs, and the human factors in their operation and management. The unit starts with a high-level view of information systems, their impact on organisations and their strategic uses. It discusses how to analyse and plan for an organisation's information systems needs, as well as a wide range of other IS management issues.

Aims

After studying this unit you should be able to:

- analyse the impact that information systems have had in organisations, and the consequent changes that have occurred to the role of business managers
- analyse information systems and their management in terms of both hard and soft systems approaches
- identify the elements that combine to form an organisational information vision and information technology architecture
- apply a strategic systems planning approach to design information systems that use IT to gain competitive advantage
- manage organisational data and knowledge using a variety of applications
- evaluate proposals for the management of various specific IT functions including e-business initiatives and outsourcing IT services
- develop effective information service management practices, including performance measures and accounting structures
- identify the factors that can contribute to the success or failure of an IS project and develop IS project proposals and management plans using appropriate tools
- develop strategies to effectively manage technological change and address the legal or ethical issues that such change can bring
- develop information security policies and controls that address potential threats and vulnerabilities and plan for business continuity.

Topics

- Managing IS to seize new strategic opportunities
- Information systems and strategy
- Managing using a systems approach
- Managing information systems development
- Moving from IS planning to IT planning
- Managing organisational data
- Managing IS services and business networks
- IS project management, professional ethics and managing technological change, information security management

Authors

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Ray Farrelly at the end of 2007 concluded over 27 years as the Chief Executive Officer of AAPA, having played an instrumental role in AAPA being a highly regarded professional organisation, recognised both nationally and internationally. During this period considerable involvement took place on various industry committees, including those of Standards Australia and Road Engineering Association of Asia and Australasia (REAAA) - Australian Chapter.

At the start of 2008, he was appointed as the Executive Manager : Development, with the Centre for Pavements Engineering Education (CPEE), which fosters the enhanced knowledge and skills in the roads and pavements sector. This is a role Ray is very passionate about with an organisation he was instrumental in establishing in 1994.

Ray is a qualified civil engineer, a Member of the Institute of Engineers (Aust), a Chartered Professional Engineer, and a Councillor of Australian Chapter, R.E.A.A.A. (Road Engineering Association of Asia & Australia).

Ken Mavin, Executive Manager - Academic, Centre for Pavement Engineering Education (CPEE), Victoria, Australia

KEN MAVIN is the Executive Manager: Academic, CPEE, responsible for academic accreditation of CPEE courses and liaison with universities. His career includes working

as a consultant engineer, construction engineer and university academic as well as periods employed by government authorities in U.K. and Australia. Prior to taking up a position with CPEE, Mr Mavin was Associate Professor Civil Engineering at RMIT where he held a number of positions including Head, Department of Transport and Resource Engineering, Discipline Leader, Civil Engineering and Principal Lecturer. His qualifications include Bachelor of Science (Civil Engineering), Durham University, UK and a Master of Engineering Science, Monash University. Ken is a Fellow of the Institution of Engineers, Australia, with expertise and competence in Engineering Education, Postgraduate Distance Learning, Project Management, Financial Management and Quality Auditing.

Peter Way, Chairman, National Asset Management Strategy Committee (NAMS.AU), Institute of Public Works Engineering Australia (IPWEA), Queensland, Australia

Peter Way, PSM, has had a long and distinguished career of over 40 years in civil engineering with a focus on the construction and management of community infrastructure. Much of his career involved serving the community of Logan City in Queensland for some 27 years in various roles as City Engineer, City Planner and City Building Surveyor and finally as Director of City Works. Logan C C enjoyed the status of being one of the top ten growth areas in Australia, so Peter is well versed in the challenge of providing the necessary infrastructure, upon which our modern Cities rely.

Peter has served terms as both State and National President of IPWEA. He has been recognised by his peers with distinction through various Awards for his work, including the Keith H Wood Medal in 2001, Emeritus Member status in 2005, in addition to his receipt of the Public Service Medal in 1998 for service to local government engineering.

Peter continues to actively serve the profession as a Member of the Board of Professional Engineers of Queensland, and Chair of the Queensland Foundation for Public Works Engineering. Most importantly, Peter is also Chair of the National Asset

Management Strategy (NAMS.AU) Group for the IPWEA.

The primary goal of NAMS.AU is to provide national leadership and advocacy in the sustainable management of community infrastructure. NAMS.AU is recognised internationally as the preeminent group of its type working in the field of community and municipal infrastructure. Peter also represented IPWEA on the Australian Asset Management Co-Ordination Group, auspiced by the Centre for Integrated Engineering Asset Management.

Peter has a distinguished record of achievement, strong experience and continuing passion and contribution to promote best practice in the area of community infrastructure and infrastructure asset management.