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(i) Canadian members of IEEE;
(ii) Canadian members of the profession and community who are non-members of IEEE;
(iii) The associated Canadian academic (i.e. universities, colleges, secondary schools), government and business communities.

To ensure that the ***IEEE Canadian Review*** has the desired breadth and depth, editors are responsible for screening articles submitted according to the following general themes:

1- National Affairs	4- Education	7- Computers
2- International Affairs	5- Power	8 - Electronics
3- Industry	6- Communications	9 - News

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Quelques mots du rédacteur en chef

Vijay K. Sood, Hydro-Québec

En cette fin d'année, je suis heureux de vous annoncer que la revue canadienne de l'IEEE a su (encore une fois) réaliser son mandat. Ce numéro de la revue (ainsi que le suivant) est très dense, et j'ai même du refuser un certain nombre d'articles. C'est certainement un excellent état de choses et je voudrais remercier tous ceux qui ont rendu cela possible. Nous avons une saine diversité d'articles dans ce numéro. Le premier article, qui traite du AESO, l'exploitant de réseau électrique en Alberta, est un bon indicateur de la situation de l'industrie canadienne en systèmes de puissance, spécialement à la lumière des récents développements en Ontario. Nous avons aussi des articles sur le génie du logiciel et sur les enjeux en éthique professionnelle; ces deux articles décrivent la situation ayant cours présentement en industrie.

Pour les prochains numéros de la revue, je recherche des articles traitant des sujets suivants :

1. Systèmes photovoltaïques et leurs applications,
2. Systèmes de télécommunications mobiles,
3. Comment écrire un rapport technique, et
4. Systèmes d'imageries pour les applications médicales.

Les auteurs intéressés peuvent me contacter, ou bien contacter un des adjoints à la rédaction; les adresses apparaissent sur la deuxième page de ce numéro. De plus, si vous désirez suggérer des articles et/ou des items d'actualité, n'hésitez surtout pas à m'envoyer un courriel.

Et finalement, je tiens à souhaiter à vous et à vos proches:

Opinion

I had the pleasure to attend the Fall meeting of IEEE Canada in Toronto during the Toronto Section Centennial Celebrations. I must say that the section did a marvellous job in hosting the Blackout panel session and the banquet afterwards (see page 9). My congratulations to all concerned. What struck me was that IEEE Canada is alive and well and on the right track as far as contributions to the community and professional networking are concerned.

However, where IEEE Canada is not yet upto-the-mark is in the lobbying to the government(s), job market demands and looking after new entrants to our profession. Consider the following:

1. Would Canadians be suffering blackouts if we, as an industry, were paying enough to engineers (not bureaucrats, lawyers and accountants) to look after the power infrastructure? Remember blackouts cost - a lot. Ask GM, for example.

2. Consider the roller coaster that Canadians lived through in the past 5 years in the telecommunication and information technologies sectors.

3. Why does it take a year after graduation for an above average Masters student in Electrical Engineering from a reputable Canadian University to land a job? Are the universities preparing these students adequately for the job market? Are the universities and industry in tune with each others demands and requirements?

IEEE Canada has a ways to go in these directions: promoting the profession, assisting the continuing education of members, and easing the integration of new entrants to the profession.

Cover picture / *Photo de couverture*

The System Coordination Centre (SCC) is the heart of Alberta's Interconnected Electric System. It opened in early 1999 and operates independently of market participants. The Centre features advanced technology, and is customized to meet the requirements of Alberta's competitive electricity market. It is staffed 24 hours a day, 365 days a year, by a team of 13 system controllers. Seen in the cover photo are Ralph Gruendel and Ken Gardner (seated).

A few words from the Managing Editor

As we close another year, I am pleased to report that the IEEE Canadian Review delivered (again) on its mandate. This issue (and the next issue) of the CR is full again, and I had to turn articles away. It is definitely a good situation to be in and I thank those of you who made that possible. We have a healthy mix of articles in this issue. The lead article from the Alberta Electric System Operator (AESO) is a good indication of the status of the Canadian power industry, specially in the light of recent developments in Ontario. We also have articles on software engineering and issues related to professional ethics; both articles reflect on current situations within the industry.

In forthcoming issues of the CR, I seek articles on the following topics:

1. Photo Voltaic systems and their applications,
2. Mobile Telecommunication systems,
3. How to write a technical report/specification, and
4. Imaging systems for medical applications.

Potential authors can contact me or any of the associate editors; our addresses are on page 2 of this issue. Furthermore, if you would like to suggest articles and/or news items, do not hesitate to email me.

And finally, I wish you and your close ones:

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Newslog Editor

Rédacteur des Coupures de presse

Alexandre Abecassis is a patent agent trainee in Montreal at Ogilvy Renault, Lawyers and Patent and Trade-mark Agents.

Alexandre Abecassis travaille à Montréal chez Ogilvy Renault, Avocats et agents de brevets et de marques de commerce, comme agent de brevets en formation.

Send any news clippings you would like to contribute via e-mail to alexandre.abecassis@ieee.org

Veuillez faire parvenir les coupures de presse proposées par e-mail à alexandre.abecassis@ieee.org

SCHAUMBURG, IL, Sep. 23, 2003. Motorola will provide Toronto Police with an integrated identification system. The system, valued $3.1 million USD, will comprise an automated fingerprint identification system for fingerprint and palmprint identification. The installation of the system should be completed by 2004.

MONTREAL, QC, Nov. 4, 2003. Discreet, a division of Autodesk, Inc, has announced that Universal Images has signed a multi-million dollar agreement to standardize its facility using Discreet products.

MISSISSAUGA, ON, Oct. 24, 2003. Certicom Inc. has announced that National Security Agency (NSA) has purchased extensive licensing rights to Certicom's MQV-based Elliptic Curve Cryptography (ECC) intellectual property. Certicom Inc. provides inter alia wireless security solutions. ECC is a computationally efficient form of cryptography that offers equivalent security to other technologies but with a smaller key size, therefore limiting computations.

MONTREAL, QC, Oct. 7, 2003. VisuAide is launching Trekker for PAC Mate. Trekker is a GPS-based orientation solution which is designed for the visually impaired. PC Mate is a Pocket PC device used for note taking and other data intensive applications. Trekker enables a blind person to, inter alia, determine its position including street address and surrounding intersections. Furthermore, talking menus, talking maps and GPS information is available.

RICHMOND, BC, Aug. 4, 2003. NASA announced that the Scout Mission "Phoenix" which comprises sophisticated instrumentation package developed by a team of Canadian scientists and engineers will go to Mars in 2007. Martian atmosphere will be studied using laser radar technology. MD robotics will provide the Canadian weather sensing system.

TORONTO, ON, Oct. 21, 2003. The Linux Professional Institute, the premier international professional certification program for the Linux community has affiliated with the Canadian Linux Users' exchange, a non-profit organization whose goal is to increase the use and appreciation of Linux in Canada, in order to increase professionalism, exposure and participation of Linux by corporate, government and academic environments across Canada.

OTTAWA, ON, Sep. 15, 2003. Data Kinetics Ltd has developed a new custom e-learning solution development service. The new service will provide customers with a copy of a storyboard creator software that customers will use to quickly and cost-effectively capture their training content and skills assessment tests. The story board developed will then be used by Data Kinetics in order to create a custom e-learning training solution.

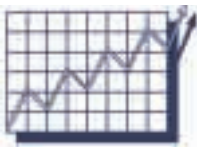
RICHMOND, BC, Sept. 9, 2003. MacDonald, Dettwiler and Associates Ltd. announced that Department of National Defense has renewed a long-term contract, worth $1.9 million over 3 years, to research and develop an experimental airborne contract for Canada's CP 140 patrol aircraft.

VANCOUVER, BC, Aug. 20, 2003. Briyante Software Corp has announced that the Charlotte-Mecklenburg police department in North Carolina has selected Briyante Software for providing products and services as part of their overall enterprise integration strategy.

DORVAL, QC, Oct. 28, 2003. A mobile robotic security system has been developed and is being used in Montreal. It can be programmed for patrolling locations such as warehouses, factories, etc. The system is equipped with three radars antenna units that detect motion through walls. It also comprises infra red motion detectors, sonic detectors, streaming camera and a biometric unit. The system can be customized to detect various environmental parameters. It also comprises a siren and a two-way voice communication system.

DALLAS, TX, Oct. 21, 2003. Entrust announced a contract award from Northrop Grumman Information Technology for its Public Key Infrastructure based secure solutions for deployment at the Federal Bureau of Investigation. The solutions will be used by the FBI to authenticate employees at FBI headquarters. Later the solution will be used to support the FBI's 50000 users.

TORONTO, ON, Oct. 20, 2003. AirIQ launched a suite of satellite-based service to complement the company's terrestrial-based service. AirIQ operates as a wireless Internet applications service provider specializing in Telematics.



IEEE Canadian Review is pleased to announce a new partnership with **Kluwer Academic Publishers**. This partnership will allow IEEE Canada members to purchase copies of Kluwer books at a 20% discount through the link on the webpage at:

http://ewh.ieee.org/reg/7/canrev/ind_lnks.htm

Alleviating Unsolicited Commercial Email

At the IEEE Sections Congress in October 2002, www.ieee.org/sc/, one of the many recommendations for action included dealing with unsolicited email messages sent to IEEE email aliases. At that time, the IEEE IT staff started looking for a system using appropriate software and hardware. They started their search by studying the method used by the University of New Brunswick, www.unb.ca. As it turned out, this method formed the basis of the approach used by the IEEE. However, the IEEE had to expand the system to deal with about ten times the number of email messages, international laws, and additional functionality.

Internal trials of the system by the staff were favorable and an initial version of the system is scheduled to be launched on an opt-in basis in November 2003.

One aspect of the system is that it can be configured via a Web interface in order that email which is likely unsolicited is flagged, but not discarded. The user selects the method of flagging using the "Subject" email header. Subsequently, it is easy for the recipient to search for the flag and to deal with that likely unsolicited email in any chosen manner. One manner is to have the user's email software filter search for the flag and save the email in a file or folder. The user may look at the emails once in a while, in case a legitimate email was inadvertently flagged. Another manner is to discard unconditionally, known as blocking, the flagged email. Finally, the system could be configured to do nothing at all.

An enhancement being considered by the IEEE is to allow the end-user to control how or which emails should be allowed and disallowed for delivery. This enhancement also allows the end user to control the sensitivity thresholds associated with the inspection and filtering of unsolicited email. The end-user will be able to view up to 8 kbytes per message of the email that the system considers to be unsolicited email in order to determine whether or not the message can be delivered. No implementation dates are available yet for this enhancement.

There is no solution for unsolicited email, only strategies to minimize it. However, it is better to let the staff be the experts in minimizing it. This system will save time for IEEE email alias users because most unsolicited email will no longer clog their "Inbox" and because users will not have to waste time finding their own strategies to deal with the problem. Furthermore, these strategies are constantly changing.

The author finds significant utility in having a lifetime email address with the IEEE. However, the prospect of getting large amounts of unsolicited email for life was not pleasing, a situation which will soon be improved.

On a personal note, I know someone who works solely in the business world who I think would become an associate member of the IEEE in order to have access to the IEEE's world-class email system with daily updated virus scanning and unsolicited-email flagging. Furthermore, this person's business associates may not necessarily know about the use of this system because the person's lifetime MBA email alias would get forwarded to the IEEE email alias and then to a destination account. However, if an email containing a virus was sent to the MBA email alias and then automatically re-directed to the IEEE email alias, the IEEE email system would delete the virus and email a brief report to the email's originator. People may apply on-line for associate grade membership in the IEEE at www.ieee.org/join/, in order to obtain access to the email system capabilities of the world's largest technical professional society.

The IEEE staff did a great job of bringing this system, in one year, from concept to production.

Brent R. Petersen

b.petersen@ieee.org

Obituary

Dr. Michael Z. Tarnawecky, passed away Sat., Oct. 11, 2003.

Dr. Tarnawecky joined the Electrical Engineering Department, University of Manitoba in 1966 after nine years with Manitoba Hydro. Mike was University of Manitoba's expert in HVDC transmission systems and developed a number of very popular graduate courses in the area. He supervised 35 graduate students and worked closely with the Canadian Electrical Association, CIGRE and the Manitoba HVDC Research Centre. Mike retired in December 1991 and was named Professor Emeritus in January 1993.

He joined IEEE in March 1966 as a Member and was elevated to Senior Member grade in January 1976.

He was Section Secretary (Northern Canada Section) from June 1977 - July l978; Vice Chair (Northern Canada Section) July 1978 - June l979; and Section Chair (Winnipeg Section) June 1979 - September 1980.

IEEE MILCOM Technical Achievement Award

Barry Felstead become the first Canadian and non-American to receive the IEEE Milcom Technical Achievement Award. Presented annually, this career achievement award recognizes a person who has made significant technical contributions in the field of military communications, as evidenced by several significant high-quality technical publications in the MILCOM unclassified conference record.

Barry is a special projects leader in the Military Satellite Communications research group at CRC (Communications Research Centre Canada) in Ottawa, and has been with CRC since 1969.

Barry was officially presented with the award on the 14 October 2003 at the Milcom'2003 (www.milcom.org/2003) conference (the largest such conference in the military communications field) in Boston.

Photo: Leonard F. Kwiatkowski (right), chair of the MILCOM Board, presents Barry Felstead with his award.

Ethics in Project Management

1.0 Introduction

The scandals of WorldCom, Enron, Tyco, Merck, Bristol Meyer, Bre-X, Livent, Cinar, YBM Magnex and many others have shaken the public confidence on organizations in North America. A study by a Canadian accounting firm revealed that large Canadian corporations each lost on average $1.3 million (Can.) from fraud in 1997. Similar studies in the United States have revealed that white-collar crime may cost the private sector as much as $100 billion (US) each year. These developments have stimulated a growing realization that ethics and business are closely connected to each other. This has led to developing better and more robust understanding of the role of ethics in leadership and corporate culture [5]. The result is that the issue of ethics in organizations is getting lot of attention from public to senior management and government.

1.1 Ethical Issues in Project Management

Is ethical conduct especially important in the management of projects? Reference [3] has emphasized that ethics in project management is very important for several reasons. First, projects are often high risk, high reward, high visibility ventures; when the stakes are high, the pressure to cheat - or at the very least, to cut corners - is high as well. Second, the long project lifecycle in many industries means that the consequences of a particular action - like leaving the reinforcement out of the concrete won't be discovered for years, or even decades, or may be even never.

A survey of project managers in New Zealand revealed that a significant number of project managers face ethical challenges with varying degrees of frequency [10]. In an informal survey of PMI members, it was reported that 80% of the respondents encountered ethical dilemmas in the practice of their job [4]. These dilemmas range from being pressured to alter status reports, backdate signatures, or shade documentation to masks the reality of project progress, and approving shoddy work. Some project managers even lack consciousness about what constitutes an ethical problem. In the same survey, about 19% failed to recognize that ethical dilemmas occur in their world. Yet for those, conscious of the ethical dimensions of their behavior, every day is chock-full of ethical issues. For example, paddling of time and cost estimations, exaggerating pay-offs of project proposals, and so forth. Ethical dilemmas involve situations where it is difficult to determine whether conduct is right or wrong. Is it acceptable to falsely assure customers that every thing is on track when, in reality, you are only doing so to prevent them from panicking and making matter worse? [6]. Some common ethical missteps identified in businesses that are equally true in case of projects [7] are:

- "Wired" bids and contracts (the winner has been pre-determined),
- "Buy-in" (bidding low with intent of cutting corners or forcing subsequent contract changes),
- Kickbacks,
- "Covering" for team members (group cohesiveness),
- Taking "shortcuts" (to meet deadlines or budgets),
- using marginal (substandard) materials,
- Compromising on safety,
- Violating standards, and
- Consultant loyalties (to employer or to client or to public).

Surprisingly, PMBOK [8] and many of the leading project management reference books do not discuss PMI Code of Ethics, or the ethics of project management in sufficient detail [3]. Also, until recently, the topic of ethics in project management has received very little attention in project management conferences or journal papers. Recognizing the importance of ethics in project management, Project Management Institute of USA (PMI) has recently included a section on Ethics and Professional Responsibility in Project Management Professional (PMP) Certification Examination.

1.2 Professional and Ethical Obligations

Project management is a complicated work, and as such, ethics invariably involve gray areas of judgment and interpretation. For example it is difficult to distinguish deliberate falsification of estimates from genuine mistakes or the willful exaggeration of project pay-offs from genuine optimism. It becomes problematic whether unfulfilled promises were deliberate deception or an appropriate response to changing circumstances [6].

As a project management professional, we have a responsibility to promote ethical practices at our work place. We should accept the responsibilities that come with our work activities. As a project manager it is our responsibility to make decisions about project activities that may have an ethical dimension that must be considered.

Project Management Institute (PMI) Code of Ethics and Code of Professional Conduct [9] define ethical responsibilities for her members. In an informal survey, [3] found that the existence and precise content of the Code of Ethics itself is not well known to many in project management profession. The Code of ethics can guide the course of project managers by being conversant with it, by using it often and using it well. As a professional in the field of project management, PMI members pledge to uphold and abide by the following:

- Maintain high standards of integrity and professional conduct,
- Accept responsibility of their own actions,
- Continually seek to enhance their professional capabilities,
- Practice with fairness and honesty, and
- Encourage others in the profession to act in an ethical and professional manner.

1.3 Integrity

As a project management professional, one of our responsibilities is to ensure integrity of the project management process, the product, and our own personal conduct. This could be achieved by following the

by *Rafi Ashrafi,*
RA Ashrafi Associates Inc., Calgary, AB

Abstract

This paper discusses some of the ethical issues in project management. The purpose is to raise awareness within the project management community about ethics in project management, and to raise the level of ethical practice in project management organizations. The paper focuses on understanding the professional and ethical obligations in project management in context with PMI Code of Ethics. Also, the paper discusses some of the strategies on how to address ethical issues. The author has a firm belief that high ethical standards at individual as well as at the corporate level offer a lot of intangible as well as tangible benefits. The paper also highlights some of the benefits of ethical behaviour to individuals as well to organizations.

Sommaire

Ce papier traite des enjeux éthiques dans le domaine de la gestion de projet. L'objectif est de sensibiliser la communauté aux questions d'éthique en gestion de projet, et de hausser le niveau de la pratique éthique dans les organisations oeuvrant dans la gestion de projet. L'article met l'accent sur la compréhension des devoirs professionnels et éthiques dans la gestion de projet en lien avec le code d'éthique du PMI (Project Management Institute). De plus, l'article explique un certain nombre de stratégies quant à la façon d'aborder les enjeux éthiques. L'auteur croit fermement que des normes élevées d'éthique aux niveaux individuel et corporatif offrent des avantages concrets et intangibles. L'article met aussi en lumière les avantages d'avoir un comportement éthique tant pour les individus que pour les organisations.

PMBOK project management processes, and adhering to PMI Code of Ethics. As the above literature found, situations do occur in the course of managing projects where one's integrity is challenged. In those situations one has to make difficult decisions. Surely, high personal ethics, moral believes and training in ethics can help in make better decisions.

1.4 Conflict of Interest

PMI members are required to report to the stakeholders, customers, or others any actions or circumstances that could be construed as a conflict of interest.

1.5 Acting Professionally

PMI members are required to behave in a professional manner in difficult situations. Also, they are required to coaching team members to conform to the standard of conduct expected by the organization they work for.

1.6 Relationship With Customers, Clients And Employers

PMI members are required to provide customers, clients and employers with fair, honest, complete and accurate information on the preparation of estimates concerning costs, services and expected results. Also, PMI members are required to fully and accurately disclose any professional or business-related conflicts or potential conflicts of interest in a timely manner. Perhaps this is one of the most single important issues, and project management professionals need to improve on this. There is a tendency among project teams to give good news (to disclose positives) and to avoid bad news (hide negatives). Project Management Organizations have to cultivate a culture where the bearer of bad news is not punished.

1.7 Confidentiality Of Information

PMI members are required to honor and maintain the confidentiality of privacy of customer, client, employer, and similar work information, including the confidentiality of customer, or client identities, assignments undertaken, and other information obtained through the course of a professional relationship, unless: granted by permission by the customer, client or employer; or the maintenance of the confidentiality is otherwise unethical or unlawful. PMI members are also required to respect and protect intellectual property rights of others, and to properly disclose and recognize the professional, intellectual and research contributions of others.

1.8 Taking Responsibility Of Your Own Actions

PMI members are required to accept responsibility of their own actions. As a PM professional our concern for project and the organization should take precedence over our own feelings.

1.9 Duty To The Project Team

Most of the organizations claim a lot for enhancing employees' professional development. On the contrary, the author's research has found that in reality training and professional of has been the least important in priority of most of the organizations researched. How comfortable are we in burning our project team, over and over again? Do we change our behavior? Do we allow people to stand and differ from us on issues such as performance and safety?

1.10 Respecting Differences In Diverse Cultures

PMI members are required to interact with team and stakeholders in a professional and ethical manner by respecting personal, ethnic, and cultural differences in order to ensure a collaborative project management environment. Global competition requires awareness of cultural influences and customary practices of the country. Project managers' need to be educated in the country's cultural norms, business and management practices, also in regulations and legal contracting framework.

2.0 Strategies: How To Address Ethical Issues

To provide greater clarity to business ethics, many companies publish a code of conduct. Cynics see these documents as simply window practice, personal ethics do not lie in formal statutes but at the intersection of one's work, family, education, profession, religious or ethical beliefs, and daily interactions [2].

Experts in ethics strongly support the adoption of a formal code of ethics a necessary step in building a sense of business integrity [3]. [10] found that encouraging ethical practices in project environment requires more than developing codes and frameworks. It demands principled leadership, openness, and a commitment to developing innovative "win-win" strategies. [10] also found that most project managers rely on their own private sense of right and wrong - what one project manager called his "internal compass". One common rule of thumb is for testing whether a response is ethical is to ask, "Imagine that whatever you did was going to be reported on the front page of your local newspaper." How would you like that? Would you be comfortable?

Many project managers claim that ethical behavior is its own reward. By following your won internal compass your behavior expresses your personal values. Others suggest that ethical behavior is double rewarding [4]. You not only able to fall asleep at night but you also develop a sound and admirable reputation. Such reputation is essential to establishing the trust necessary to exercise influence effectively. Reference [1] has suggested to developing managers as moral individuals, building an environment in which standards and values are central to the organization's strategy, and formulating and implementing policies that support ethical performance, as well as safeguard to assure they are observed. Some authors have recommended use of ethics audit in organizations [11].

Top management and the culture of an organization play an important role in shaping members' beliefs of what is right or wrong. Reference [12] found that a value based cultural approach to ethics/compliance management works best. Critical ingredients of such an approach include leaders' commitment to ethics, fair treatment of employees, rewards for ethical conduct, concern for external stakeholders, and consistency between policies and actions. What hurts effectiveness most are an ethics/compliance program that employees believe exists only to protect top management from blame and an ethical culture that focuses on unquestioning obedience to authority and employee self interest [10] found that the following attributed to better ethical decisions:

- Better trained and educated managers,
- Greater emphasis on individual responsibility and accountability,
- Flattened organizational structures with more customer focus and team decisions.

2.1 Benefits Of Ethical Behavior

The organizations who created codes and built more ethical corporate cultures have discovered that substantial positive benefits can flow from building a reputation as an ethical company. Employees prefer to work for ethical companies. A reputation for ethical business practices attracts better-qualified, better-motivated job applicants. Employee moral and public relations benefit. Long-term profitability can be enhanced [5]. Reference [12] reported the results of effective ethics/compliance management:

- Reduced unethical/illegal behavior in the organization,
- Increased awareness of ethical issues,
- More ethical advice seeking within the firm,
- Greater willingness to deliver bad news or report ethical/legal violations to management,
- Better decision making because of the ethics/compliance program, and
- Increased employee commitment.

In a survey of PMI members, [4] reported the following benefits of ethical behavior:

- Respect of peers and trust of others,
- The sense that others look up at me,
- A reputation for fair and ethical behavior is an implicit sales point for future business,
- A company is only good as its people and if they are ethical it will come back to company over and over the long run, and
- Ethical decisions lead to better products.

3.0 Conclusions

The unethical behavior in organizations is costing millions and billions dollars of taxpayers' money every year. As a project management professional, it is our responsibility, not only to uphold high standards of ethical behavior at work place, but also to foster an environment of high ethics in organizations we work for. We hope that this paper will

increase awareness of the importance of ethics in organizations in general, and project management in particular. Also, we hope that this paper will stimulate some useful discussions on the topic and other professionals will share their views and experiences on this issue of concern to general public as well as commercial and government organizations and individuals.

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About the author

Rafi Ashrafi, Ph.D. PMP, has over 25 years of experience in academia and business in the UK, Middle East and Canada. Rafi is a project management consultant providing project management consulting and training to clients. Rafi has worked in the Information Technology, Telecommunications, Energy, Utility and Public sectors. Rafi was an Adjunct Professor in the Project Management Specialization, and an instructor at the Haskayne School of Business at the University of Calgary. Rafi was also an Instructor at PMI-Southern Alberta Chapter's Project Management Professional (PMP) preparation workshop. He has published over 25 research papers in global journals and conference proceedings. He is a Certified Project Management Professional (PMP), a Fellow of the British Computer Society (FBCS) and a Chartered Information Systems Engineer (C.Eng) in the U.K.

The IEEE Toronto Centennial Celebrations - October 3 - 5, 2003

by: Robert T.H. (Bob) Alden,
IEEE Toronto Section, Toronto, ON

September 30, 1903 saw the establishment of the first Section of the American Institute of Electrical Engineers (AIEE) outside the United States. The location was the Engineers Club in Toronto. In 1963, the AIEE merged with the IRE (Institute of Radio Engineers) to form the IEEE.

October 3 - 5, 2003 was the date and the Marriott Bloor Yorkville hotel in Toronto was the place for the IEEE Toronto Centennial celebrations held in conjunction with the Fall meeting of the IEEE Canada Board of Directors. The three events described here are:

- Forum on Reliable Power Grids in Canada
- IEEE Toronto Centennial Banquet
- IEEE Canada Board of Directors Meeting

1.0 Forum on Reliable Power Grids in Canada

The Friday evening forum was assembled in response to the intense interest in understanding more about the recent power blackout (August 14, 2003) that directly affected 50 million people in Ontario and several north eastern states - a timely and important topic that was well attended. The forum featured four experts with experience in power grid blackouts and other disturbances, and was moderated by IEEE Canada President Mo El-Hawary and convened by IEEE Toronto Section chair Bob Hanna. Formal discussions and those following the presentations were extensive and spirited.

Figure 1: The Forum participants were (left to right) Bob Hanna, Dan Rochester, Jim Lee, Jean-Marie Gagnon, Prabha Kundur and Mo El-Hawary

Figure 2: The audience was interested!

Figure 3: Sample slide

Dan Rochester is the manager of the section responsible for reliability outlooks for the Independent Electricity Market Operator in Ontario. His presentation on the IMO perspective on reliability, which began with the IMO view of the August 14 blackout, provided a fitting start to the forum.

Jim Lee, supervisor of transmission system development at Hydro One Networks in Ontario, provided the transmission company perspective on the August 14 sequence of events and an overview of related Hydro One system development.

Jean-Marie Gagnon is director of interconnection development at Hydro-Québec Transnergie. He discussed the reasons why Hydro-Québec was not involved in the blackout, and concentrated on what courses of actions could be considered following a blackout or catastrophic events (e.g. the January 1998 ice storm in Quebec).

Prabha Kundur is president of Powertech Labs in British Columbia and has a distinguished record of consulting on various major outages around the world. His presentation on Power System Security in the New Industry Environment: Challenges and Solutions, provided a thoughtful and fitting finale to this set of four perspectives.

All of these presentations, speaker biographies, and many additional photographs from this event, are posted on the IEEE Toronto web site at http://toronto.ieee.org/events/oct0303.htm

2.0 Centennial Banquet

The Saturday centennial banquet started with a reception and, between the fine meal and desert, featured an IEEE Canada awards segment followed by a special multimedia presentation and a special centennial version of IEEE Toronto awards and recognitions. Section Secretary Pelle Westlind was a splendid master of ceremonies.

Figure 4: MC Pelle Westlind

2.1 IEEE Canada Awards

IEEE Canada President, Mo El-Hawary, presented three awards:

- A plaque to Dr. Wallace Read, recognizing his recent induction as a Member of the Order of Canada,
- Together with IEEE Vice President for Regional Activities, Cleon Anderson, the 2002 IEEE Sustained Membership Growth Award to the Toronto Section,
- The 2003 McNaughton Medal to Dr. Anastasios Venetsanopoulos, Dean of the Faculty of Applied Science and Engineering at the University of Toronto - the citation reads "for outstanding contributions to the design and implementation of communication systems, digital filters and multimedia systems; IEEE; the engineering profession and society at large".

Figure 5: (top left) Wallace S. Read C.M.

Figure 6: (top right) Toronto Section Award

Figure 7: (bottom left) McNaughton Medal

2.2 IEEE Toronto Multimedia Presentation

The Toronto Section presented an historical perspective of developments in Toronto and the IEEE since the founding of AIEE in the 1880's using a sequence of slides set to appropriate music of the period, decade by decade. The sequence concluded with a series of video clips capturing the thoughts of several IEEE volunteers. Please keep watch on the IEEE Toronto web site for details about downloading or obtaining a copy of this historic record.

2.3 IEEE Toronto Awards and Recognitions

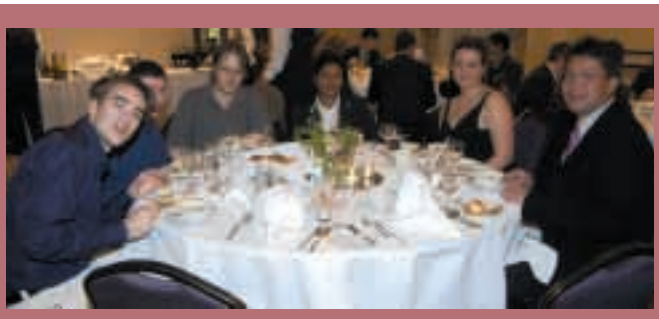


Figure 8: Student Scholarship Winners with Professor Ng

2.4 Member Recognitions

Toronto Section Chair, Bob Hanna, paid tribute to the various programs offered by the Section and the members and volunteers who contributed in various important ways. He focused on four categories of IEEE membership by naming those achieving this status in our centennial year and asking those present in that category to stand and be recognized:

- Student Scholarship Winners,
- Senior Member Upgrades,
- Fellows, and
- Life Members.

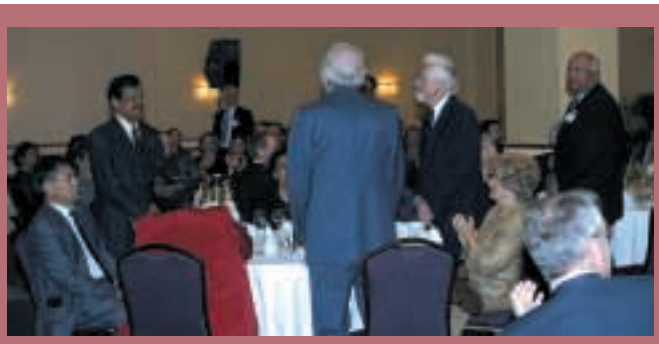


Figure 9: Some of the IEEE Fellow grade members being recognized

2.5 IEEE Toronto Centennial Medals

Special medals had been designed and struck to commemorate four groups of IEEE volunteers who had served the Section and other IEEE entities with distinction.

Figure 10: B. Hanna

Figure 11: The IEEE Toronto Centennial Medals

Bob Hanna identified and presented medals to:

Past Section Chairs Ted Millen 1950-51, Ike Morgulis 67-68, Ian Dutton 69-70, Wasyl Janischewskyj 75-76, Bob Jefferies 76-77, Tas Venetsanopoulos 77-79, Ajit Bapat 79-81, Robert Caputo 81-83, Andre Salama 85-87, Wallas Khella 87-89, Lamberto Gomes 89-91, Ted Wojcinski 91-93, David Whyte 94-95, Bruno DiStefano 96-99, Ted Sargent 00-01.

It is with deep sadness we note that Ted Millen became ill just before the Centennial celebrations and passed away a few days later. Luc Matteau of the Peterborough Section visited Ted's wife to present her with his medal.

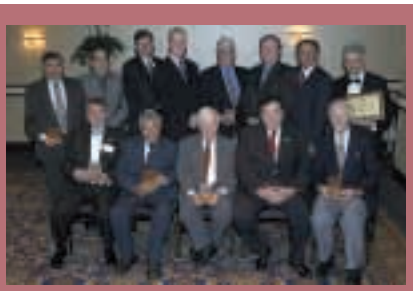


Figure 12: Current and Past IEEE Toronto Section Chairs.

Front: Hanna, Gomes, Morgulis, Venetsanopoulos, Dutton

Back: Bapat, Caputo, Wojcinski, Sargent, Jefferies, Whyte, Salama, DiStefano

IEEE Corporate Volunteers Ray Findlay, the third Canadian to serve as IEEE President, Mo El-Hawary, the current IEEE Canada President, Celia Desmond, the current IEEE Communications Society President, Cleon Anderson, the current IEEE Vice President of Regional Activities, Mike Adler (absent), the current IEEE President, Wally Read, the second Canadian to serve as IEEE President.

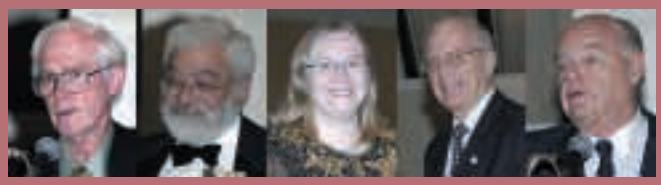


Figure 13: Findlay, El-Hawary, Desmond, Anderson, Read

Selected Section Volunteers Ramesh Abhari, Dennis Cecic, Bob Hanna, Emanuel Istrate, Randy Park, Kostas Plataniotis, Al Wallis, Pelle Westlind, Walter Zessner. Three additional section volunteers were awarded centennial medals in addition to the plaques presented in commemoration of the establishment of three Toronto Section Scholarships.

Figure 14: Section Volunteers; (left to right) Plataniotis, Istrate, Cecic and Westlind

2.6 Establishment of Three Scholarships

IEEE Toronto Section wished to recognize in a special way the contributions of three Section volunteers for their outstanding services and dedication. The Section decided to establish scholarships to be named after these volunteers.

Figure 15: Bruno Di Stefano, Bob Alden and Wallas Khella with their plaques.

- The IEEE Toronto Section Bruno Di Stefano Scholarship,
- The IEEE Toronto Section Dr. Wallas H. Khella Scholarship, and
- The IEEE Canadian Foundation Dr. Robert T.H. Alden Scholarship (to be presented jointly by the IEEE Toronto Section and the IEEE Canadian Foundation).

2.7 IEEE Toronto Section Business Meeting

The formal part of the evening's events concluded with a very brief announcement of the election by acclamation of the 2004-2005 Section officers, with Kostas Plataniotis as Chair, Denis Cecic as Vice-Chair, Al Wallis as Treasurer, and Pelle Westlind as Secretary.

3.0 For More Information

Many additional photographs and other information about this historic event are posted on the IEEE Toronto web site at:

http://toronto.ieee.org/events/oct0403.htm

4.0 The IEEE Canada Board Meetings

Twice a year, the board of directors and associated committees get together in person to conduct their formal business which compliments the extensive use of teleconferences, e-mail and other electronic forms of communication. By IEEE bylaw, Section chairs must form a voting majority at the board meeting - this is to ensure that the primary local IEEE unit, the Section, has the dominant say in decisions. Information for new Section chairs is provided, good practices are exchanged, decisions are taken, and the leadership team gets to know and learn from each other. This was the final meeting of President Mo El-Hawary's term of office and several items of business were wrapped up - one of these was the approval of many committee charters that had been revised to be consistent with the previous meeting's decisions to deliver services in both languages in a manner to keep within budget limitations. This was also the opportunity for President-Elect Bill Kennedy to set the stage for his goals - which will be posted on our IEEE Canada web site.

Figure 16: Bill Kennedy (left).

Ferial El-Hawary presented a workshop for chapter chairs on the Friday afternoon. This is a popular recurring event at these meetings and is scheduled immediately prior to the start of the administrative meetings so that delegates from across Canada can attend at no additional cost by arriving a few hours earlier than otherwise - it also provides an opportunity for volunteers from the local Sections to attend. Because Ferial's arrival was slightly delayed (due to Halifax Airport problems resulting from the widespread damage caused by the recent hurricane), Witold Kinsner (Winnipeg) started the workshop and provided the following photo.

Figure 17: Attendees at the IEEE Canada Chapter Workshop

Java Microarchitectures

by: Purnendu Sinha, Nikhil Varma & Vasudevan Janarthanan, Concordia University, Montreal, QC.

Book Edited by: Vijaykrishnan Narayanan, Mario I.Wolczko
Published by: Kluwer Academic Publishers
ISBN: 1-4020-7034-9
2002

The need for an architectural neutral language that could be used to produce code that would run on a variety of CPUs under differing environments led to the emergence of the Java programming language. With the rise of the World Wide Web, Java has propelled to the forefront of computer language design, because the web, too, demands portable programs. The environmental change that prompted Java was the need for platform-independent programs destined for distribution on the Internet. The Java platform with its target platform neutrality, simplified object model, strong notions of security and portability, as well as multithreading support, provides many advantages for a new generation of networked, embedded and real-time systems. All those features would not have been possible without appropriate hardware support. This book delves in-depth into the various hardware requirements (with suitable case-studies and examples) for realizing the advantages of Java.

Java's portability is attained by compiling Java programs to Java bytecodes (JBCs) and interpreting them on the platform-independent Java Virtual Machine (JVM). Bytecode is a highly optimized set of instructions designed to be executed by the Java run-time system namely the JVM. The first chapter presents a platform-independent dynamic analysis of the JVM, including data related to bytecode instruction usage, method frequencies and stack frame profiles. In order to test the technique, the SPEC JVM98 benchmark suite has been used, since this suite does not allow the supply of source code to all the applications. This type of analysis helps one to clarify the potential impact of the data gained from static analysis, provide information on the scope and coverage of the test suite used and act as a basis for machine-dependent studies. Based on the results tabulated in this chapter, one can gain insights into the optimization work needed for improving the performance of Java to bytecode compilers and for the design of the JVM.

As Java is being used on a variety of platforms, there is a growing importance to study and optimize the memory behavior of programs because of the various disparities between the processor and memory speeds. Chapter 2 helps one understand the memory behavior of important Java workloads used in benchmarking JVMs like SPEC JVM98 and JIT compilers. With the help of the benchmark, characteristics like heap accesses, data misses, object-field accesses including hot spots and memory system interactions have been inspected. The analysis presented in this chapter provides important insights into understanding the key sources of performance loss in Java programs. This chapter also presents a set of recommendations to computer architects and implementers of JVM components with structured information about the Java workloads useful in formulating their designs and also techniques to run Java programs more efficiently.

In embedded application, the architectural support is a key factor for improving performance. The third chapter describes a hardware architecture that provides an efficient implementation of the JVM for embedded and real-time systems. As the proposed architecture provides direct support for the entire JVM instruction set and thread model, it obviates the need for a Java interpreter or JIT compiler as well as traditional RTOS. This chapter looks into the aspects such as memory management, concurrency, interrupts and concludes that the aJile embedded Java microprocessor provides an efficient platform for developing embedded applications in Java.

Java programs execute indirectly through a translation layer built into the Java Virtual Machine (JVM). The translation process essentially converts the bytecodes into corresponding machine-specific binary instructions. The JVM has a stack architecture where operands are executed one by one using the push-pop technique. Chapter 4 presents a processor architecture for the hardware execution of the bytecodes and resolves the issue of stack dependency by the use of a hardware bytecode folding algorithm. The architecture provides a dual processing capability of execution of bytecodes and native binaries. This chapter discusses and analyzes the bytecode processing in various stages of the instruction pipeline. It also presents a comparison between the hardware translation approach and the other hardware approaches supporting Java in hardware.

Using hardware support to assist the execution of bytecodes eliminates the requirement of a software layer to emulate the bytecodes. A hardware accelerator or coprocessor that works in conjunction with a standard microprocessor can improve the execution of Java programs. The fifth chapter introduces micro-architectural techniques to improve the performance of Java applications executing on embedded Java processors and general-purpose processors. The mechanism of using a fill unit to store decoded bytecodes into a decoded bytecode cache improves considerably the fetch and decode bandwidth of Java processors. A Hardware Interpreter (Hard-Int) architecture is also proposed which bridges the performance gap between the execution of Java applications and natively compiled code by dynamically translating the bytecodes to native language instructions.

Continuing along our discussion on the issue of design of architectures for efficient execution of Java Virtual Machine (JVM) bytecode, Chapter 6 describes the Delft-Java architecture and the mechanisms required to dynamically translate JVM instructions into Delft-Java instructions. This chapter also provides micro-architectural support for dynamic translation, dynamic linking, multiple thread units, multiple instruction issue, dependency collapsing and features applicable to modern super-scalar processors. Through examples, this chapter illustrates the effectiveness of Delft-Java architecture in accelerating the Java program execution.

Since Java Virtual Machines (JVMs) rely on dynamic compilation for performance, they suffer from large memory footprints and high startup costs, which are serious problems for embedded devices. The seventh chapter presents a Quasi-static compilation framework that enables efficient use of volatile storage while executing compiled Java code on an embedded device. In this approach, the pre-compiled binary images are reused and adapted to a new execution context by using an indirection table to hold relocated values, leaving the executable code unmodified and able to be placed in ROM. This approach enables the Java code to be stored in a shared location and be used by different applications.

With hardware support for multithreading, virtual machines (VM) can enhance performance, by exploiting thread-level concurrency, by executing tasks such as garbage collection (GC) concurrently with program execution. Chapter 8 discusses a Relational Profiling Architecture (RPA)

Continued on page 16

Project Portal: Bring People Together in Virtual Teams

by *Kenneth Fung,*
University of Calgary, Calgary, AB

Abstract

A project portal is a communication channel dedicated to a specific project. Often the Project Portal is a secure website serving as a common information and working community for people involved in the project. Some companies setup the project portal as part of the community of practice in Project Management. Companies see project portals and communities of practice in Project Management as some of the next steps in the evolution of the modern, knowledge-based organization. Virtual teams often use the project portal to bring their teams together from different locations geographically. This paper examines the development and issues of the Project Portal, Community of Practice in Project Management and the Virtual Teams.

Sommaire

Un portail de projet est un canal de communication consacré à un projet spécifique. Souvent le portail de projet est un site Internet sécurisé servant de communauté d'information et de travail pour les personnes impliquées dans un même projet. Aussi, certaines compagnies développent le portail de projet pour établir une communauté d'échanges dans le cadre de la gestion d'un projet. Les compagnies voient le portail de projet et la communauté d'échange comme les prochaines étapes de l'évolution d'une organisation moderne qui est basée sur la connaissance. Souvent, le portail de projet est utilisé pour rassembler, de facon virtuelle, des équipes provenant de différentes régions. Cet article aborde les sujets suivants: le développement et les enjeux du portail de projet, la communauté d'échanges dans la gestion de projet, et les équipes virtuelles.

1.0 Introduction

The Internet, in a very short period of time, has impacted all of us. It allows us to:

- Arrange information our way,
- Navigate easily and quickly among related information in diverse locations,
- Establish multiple perspectives and views for various work teams and individuals,
- Easily structure and restructure data and information relationships and associations,
- Provide immediate publication and distribution at very low cost,
- Work and release information incrementally and continuously,
- automatically notify a pre-identified group of people when information is changed,
- Collaborate in new ways, and with new efficiencies,
- Have simultaneous and instantaneous information dissemination at a low cost,
- Do single entry to data,
- Maintain, reuse and rapid propagation of processes, lessons learned, and process changes,
- Have ease of use,
- Do easy and inexpensive data archiving and purging,
- Easily partition data and data access across different stakeholders,
- Routinely and frequently engage in collaboration among geographically dispersed participants at a rich enough bandwidth so that some travel may be avoided [6].

It would be great if we can apply all the features of the Internet to Project Management. Project management involves identifying and building teams of skilled people Just-In-Time, defining the scope and requirements, working on the right tasks, communicating ideas, tracking project progress and building knowledge.

Recent advances in technologies have revolutionized the design and structure of project organizations and their relationships. Instead of using co-located project teams, virtual project management involves building virtual teams. It is radically changing how projects are implemented. The availability of Information Technology has made the Virtual organization a reality. Implementing a virtual organization involves adopting new business strategies, project-driven organizations, and informal relationships leading to new organizational models and realities. Virtual Projects transcend distance, time, and organizational boundaries. It attempts to solve the problem of managing large projects and improving the economics of their planning and execution by enabling collaborative technologies, Internet and other global networks.

Virtual Project Management utilizes virtual teams to provide flexibility in terms of project work. Work can be done by "anyone at anytime from anywhere."

2.0 Virtual Teams

Virtual Project Management uses virtual teams to implement projects. A virtual team consists of a highly electronic mediated set of individuals with a common purpose. It is the degree of online communications that characterizes a team as virtual. Virtual teams are characterized by the large amount of on-line communication. While geographic dispersion among team members typically drives online communications, it is the degree of online communications, not the dispersion of the team that characterizes a team as virtual. A co-located group that conducts the majority of online communication may be considered as a virtual team.

One of the critical factors in the effectiveness of virtual team is trust. A major problem for virtual team is to rely on the skills and efforts of strangers who depend on and communicate with each other for a short period coordinated by communication technologies. Virtual teams have to quickly develop and maintain trust relationships with people that they hardly know.

3.0 Virtual Teams Success Stories

One of the most drastic success stories is the case of the SLICE (Simple Low-cost Innovative Concepts Engine) team initiated by Boeing-Rocketdyne [3]. The team was able to drive the cost of a rocket engine down by 100 times, get the engine to market 10 times faster than before, and increase the useful life by a factor of three. The team of eight people, located 100 - 1,000 miles away, have never worked together on previous team activities with no team member devoting more than 15% of his or her time. The only time that all members were co-located was the last day of the project.

IBM studied 30 teams as they addressed production-line quality issues. Teams that used groupware tools have an average of 50% fewer labor hours to work on the problem and completed the task 91 percent faster. Boeing tracked 64 teams that used groupware tools to define design requirements. Team activities included problem definition, design alternative generation and evaluation, planning, and documentation of group decisions and accomplishments. The use of groupware reduced project execution time by an average of 91% and labor costs by 71%. The estimated return on investment was 170% [1].

4.0 Virtual Team Issues

Virtual Project Management utilizes virtual teams to provide flexibility in terms of project work. Work can be done by "anyone at anytime from anywhere." In a project, virtual teams are temporary and fragile. The project manager has to foster trust in the virtual team. A traditional

project manager has the responsibility, accountability, authority, and power to act in the interest of the project. In a virtual project, these attributes would be distributed to the members of the virtual team. It requires commitment from every member of the virtual team. The team members act as leaders for their assigned tasks. A virtual project involves transcending the limitations of time and distance without losing focus on the power of the originator and the commitment of the team member. The virtual project manager has to be present in effect but not in form.

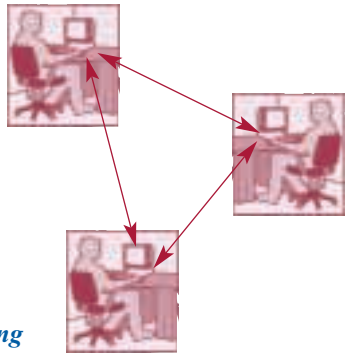
The project manager has to integrate a common set of technologies, tools and techniques for the project team, and provide comprehensive training in the effective use of these technologies. He has to take into account the skills and prior experience of the team members who he may not have met face-to-face. He also has to address communication, social and cultural issues of the team. The people issues increase in complexity as the team increases in size.

Assembling the virtual project team would be very much different from that of a traditional project team. In a virtual project, the project manager would not have the chance to interview the team member or conduct meetings face-to-face. The Virtual Project Management process such as project initiation, ground rules/protocol, work dynamics, best practices, communication, team organization, metrics and measurement would be very much different to that of the traditional project management process.

5.0 Key Success Factors And Best Practices For Virtual Teams And Using Collaboration Tools

In general, the basic elements of effective teamwork and collaboration are the same regardless of whether team members are working in a face-to-face meeting or working in a virtual environment that connects team members separated by either time or space [1]. The 10 key elements that influence the effectiveness of collaboration efforts are:

1. Culture of Sharing
2. Common goals
3. Process and workflow
4. Trust
5. Rules of interaction
6. Mutual benefits
7. Management support
8. Team rewards
9. Training
10. Critical mass



5.1 Develop A Culture Of Sharing

The fundamental success determinant of virtual team using collaborative technologies is whether the underlying culture and structure of an organization is supportive of collaboration. To be successful, collaboration expectations and practice must exist before implementation of the introduction of the technology. Inappropriate corporate culture is the greatest obstacle to the effective knowledge transfer within their organizations. Management consulting firms have been very successful in collaboration because information sharing was set at the partners level.

5.2 Develop A Common Goal For Collaboration

As in traditional teams, virtual teams need to have a clearly defined common goal to provide focus and motivation for participation. Successful collaborations are usually driven by a specific business need. Defining the metrics to measure the success of the common goal is very important. Users also, and not just management, need to buy in to the importance of the goal. Collaboration goals should be consistent with the organizational or community culture of the organization(s).

5.3 Business Process And Workflow

Often management approaches collaboration issues with a technology rather than a process approach. Managers look at collaboration as installing an Information Technology, rather than as a business initiative. It takes time and effort to change the existing process. Collaboration means change. Collaborative technology initiatives are best managed as business change projects rather than traditional information technology IT projects.

5.4 Develop Trust Among Virtual Team Members

Trust is central to effective virtual teams. The effectiveness of virtual teams is dependent on a network of social relationships based on trust. Virtual teams need to trust that the information they receive from each other is accurate and reliable. Team members need to trust that the information they pass on to their colleagues will be handled in the agreed upon manner (e.g. rules regulating further distribution). Most organizations are structured on the assumption that people cannot be trusted. Collaborative technologies work better if organizations are in a structure and culture based on trust rather than control.

Face-to-face interaction is an essential element for establishing trusting relationships in virtual teams. Virtual communications are most effective when it is a supplement to, not a substitute for, face-to-face interaction. Video teleconferencing, although effective, would not eliminate the need of face-to-face interactions. Initial face-to-face meetings are especially critical to kick off team activities. Personal interaction provides the opportunity for team members to become familiar with the subtleties of personality and work style that may be difficult to convey through virtual communication. Personal interactions in informal settings are also seen as advantageous to establishing trusting relationships.

Trust that is formed through virtual communications is called swift trust. It is based primarily on professional reputation. It is very fragile and can erode quickly if not reinforced by action during the communication. Behaviors to build swift trust include predictable communication, substantive and timely responses to requests for information, leadership, focus on task execution and not procedural issues, and establish strategies for handling team conflict and crisis operations. Existing conflict among organizations or individuals creates challenges to establishing trust for any team, but it likely prohibits the ability to establish trust solely based on virtual communications. Technology will not repair bad relationships. Trust begins with the development of personal working relationships. One way to build trust and communication is to introduce communities of practice (COPs).

5.5 Define Rules Of Interaction

Rules of interaction are the procedures by which team members are expected to interact in the virtual teams and collaborative tools. They include the type and frequency of communications expected among team members, process procedures, and data classification level. Clearly specifying these rules prior to system deployment defines initial ground rules for system use that can significantly enhance the level of trust and comfort level with the system. Unclear rules will lead to confusion that can inhibit effective application of the tools. They are especially critical for teams that have not previously worked together or when issues related to trust have been identified.

Rules of interaction include user protocols for logging in, checking information, and responding to requests for information. Response time of virtual communications is a critical element affecting trust among virtual teams. In face-to-face interactions, feedback is immediate. Long delays between communications in a virtual environment can significantly erode trust among team members.

Ownership can be a significant issue in collaborative systems. Knowledge is frequently perceived as power. There should be mechanisms to ensure contributors receive recognition for their contributions to collaborative efforts.

All users at the team level should be involved in the process of defining rules of interaction. This involves negotiation and buy-in from all. Overly restrictive rules can significantly inhibit the potential benefits of collaboration systems.

5.6 Ensure Mutual Benefit

If users do not perceive a direct benefit to themselves or their organization, they probably will not make the investment. It is critical to have all users buy in to the value of their participation. The effectiveness of the collaborative tools is generally dependent on the participation of all users. A key strategy for the successful implementation is to provide a direct benefit to all users. This may involve building in additional features to reduce the workload or increase the value-added. It is important to recognize and reward those individuals who contribute extra work for the benefit of others.

5.7 *Secure Management Support*

Collaboration efforts are more successful in organizations when management is actively involved in the decision to invest in collaborative technologies. They should also communicate that support to all ranks of the organization. The true benefits of collaboration cannot be pushed but rather need to be nurtured. Users have to perceive real value to initiate and sustain quality collaboration efforts.

5.8 *Provide Recognition And Rewards*

Problems associated with effective groupware implementation are rooted in corporate reward structures that do not reinforce collaboration. If existing organizational reward structures focus on individual performance, specialized expertise, or information access, it may be difficult for workers to justify their participation in collaboration systems. In competitive corporate environments, collaborative behaviors are perceived as a threat to individual power, status, and distinctive competence. Organizations have to adjust their reward systems to match new collaborative goals. Some consulting firms emphasize the importance of employees contributing knowledge to a shared environment and provide recognition and financial incentives for teamwork. They organize contest sponsored by management that rewarded the best-formed and functioning teams. Winning teams were rewarded with leisure travel at the company's expense. The power of rewards is much stronger than the draw of the technology. Proper emphasis on teams and information sharing will lead groups to collaborate, regardless of the tools available to those teams.

Traditionally, we have been recognized and rewarded for possessing unique and specialized expertise achieved through outstanding individual performance. Knowledge workers are often rewarded based on the ability to access, filter, and interpret data. This reward culture may be in opposition to the goals of collaboration that encourage teamwork and information sharing. Reward systems supporting collaborative behaviors should focus on team, rather than individual, performance. Timing of rewards is also important. It is best to provide rewards concurrent with team accomplishments rather than on an annual basis.

5.9 *Promote Training*

Training is one of the easiest ways to bolster the success of virtual team. Successful programs address business process issues as well as tool functionality. Users have to understand how the technology can support collaboration. Training programs should have the targeted goals for the system, as well as specific process, roles, and responsibilities required to meet those goals. It is a mechanism to market the tool to users. Organizational support for groupware and collaboration goals is best communicated directly by management during training. Training content issues include presentation of collaboration goals, outlining rules of interaction, and addressing effective team processes and skills.

5.10 *Attain Critical Mass Usage*

Lack of critical mass is a major issue for collaboration system. It is important to attain a critical mass by assembling a group of active users large enough for the system to be useful. Low system use results in insufficient data and communication problem. The right people are not online. This creates frustration of active users who would choose not to use the system further, thus creating even lower system use and further data and communication problems. The best method for achieving critical mass is to deploy the system to a core set of users with defined tasks. Management should actively participate on the system to provide leadership that encourage others to use the tools. Preloading relevant content can also help support critical mass usage.

6.0 Community Of Practice In Project Management

A “Community of Practice” in a Virtual Team can be used to overcome some of the barriers to effective virtual teamwork [2]. Communities of Practice (CoPs) are groups that form to share what they know, and to learn from one another regarding some aspects of their work. One of the best-known early examples of a CoP is one formed by the copy machine repair technicians at Xerox Corporation. Through networking and sharing their experiences, their problems and the solutions, this group proved very effective by providing support. For the most part, this group was a voluntary, informal gathering and sharing of expertise, not a corporate program.

Successful companies depend on continuous innovation to seek sustainable competitive advantage in processes, products and services. Innovation depends on people attributes, such as curiosity, insight, ideas and determination. Innovation is about people applying knowledge to devise new solutions to problems. In the context of innovation, Community of Practice is where best practices and innovations first emerge and where the solutions to shared problems are first identified. But it takes time for CoPs to emerge, to flourish and to become productive. They cannot be mandated.

7.0 Types Of CoPs

There are two types of Communities of Practice:

1. Self-Organizing, and
2. Sponsored.

Self-organizing CoPs share interests of the group's members. They add value to a company by sharing lessons learned, best practices and providing forums in which issues and problems can be raised and resolved, i.e. by learning from each other. Management’s attempt to manage or control them can result in disbanding a group or going “underground” instead of sharing their expertise and knowledge more broadly. Members come and go as interests and issues shift and evolve. They adapt and may evolve into a formal or sponsored CoP. or disband, if there is no interest. There are many self-organizing CoPs in Project Management. Your local PMI chapters and their websites are prime example of self-organizing CoPs.

Sponsored CoPs are initiated, chartered, and supported by management. They are expected to produce measurable results. They have resources as well as formal roles and responsibilities. They are usually more self-governing and cross-functional than the typical cross-functional project team. In project management, a company may setup a company sponsored CoP to focus on project management within the company. For example, the US Navy sponsored the Program Management Community of Practice (PMCoP) portal and opens it to the public.

8.0 Project Portal

A project portal is a suite of integrated applications that provide users with a single point of entry to information associated with a project [4]. The traditional definition of portal is “door, entrance; especially: a grand or imposing one” (Dictionary). The term Portal has been adopted by the Internet technology industry to mean a relatively concise, convenient gateway for accessing a variety of useful data – wherever that data is located. A “project portal” is a gateway to the collection of project data and data resources. It is the access mechanism to all of the information that are useful for the project – wherever that data is located [6]. The Portal may be used for creating, organizing, navigating, viewing, and gathering project information, linking it with underlying business processes, and capturing, sharing, and utilizing knowledge within the project team, its customers, suppliers and partners.

Rapidly emerging and maturing web technologies support a wide range of alternatives for implementing a project portal. The architectural alternative that you choose should be based on both your near term objectives as well as your long term vision. In addition to technical capabilities, considerations will include business environment, schedule, cost, deployment, support, maintenance, IT infrastructure, business culture, standardization, enterprise consistency, and existing legacy systems [4].

9.0 When Do You Need A Project Portal?

Your team may want to aggressively pursue development of a Project Portal if:

- Your project is relatively early in the project life cycle,
- Your project team is geographically or organizationally distributed,
- Your customers want it,
- Your team is familiar with electronic collaboration concepts and approaches,
- Your company invests in the people, processes, and tools to facilitate effective and efficient portal development,
- Your team can reduce or avoid significant travel costs, document distribution and reproduction costs normally involved in project coordination [5].

10.0 Some Of The Key Success Factors In Project Portal Implementation

- **Management embraces the Internet:** Getting buy-in from management willing to commit resources is very important.
- **Incremental implementation:** Plan and invest for incremental implementation of project portal development and use.
- **Wired the infrastructure with sufficient bandwidth:** To ensure that it supports the intended uses of the project portal.
- **Start Early:** Project portal can help even early in the business development cycle, e.g. Request For Proposal and before award.
- **Up in a Day. Always Up to Date:** Strive to bring up a basic project portal in a day by setting a generic template. Not all features need to be active immediately, but the framework can be operational very quickly. Posting and linking of existing project data to date onto the site as soon as they are available. Portal content evolves as the project requires and it should be up to date.
- **Self-Organizing:** Provide guidance for a project participant to post project in a logical place and link appropriately to related data [6].

11.0 How Does CoPs Relate To Project Portals

While project portals are for specific projects, they link to the Community of Practice in Project Management. In a company, there will be many project portals for the different projects. The Community of Practice in Project Management will provide the foundation and best practices for projects that are facilitated by Project Portals. As the project goes through the project life cycle to completion, lessons learned and knowledge gained during implementation will be captured in the project portal and can easily be transferred to the Community of Practice in Project Management.

12.0 Conclusion

Virtual Project Management utilizes Virtual Teams to implement the projects. These virtual teams communicate through Project Portals with Internet Technologies. The project teams also participates in Community of Practice in Project Management by utilizing the best practices and prior experience as well as providing value lesson learned for future project implementation.

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About the author

Kenneth Fung, B.Sc., CMA, CCP, MBA, ISP, PMP, CSQE, is currently working as a Program Director at the Faculty of Continuing Education in University of Calgary. He has 10 years of Information Technology experience as systems analyst; project manager and QA team leader and 10+ business experience in accounting and finance. He has worked, implemented systems and led cross functional teams in oil and gas, medical claim processing, banking, high-tech, Information Technology, manufacturing and distribution industries in Calgary, Winnipeg, Vancouver, Portland, Chicago, Atlanta, Austin, San Francisco, Hong Kong and Beijing. He has developed and taught project management courses at Mount Royal College, Motorola and Cisco as well as conducted Business Process Reengineering workshops, accounting and management courses. He is working towards a Ph.D. in Information Systems. His research interests include collaborative technologies and virtual teams.

Book Review: Continued from page 12

that can be augmented to the existing hardware supports to enable VMs perform concurrent garbage collection. The proposed architecture helps the GC system to have a short pause time and a low average run-time overhead. This chapter also presents tabulated results of simulated times for various phases of GC for various available benchmarks.

It has been noted that the Java language provides unique opportunities to exploit parallelism by permitting architectures to execute single threaded applications as multi-threaded applications. The ninth chapter presents a technique called Space-Time Dimensional Computing (STC) for the execution of speculative threads extracted at the method and loop level from non-threaded Java programs. This chapter also provides hardware support to efficiently implement STC without introducing delays in critical paths for obtaining high frequency designs. Furthermore, this chapter describes an architecture named MAJC, which has been designed to support the STC technique.

Java provides unique opportunities to exploit parallelism by permitting architectures to execute single-threaded applications as multi-threaded applications.

In order to produce a single-chip multiprocessor and to provide support for high performance Java based systems of the future, the Java Machine and Integrated Circuit Architecture (JAMAICA) was designed. Chapter 10 discusses the design of Instruction Set Architecture (ISA) of JAMAICA that has on-chip multiprocessor structure targeted for multithreaded Java implementations. A selection of programs from the SPEC JVM98 benchmarks has been used to analyze the various ways in which bytecode can be executed and the resulting overheads that occur. This chapter also presents some optimization techniques to decrease the method call overheads and compares the effects of proposed optimizations on static instruction count for selected SPEC JVM98 kernels.

The JAMAICA system is a combination of a multithreaded single-chip multiprocessor and a dynamic thread distribution mechanism to provide hardware support for fine-grained Java threads. The last chapter provides an overview of the threading mechanism and investigates the granularity of parallelism that can be exploited in this way. This chapter also confirms through experiments with two real Java applications that the technique could be used in place of more traditional load balancing methods. The JAMAICA system considered in this chapter is a Container Managed Persistence (CMP) processor where each processor core is multithreaded keeping the processors always occupied.

In summary, this book provides a detailed analysis of hardware support for Java. In particular, it introduces the state-of-the-art in the area of design and development of Java micro-architectures. The book presents extensive simulation results covering different proposed architectures that could benefit practicing engineers and academic researchers alike in the design, implementation and evaluation of newer architectures. As Java-based technology is evolving, this book could be a valuable tool in understanding the impact of Java's features on micro-architectural resources.

Self-Erecting Inverted Pendulum: Swing Up and Stabilization

by *S. McGilvray,*
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Abstract

Inverted pendulum control is a well-known and challenging problem, which is generally associated to attitude control of a rocket during take off. When upright the pendulum is at an unstable equilibrium point and constant attitude adjustments are required to maintain proper orientation. This problem is like trying to balance a broomstick at the tip of one finger. This nonlinear one-input, two-output system consists of a slender pendulum rod attached passively to a cart on a rack and pinion system driven by an electric motor on a horizontal axis. The objective is to swing the pendulum upright and maintain this angular position while satisfying a specified linear cart position by adjusting the terminal voltage to the motor. This objective is achieved by real-time control implemented with a Visual Basic computer program.

Sommaire

Le contrôle du pendule inversé est un problème très connu et stimulant, qui est d'habitude associé au contrôle d'attitude d'une fusée pendant le lancement. Quand le pendule est dans une position verticale, il est considéré dans une position d'équilibre instable et des ajustements constants de l'attitude sont nécessaires pour maintenir une propre orientation. Ce problème est similaire à celui de faire tenir en équilibre un manche à balai sur la pointe d'un doigt. Ce system non linéaire à entrées et deux sorties est constitué d'un pendule mince, attaché passivement à un chariot sur une crémaillère qui fonctionne par moteur électrique sur un axe horizontal. L'objectif est de balancer le pendule jusqu'à ce qu'il soit en position verticale et de le maintenir dans cette position tout en spécifiant la position linéaire désirée du chariot. Cet objectif est réalisé par un contrôle en temps réel implémenté via Visual Basic.

1.0 Introduction

The self-erecting inverted pendulum system can be used as an educational tool for control engineering students. The physical system is simple allowing an easy link to be made between the mathematical model and the real world. However, this system can also pose a challenging nonlinear control problem for students at the graduate level.

A simple yet functional graphical user interface (GUI) gives users the ability to explore differences created by changing settings such as sampling frequency and filter cutoff frequencies in real-time by the click of a button. This allows the user to transform mathematical theories into something tangible, ultimately leading to a better understanding of the interactions between theory and the physical world. The state feedback gains and the integral gain may be changed on the main form by simply typing in the desired numerical values. If changes are made while the system is running in real-time, the effects on the system performance are seen immediately.

Since the controller design is based on a linearized model, program modifications must be made to test nonlinear controller designs. However, with some programming skills and reference to a Visual Basic book [1], the documented and organized code may be altered to accommodate these changes.

The self-erecting inverted pendulum can be manufactured for a small cost making this an ideal laboratory experiment for undergraduate students studying physics, system modeling or control engineering.

2.0 Problem Formulation

The control objectives for the self-erecting inverted pendulum include swinging the pendulum rod into the upright position and then maintaining the rod in this position while holding a specified cart position.

The control design for the swing up of the rod will be separate from the control design for the stabilization of the cart and pendulum. The only objective for the open loop swing up controller will be to upright the pendulum. Once the angular position of the rod reaches a specified capture range the closed loop stabilization controller will take over. However, challenges lie in swinging up the rod. If the rod reaches the upright position with a high angular velocity, the controller designed for stabilization will not be able to compensate.

3.0 Control Scheme

Swinging the pendulum rod upright using minimal energy is achieved when the oscillating control input frequency is the natural frequency w_n of the rod. The natural frequency of the rod is obtained through calculation and measurement. The open loop control function is given by

$$V = A \sin(w_n t) \qquad (1)$$

This function has two software adjustable values, the natural frequency w_n and the gain A, which allows different rod lengths to be tested with the system.

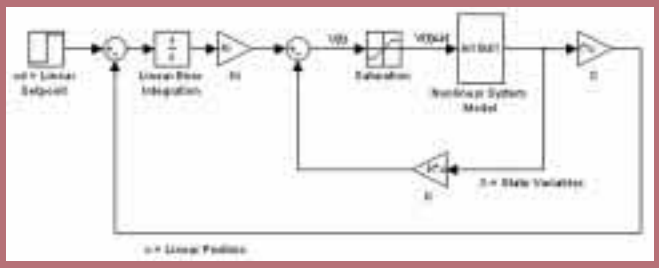

Figure 1: Closed Loop System

The stabilization control design is based on linear quadratic regulator (LQR) design with a tracking controller [2]. The LQR design will return the state feedback gains needed to ensure stability of the system. However, to bring the steady state error of the linear position to zero, a tracking controller is added by integrating the error of the cart position. The gain adjustment of the integration allows performance changes to be made. The control law implemented is given as follows

$$V(t) = -KX(t) + Ki\int_0^t (x_p - x)dt \qquad (2)$$

The closed loop system is shown in Figure 1. From this block diagram it can be seen that the control design uses state feedback. The gain values for the state variables are denoted by K, a 1x4 vector, and are the desired values to achieve stabilization and good performance. The gain block for the integration of the linear position error is denoted by Ki and is also the desired value to achieve near zero steady state linear position error and good performance. The saturation block is necessary to represent the experimental system as accurately as possible. Since $V(t)$, the calculated motor voltage, may reach higher than acceptable values for the motor, a saturation function is embedded in the software clipping the control effort, or motor voltage signal.

4.0 Experimental Setup: Physical System

The mechanical components, all made from lightweight aluminum, consist of a cart and gearing system, pendulum rod and track. The cart guide-rail and rotating pendulum rod shaft are made from stainless steel, ensuring strength and integrity. The position sensing electronics include a 10-turn potentiometer for measurement of the linear cart position and 2-channel optical encoder for measurement of the pendulum rod angle. The motor used is a high-speed DC permanent magnet mini motor. Combined with a large drive shaft gear the speed is significantly reduced while increasing the torque.

Acquisition of the sensor signals requires only one analog input for the cart position potentiometer and an up/down counter for the pendulum rod optical encoder. The control signal from the computer requires only one analog output fed through a buffer for current amplification to the motor.

The system has been designed so multiple pendulum rods of different lengths are easily interchanged. The difference in rod length and weight requires new gains to be calculated for the controller giving insight into system limitations and optimal performance.

Figure 2: GUI Main Form

5.0 Experimental Setup: Software Interface

The program created to control the self-erecting inverted pendulum was designed using Visual Basic for the GUI and rapid modification and design capabilities. The user can swing the pendulum upright with a command click or manually bring the pendulum upright by hand. When the pendulum rod is within a user specified inner capture range the closed loop controller will maintain stability of the pendulum rod.

Safety limits have been implemented that zero the control signal to the motor for four unique conditions. These conditions are as follows

1. The 'stop' command button is clicked.
2. The program is exited.
3. The pendulum rod violates the maximum angular position greater than the user specified outer capture range.
4. The cart reaches a plus or minus linear position greater than the user specified cart shutdown limit.

Figure 2 shows the GUI main form. This design allows for input of control parameters and displays measured and calculated feedback information to the user. The 'Active X' universal circular gauge and inverted pendulum model created for a simple inverted pendulum have been modified for this interface. The original 'Active X' controls are described in [3].

The user may also alter the system settings including base addressing, sampling time and inner and outer capture range for the pendulum angle. Other settings include safeties such as a motor shut down upon a critical linear position. This can potentially avoid damage to the linear position sensor and the mechanical system itself. Other adjustable settings include the swing up frequency and gain.

Digital filter settings allow the user to control the cutoff frequency of the linear position, angular position and the motor output. Each filter uses a first order discrete equation programmed into the software. The filtering of the input measurements from the linear position sensor and the angular position sensor are imperative for accurate readings. Due to the nature of the controller, any measured noise can affect the stability of the pendulum rod, and the position of the cart.

6.0 Simulation Results

The Matlab simulation will only test the pendulum when in the upright position. However, it will consider initial angular and linear positions as well as disturbances, and allow linear set point changes. When simulating the controller performance it is important to represent the system with the nonlinear equations. This is necessary to obtain results as close as possible to the real system. The block diagram of the nonlinear system representation, shown in Figure 3, was designed using Simulink because of the rapid model-based design capabilities and quick modifications for simulations [4].

The simulation is performed using calculated values for *K* and *Ki*. The simulation parameters are given below:

- Initial Angular Position: 0.398 radians
- Linear Set Point (initially 0m): 0.2m at time 7.5s
- Disturbance Introduction: 0.2 radians at time 5s
- Disturbance Cancellation: -0.2 radians at time 5.2s
- Simulation Time: 20s

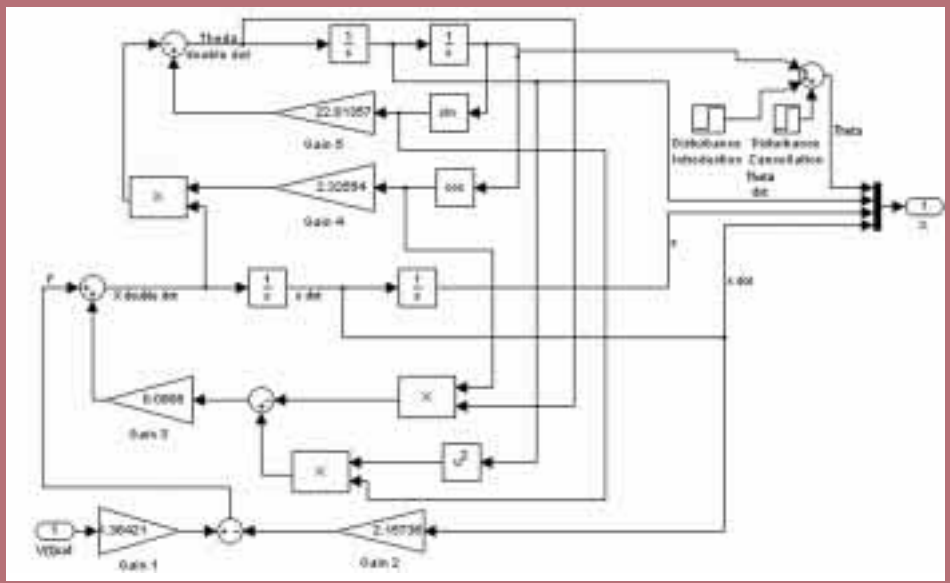

Figure 3: Nonlinear System Representation

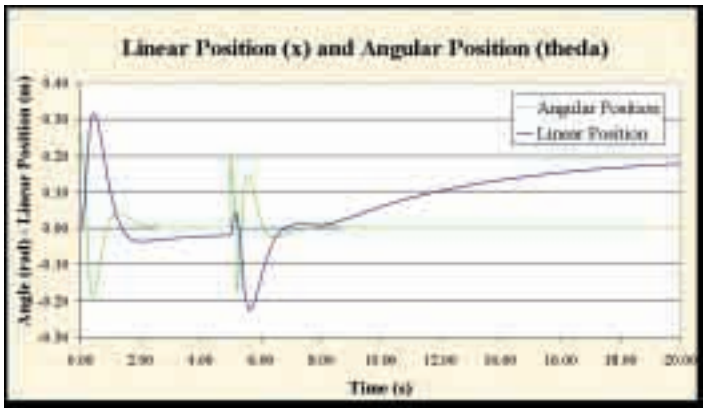

Figure 4: Simulated Response

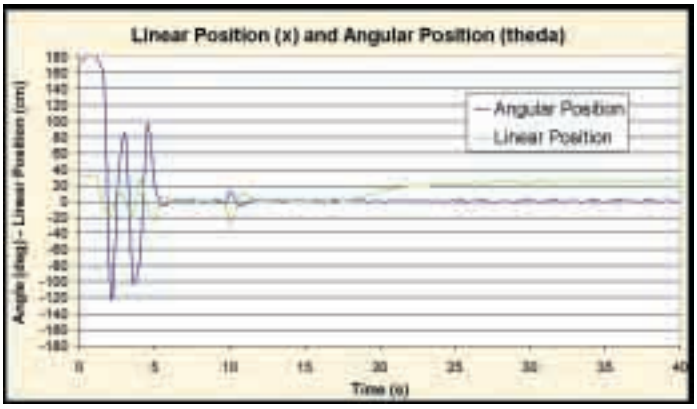

Figure 6: Experimental Response

The results obtained from the simulation are seen in Figure 4 and Figure 5. It is apparent that the calculated motor voltage has been limited to a ±5 Volt limit to more accurately represent the physical system. For the physical system the voltage saturation is necessary to avoid drawing too much current during swing up, eliminate possibilities of exceeding maximum terminal voltage and to achieve a better response from the motor.

From the results of the simulation it can be seen that at time 5 seconds, a disturbance to the angular position was introduced and cancelled 0.2 seconds later. To compensate the controller responded accordingly, changing the linear position and subsequently the angular position and maintained stability.

It can also be seen that at time 7.5 seconds, the desired linear position set point changed from 0m to 0.2m and the corresponding linear position gradually began to converge to the set point. However, even after a simulation time of 20 seconds the linear position did not quite meet the desired set point. This implies that a larger integral gain *Ki* is required to reduce this convergence time.

7.0 Experimental Results

To ensure an accurate comparison between the simulated results and the experimental results, the same state feedback gain *K* and integral gain *Ki* were used for experimental testing. The results can be seen in Figure 6 and Figure 7.

The system parameters are slightly different from the simulation in that the initial angular position is the stable equilibrium point at 180°. Additionally, the swing up control is used to erect the pendulum in the upright position.

The system gain *A* is shown to be greater than the ±5 Volt saturation cutoff limit of the simulation. The software has been programmed with two terminal voltage saturation points. The first is set to ±7.5 V during swing up, and the second is set to ±5 V once the stabilization controller initiates. This is necessary to achieve a cart driving force great enough to erect the pendulum rod. At the ±5 V limit, the motor is not able to produce enough energy to swing the rod upright. However, using the ±7.5 V limit during stabilization can cause the system to destabilize.

Once the swing up controller erected the pendulum, the stabilization controller initiated at roughly 5.5 seconds. After stabilization was achieved a disturbance was introduced to the pendulum rod at about 10 seconds. This disturbance was introduced by 'tapping' the pendulum rod in one direction with a force from the hand. Also at roughly 17 seconds the linear set point was changed from 0 cm to 25 cm.

When viewing the experimental results, there are a number of observations to be made. It is important to note the angular position response of the physical system during swing up. It appears that the angle is crossing the 0° threshold on each pass of the cart. This would imply a full revolution of the pendulum rod. However, this is not the case. When viewing the GUI main form, one can see the angular position measurement has been set up with 0° at the top, and 180° and -180° both meeting at the bottom of the circle. Due to this configuration, as the pendulum swings through the bottom of the measurement circle the system interprets this as a full revolution due to the digital filter on the angular position.

The calculated motor voltage seen in Figure 7 shows a noisy response. Even with the digital filter added to the output of this calculation, there is a substantial amount of calculation noise present. However, it is important to note the peak values at different times during this test. When a disturbance was introduced at 10 seconds, the motor voltage spiked up to roughly 5 V. The other various spikes in the response of

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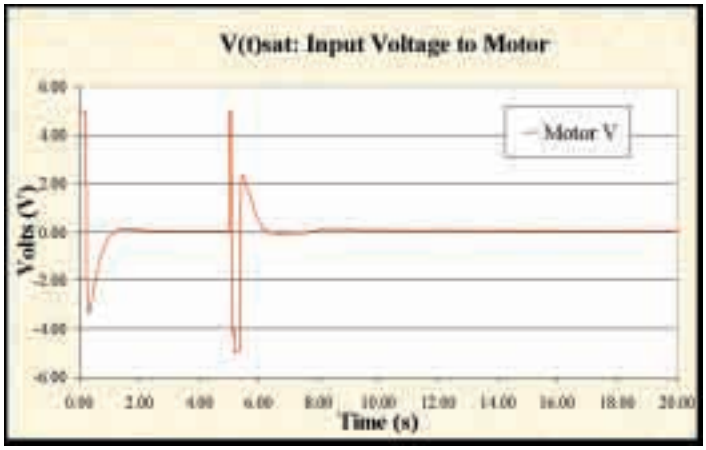

Figure 5: Simulated Control Effort

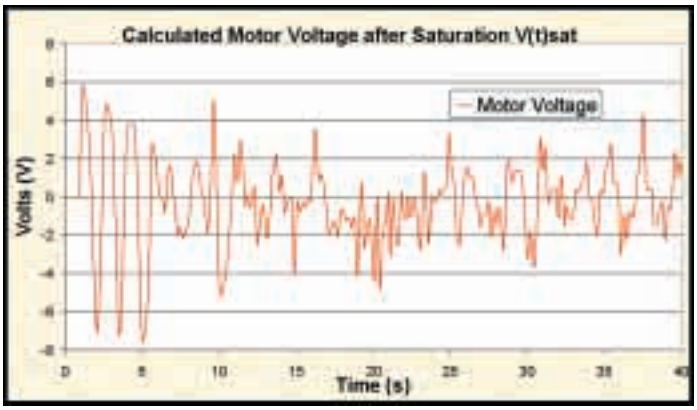

Figure 7: Experimental Control Effort

Communications Research Centre Canada
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Centre de recherches sur les communications Canada
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Making networks more secure

New communications technologies continue to bring us more bandwidth, improved links and a host of new wireless, mobile communications capabilities. However, as our communications networks evolve, they need to be kept secure, which is where Communications Research Centre Canada (CRC) is making a contribution.

CRC is the Government of Canada's leading laboratory for research and development (R&D) in advanced communications. Positioned between the research done by industry and academia, CRC is the Government of Canada's primary centre of expertise and long-term vision for emerging communications technologies and issues. Its R&D serves as a roadmap for policy and industrial development.

As a communications technology leader, CRC has identified network security and reliability as one of its main strategic focuses for the next three to five years. CRC is well connected to partners with complementary expertise, which provides CRC with a broad view of the issues. CRC's research in network security is designed to support the Department of National Defence's need for secure communications, as well as the needs of CRC's parent department, Industry Canada.

One of CRC's research objectives is to investigate the management and security required for the safe and reliable exchange of information across networks. A longer-term goal is to investigate future networks based on leading-edge technologies, such as intelligent agents and active networks.

Projects will range from basic research, to the development of technologies and subsystems, to field trials and the demonstration of system concepts. The areas that will be covered include wireless security; virtual private networks; IP security; detecting and responding to network intrusion; network management and security; signal processing to counter radio jamming; and communications systems for emergency/disaster response, such as software defined radio.

For more information and to find out about opportunities for collaboration, please visit **www.crc.ca**.

Accroître la sécurité des réseaux

Les nouvelles technologies de communication offrent une bande passante élargie, des liens améliorés et une gamme de nouvelles possibilités de communications mobiles et sans fil. Toutefois, à mesure que les réseaux de communication évoluent, il faut garantir leur sécurité, ce à quoi le Centre de recherches sur les communications Canada (CRC) s'emploie.

Le CRC est le plus important laboratoire de recherche-développement (R-D) du gouvernement du Canada dans le domaine des communications de pointe. Organisme situé entre les centres de recherches universitaires et industriels, le CRC constitue le centre d'expertise principal du gouvernement canadien et sa vision à long terme des nouveaux enjeux et des nouvelles technologies de communication. La R-D qui s'y fait sert à l'élaboration de politiques et à la croissance industrielle.

À titre de chef de file des technologies de communication, le CRC a décidé d'intégrer la sécurité et la fiabilité des réseaux dans ses principaux objectifs stratégiques des trois à cinq prochaines années. Le CRC entretient des relations privilégiées avec des partenaires aux spécialités complémentaires, ce qui lui donne une vue d'ensemble des enjeux. Les recherches du CRC sur la sécurité des réseaux aident le ministère de la Défense nationale à établir des communications sécurisées et répondent aux besoins du ministère d'attache du CRC, Industrie Canada.

L'un des objectifs du CRC en matière de recherche est d'étudier la gestion et la sécurité essentielles à un échange sûr et fiable de renseignements au moyen des réseaux. À long terme, le CRC cherche à examiner les réseaux de l'avenir fondés sur des technologies de pointe, comme les agents intelligents et les réseaux actifs.

Ses projets comprennent la recherche fondamentale, le développement de technologies et de sous-systèmes, les essais pratiques et la démonstration de concepts de système. Les domaines visés incluent la sécurité sans fil, les réseaux privés virtuels, la sécurité IP, la détection des intrusions dans les réseaux et les méthodes d'intervention, la gestion et la sécurité des réseaux, le traitement des signaux pour déjouer le brouillage des ondes ainsi que les systèmes de communication en cas d'urgence ou de catastrophe, comme la radio réalisée par logiciel.

Pour de plus amples renseignements et pour découvrir des possibilités de collaboration, veuillez consulter le site Web suivant : **www.crc.ca**.

Canada

Alberta's Competitive Electricity Marketplace Moves Forward

by Submitted on behalf of Bill Kennedy, AESO, Calgary, AB

Abstract

This article presents a look at Canada's first, and to date only jurisdiction to embrace electricity competition. Alberta's wholesale market was opened to competition on January 1, 1996. The past 7 years have seen further restructuring to establish a competitive marketplace. A new independent system operator began to take form as the AESO - the Alberta Electric System Operator in June 2003. The AESO is Canada's first competitive, customer-focused exchange for electricity.

Sommaire

Cet article dresse le portrait de la première, et à ce jour la seule, juridiction canadienne ayant permis la compétition dans le domaine de l'électricité. Le marché de gros de l'Alberta s'est ouvert à la compétition le 1er janvier 1996. Les 7 dernières années ont vu une restructuration qui a permis d'établir un marché compétitif. Un nouvel exploitant de réseau a pris forme en juin 2003, l'AESO qui est la première bourse de l'électricité au Canada orientée vers le consommateur.

1.0 Introduction

As Canada's first, and to date only jurisdiction to embrace electricity competition, Alberta is forging a path of great interest. All eyes are on Alberta, including current and potential generators, investors, electricity wholesalers, retailers, and, of course, consumers. The guiding force for government policy in Alberta's electricity marketplace is the long-term interest of all market participants and consumers. From the outset, the government sought to shape a level playing field with open and fair competition, transparent regulation and accountable oversight by the appropriate regulator.

To kick-start the process, Alberta's wholesale market was opened to competition on January 1, 1996, the former Power Pool of Alberta operated an independent, fair, open and efficient market for the exchange of electricity and an independent system coordination centre to operate the electric system in a safe and reliable manner.

By 1998, major industry components included the Power Pool Council, Market Surveillance Administrator, Balancing Pool, and the Transmission Administrator.

Competition took hold in the electricity generation segment of the industry through an auction in the summer of 2000. The auction of power purchase arrangements (PPAs) introduced competition to more than 6,400 megawatts of power capacity built under regulation. By offering the rights to the power capacity from these plants to the open marketplace, competition was furthered without the forced divestiture of privately held assets.

The PPAs and auction were designed to reflect the objectives related to restructuring: establish a competitive marketplace and ensure that Albertans continue to benefit from generating units built under regulation. The PPAs took effect on January 2001, at the same time as retail service competition was launched for all consumers.

While electricity customers could chose a new provider, they could also decide to remain on a regulated rate option which was designed to ease the transition for consumers.

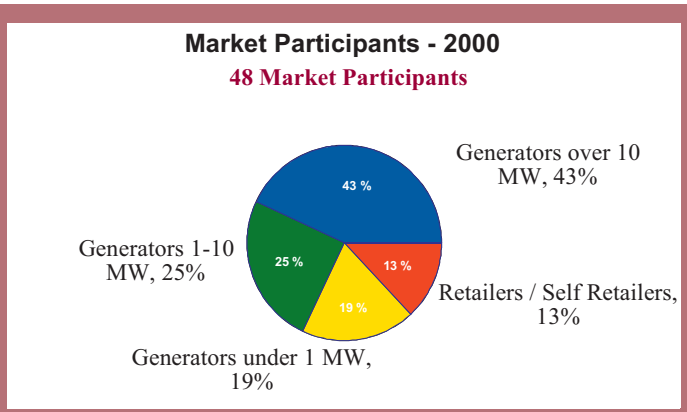
Competition in the wholesale market was making great strides. The market was responding to market signals such as supply and demand, and the market itself was exhibiting healthy signs including new and diverse generators, from natural gas combined cycle and cogeneration facilities to wind and biomass energy to large coal-fired generation. Market participation was increasing too, in both volume and diversity (Figure 1).

Evan Bahry, Executive Director of the Industrial Power Producers Society of Alberta (IPPSA), remarks, "IPPSA supported deregulation from the outset. We believed that competition would be good for the market, that we would see an increase in the number of retailers and a wider choice of electricity products. That has certainly happened - today's wholesale electricity market in Alberta is very robust."

At the five-year mark, Alberta had seen about 2,800 megawatts of new generation added to the market, and the number of participants grew from about 50 to more than 200. Some things were working well, but was there room for improvement? That's the question Alberta Energy (the provincial department responsible for electricity) posed with its industry structure review.

In 2001, the department commissioned an independent consulting firm to prepare a report on the state of the industry, and to make recommendations for improvement. The review included comprehensive stakeholder input, through written submissions and interviews. The consultant also looked for best practices in other jurisdictions throughout the world. Other jurisdictions evaluated for their experiences and best practices included Ontario, the UK, New Zealand, Pennsylvania, Ohio, Texas, and the state of Victoria, Australia.

In March 2002 the consultant's report identified several factors affecting the performance of the wholesale market, including regulatory



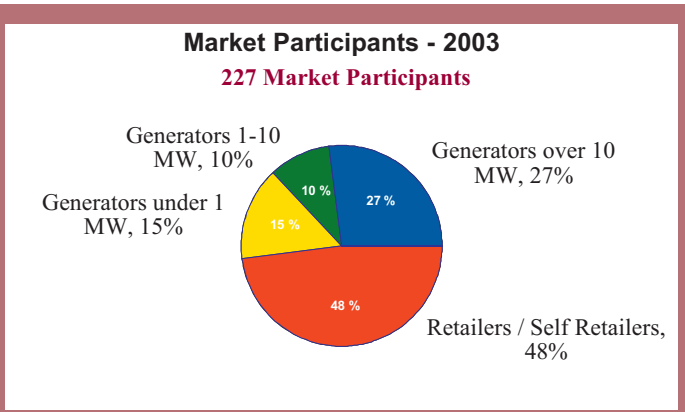


Figure 1: Customer segmentation

uncertainty, pool price determination and price uncertainty, unsold PPAs and market liquidity. Chief among these was regulatory uncertainty, which tended to keep new participants from entering the market, both in generation and transmission. The report noted that a successful, competitive wholesale market in Alberta would be contingent upon the availability of transmission capacity.

In addition, the review noted that significant synergies could be realized from combining the Power Pool with the Transmission Administrator into a single entity. The report found that division of functions between the former Power Pool and Transmission Administrator created operational concerns, such as differing objective-setting mechanisms (for-profit versus not-for-profit). In addition, stakeholder concerns included the need for continuous improvement in market design, system access, capital planning, and related matters. (As mentioned above, these concerns were expressed during the industry review; merging the functions was among the review's recommendations.)

These and other review findings all pointed to the need for an overhaul of the Electric Utilities Act (EUA) and an adjustment of the industry.

Amendments to the EUA were enacted on June 1, 2003. Highlights of the revised Act include:

- Further leveling the playing field in the electricity marketplace by moving the approval of tariffs for municipally owned utilities that offer competitive contracts to the Alberta Energy and Utilities Board (EUB).
- Expanding the responsibility of the Market Surveillance Administrator, which oversees market competition, ensuring Albertans benefit from competitiveness in the wholesale and retail markets.
- Introducing a more cost-efficient industry structure including a non-profit independent system operator to operate a competitive power pool, take responsibility for system control, and plan the transmission system.

That new independent system operator began to take form as the AESO - the Alberta Electric System Operator. John Tapics was appointed President and Chief Executive Officer in October 2002, and the executive team was announced in January 2003. The company completed a reorganization in February 2003, and the AESO was officially proclaimed by the new Act in June 2003 (Figure 2).

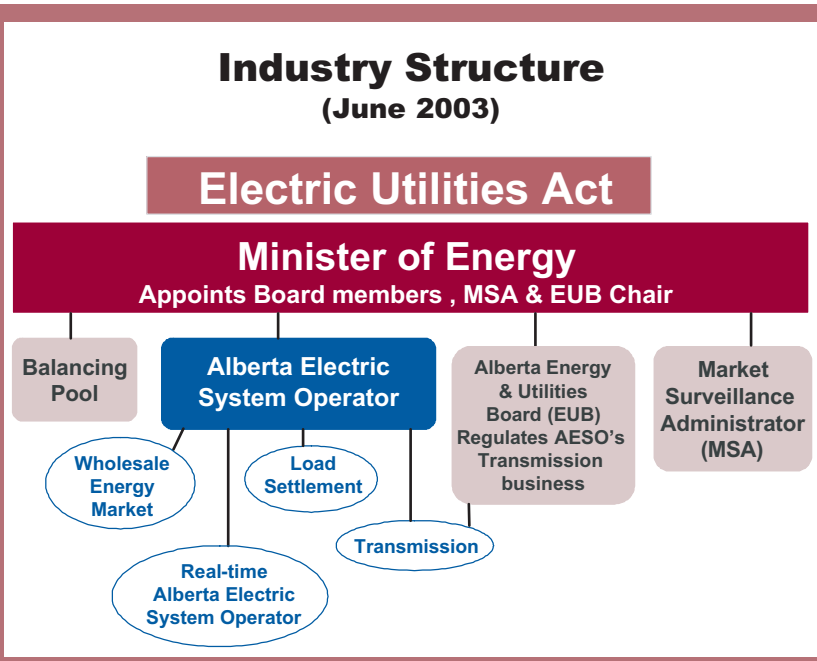


Figure 2: Revised industry structure - June 2003

2.0 Introducing the AESO

"Our new company, the AESO, brings together two former corporations, the Power Pool Council and the Transmission Administrator of Alberta," says President and CEO John Tapics.

The AESO is Canada's first competitive, customer-focused exchange for electricity. As an independent system operator, the AESO leads the safe, reliable and economic operation and planning of Alberta's interconnected power system and facilitates Alberta's hourly wholesale market, which (as of June 2003) has more than 200 participants and from about $3 to $5 billion in annual energy transactions. The company has an independent Board who provide governance and direction, with a strategy founded on balancing the diverse interests of stakeholders, while providing benefit for the overall industry stakeholder needs. The Alberta Energy and Utilities Board (EUB) provides regulatory oversight of the AESO's transmission planning responsibilities, and approves the AESO's transmission tariff.

The AESO's accountabilities include:

- Directing the operation of the provincial electric grid and coordinating the flow of electricity inside Alberta and on the interconnections with neighboring jurisdictions;
- Planning the transmission system and identifying the need for upgrades and additions to the transmission infrastructure; and
- Carrying out load settlement, the financial accounting to allocate the hourly electricity commodity costs to retailers.

"The AESO is building on what the industry has learned since 1996, we are not re-inventing the wheel. For that reason, we think the AESO can offer streamlining and efficiency to the Alberta electricity marketplace in addition to optimizing years of expertise on both the market and transmission sides of the business."

3.0 A Closer Look: Transmission

In Alberta, transmission facilities are built, owned and maintained by investor-owned companies, and regulated by the Alberta Energy and Utilities Board (EUB). The AESO's costs of transmission planning, development and operations are recovered through a province-wide transmission tariff. Although the province's generation market has increased by about 25 per cent between the end of 1998 and 2002, the transmission infrastructure has seen no new significant expansions in more than 15 years - a situation not unlike other electricity markets throughout North America.

"Strategic transmission planning, to ensure adequate transmission capability, is among our top priorities," comments Tapics. To that end, the AESO recently received approval from the EUB for the need for a new transmission line to increase transfer capacity out of the Fort McMurray region in northeastern Alberta. When completed, this line will increase the area's transfer capability to about 610 MW from the current 370 MW. The project will also contribute to another AESO objective: reducing transmission line losses. "We estimate this new line will reduce losses by about 65,000 megawatt hours annually, which at a $60 per megawatt hour AESO pool price translates into annual savings of about $4 million," Tapics says, adding that the AESO is investigating other major transmission projects that will reduce congestion and losses.

Areas of focus are the Edmonton-Calgary corridor, the northwest section of the province, and the southwest region where about 500 MW of wind projects are keen to connect to the system. "We expect to have needs applications for both the Edmonton-Calgary corridor project and the southwest region filed with the EUB by the end of this year," Tapics adds. Estimated in-service dates would be range from 2006 to 2010 for the Edmonton-Calgary project and spring of 2005 for the transmission expansion in the southwest region of the province.

"We have also launched a study to develop a long-term transmission plan for Alberta as part of our business focus," Tapics says. A major conundrum facing electricity markets across North America is the long lead time required to site and construct transmission lines versus the shorter lead time required for some new generation, especially gas-fired generation.

"Our planning is aligned with the government of Alberta's proposed transmission development policy which requires transmission planning to be proactive and ahead of load growth and generation development."

At time of printing, the government had circulated its transmission development policy for industry comment and a regulation was expected to be finalized by year end.

"Generally we are supportive of the government's new proposed transmission development policy, it addresses several concerns we raised early this year with respect to the difference in lead time between generation and transmission projects and the potential to be proactive and at the same time prudent about transmission development. Our job is to implement the policy and we look forward to working with customers and stakeholders on plans for implementation."

4.0 A Closer Look: System Control

Coordinating and directing the operation of Alberta's electricity market and integrated electric grid is one of the AESO's main objectives, but nothing could be accomplished without another of the AESO's key functions: system control.

The System Coordination Centre is the heart of Alberta's Interconnected Electric System. The SCC, which opened in early 1999, operates independently of market participants. The Centre features advanced technology, customized to meet the requirements of Alberta's competitive electricity market. It's staffed 24 hours a day 365 days a year by a team of 13 system controllers, whose combined expertise represents the best senior operators in the business.

System Controllers (e.g. Lane Belsher in the image on the left) are responsible for the real-time operation of the Alberta Interconnected Electric System. They dispatch all electric power generation in Alberta through the SCC, schedule energy flow on the transmission interconnections with neighboring control areas and monitor and direct the operation of Alberta's electricity network to ensure safe, reliable and economic operations.

The System Coordination Centre relies on two essential information technology systems to provide the infrastructure for these operations: the Energy Management System and the Energy Trading System.

The Energy Management System (EMS) provides the centralized operations of the Alberta Interconnected Electric System; it's the 'engine' of the System Coordination Centre. On a 24-hour operation, it enables system controllers to perform real-time activities such as dispatching electricity to meet demand, and monitoring the status of the provincial electric system. It interfaces with other control centres and power plants across the province. Every few seconds, the system scans 150 points: generator outputs, interconnections flows and system frequency. About every 10 seconds, the system checks another 6,000 points, including voltages, line flows and switch points.

The Energy Trading System (ETS) receives energy supply offers and demand bids from market participants, receives metering data, provides market information to the AESO's Web site and performs settlement and billing. The ETS was one of North America's first secure Web-based energy trading systems. The company developed and introduced the ETS during a 12-month period to meet a target in-service date of August 2000.

5.0 Challenges

The 2002 industry review found that load settlement was a significant barrier that required resolution in order for competitive markets to continue to develop in the province.

Load settlement adds up the energy each meter uses for all 1.3 million customer sites in Alberta and allocates the appropriate hourly price. Energy is priced on an hourly basis and most meters in the province can't measure energy consumption on an hourly basis. Even if all customer sites had interval meters, which measure energy consumed for each hour, load settlement would still be needed for the AESO to calculate bills for retailers. The load settlement process ensures the aggregate power consumed by each retailer's customers is allocated to that retailer, and the total allocated to all retailers in each service area matches the energy flowing in.

Efficiency and streamlining are the AESO's goals for load settlement. Tapics says the AESO is considering the feasibility of a single, province-wide, centralized site registry that would offer consistent data standards, information exchange and compliance monitoring. The AESO is also assessing the cost-benefit of a centralized meter data repository.

Consumer education is another challenge facing the new company. "Consumer markets are responding to market forces as they should, but consumers are still uncertain," comments Tapics. "Electricity is a commodity now and the price will naturally fluctuate, the same way all commodities do. At the AESO we want to contribute to raising awareness about the market to help inform consumers so they are able to make well-informed choices."

6.0 Moving Forward

In Alberta, the journey to a competitive wholesale electricity market is unfolding positively. Indicators of success include the number and diversity of players, both in generation and as market participants. As of June 2003 there were approximately 240 participants, including small and independent power producers, retailers, self-retailers, marketers and consumers in fields as diverse as forestry, education, manufacturing and health care.

"The AESO's role has been clarified by the new Act, and their new mandate definitely offers opportunities for efficiency and improvement," says Evan Bahry. "Still, there are lots of issues on the AESO's plate, in particular a dynamic debate about transmission expansion. It's going to be something of a baptism by fire, but they have good people in place, and a strong Board."

Creating a competitive market is a complex and unpredictable process, but the mid-course review that created the AESO holds tremendous potential. "Alberta is in the global forefront," says Tapics, "and I think we are one of the leaders in terms of facilitating innovative solutions, both on the technical and market sides of the business."

"As Canada's first competitive, customer-focused exchange for electricity, we take a leadership role in planning and operating Alberta's electricity system safely, reliably, and at a reasonable cost," Tapics concludes. "Our aim is to strike a balance between the diverse interests of customers, stakeholders and market participants. We are not going to build transmission lines, or implement market enhancements, before we have listened and discussed our plans with customers, stakeholders, and the public (see sidebars on next page)."

About the author

Bill Kennedy graduated in Electrical Engineering from the University of New Brunswick, Fredericton, in 1969. His education has been supplemented by graduate courses in power system engineering and management.

In 1970, he joined the Shawinigan Engineering Company, Montreal Quebec where his early experience consisted of work on the Nelson River HVDC transmission system in Manitoba. This was followed by experience on 400/500 kV transmission systems in Iran and Pakistan. During this time, he gained industrial experience in pulp and paper mills in Ontario, Newfoundland and the former Yugoslavia. His utility background consisted of employment with SaskPower in increasingly responsible positions from 1979 to 1995. From 1995 to 1998, he was self-employed as a consulting engineer. He is Principal Engineer with the Alberta Electric System Operator (AESO). He has been associated with the deregulated electric industry in Alberta since 1997.

Bill is a registered professional engineer in the provinces of Alberta, Saskatchewan andManitoba. In 1998, he was elected a Fellow of the Engineering Institute of Canada. He is a Senior Member of the IEEE and the IEEE Region 7 Director-Elect for 2002 - 2003. He is a member of the Power Engineering and Industrial Application Societies and is active on the Power System Relaying Committee. He has published a dozen papers on protection related issues.

Countdown To AESO

1996

- New legislation - Electric Utilities Act (EUA)
- Wholesale market opens
- Independent System Controller/Power Pool Adminstrator appointed
- Affiliated Transmission Administrator (GridCo)

1997

- Independent Transmission Administrator appointed

1998

- EUA amended
- Wholesale Market Power/Power Purchase Arrangements/Balancing Pool
- Limited retail competition
- Market surveillance
- Transmission planning guidelines

2000

- Auction of Power Purchase Arrangements (PPAs)

2001

- Retail competition
- Market Achievement Plan auction of unsold PPAs
- Industry review of market structure

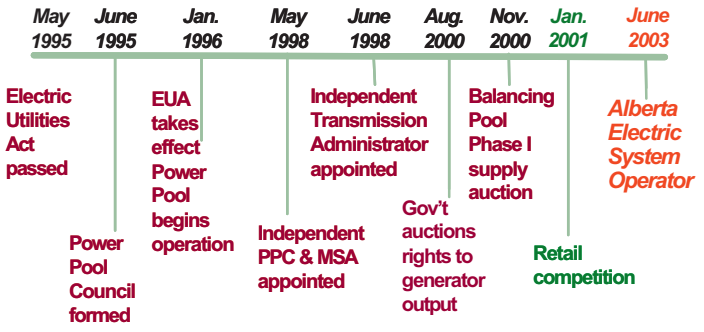
2002

- Second auction of unsold PPAs
- Review of industry structures completed
- Former Transmission Administrator merged with Power Pool
- Design of new independent system operator initiated

2003

- EUA amendment proclaimed
- AESO launched June 1

Market Evolution Timeline



Alberta Electricity Industry at a Glance

- More than 20,000 km transmission
- More than 550 substations
- Annual load factor 80 per cent
- Industrial load about 56 per cent of system load
- Transmission voltage levels of: 500 kV, 240kV, 138/144kV, 69/72kV
- More than 130 generating units
- 8,570 MW system peak
- 10,515 MW Alberta supply
- Approximately 240 participants
- Single control area of 660,000 km^2
- The total demand for electricity in Alberta in 2002 was 54,328 gigawatt hours (including exports) down slightly from 54,674 in 2001.

IEEE Canada Awards

IEEE Canadian Foundation Scholarship Certificate Presentation held on October 9th, 2003, at the "IEEE Southern Alberta Section (SAS)/University of Calgary Student Branch" Mixer.

As shown in this photo:

IEEE Canada President Elect, Mr. Bill Kennedy (left) presented the ICF Scholarship Certificate to Ms. Christine Cook (right) from the University of Calgary.

The IEEE Canada Student Activities Committee is very pleased to announce the recipients of two prestigious awards granted by the IEEE for extraordinary Student Branch activities within the IEEE Region 7 (IEEE Canada).

George Armitage Outstanding Student Branch Award.

This award, supported by IEEE Canada, is given to recognize extraordinary Student Branch achievements by Student members engaged in activities conforming to IEEE objectives and purposes. For 2003, this award is granted to the **Carleton University IEEE Student Branch** for exceptional achievements in organizing professional and technical events that resulted in a significant increase in student membership. This award consists of a plaque and a cash prize of two hundred dollars ($200).

IEEE Region 7 RAB Larry K. Wilson Regional Student Activities Award.

This award is to recognize annually the student most responsible for an extraordinary accomplishment associated with IEEE Student Activities in each Region. For 2003, this award is granted to **Kevin Yang Ma** of the **University of Waterloo** for an exceptional achievement by initiating, organizing and coordinating the Blackberry Programming Contest involving the IEEE Student Branches of the Kitchener-Waterloo Section, in partnership with Research in Motion Ltd. This award consists of a plaque and three years of free membership in the IEEE.

Dominic Rivard, Eng.

Region 7 (IEEE Canada) Regional Student Activities Coordinator

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Making Usability a Respectable Quality Attribute in the Engineering Lifecycle

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Concordia University, Montreal, QC

Abstract

In this paper, we introduce usability as a quality attribute of a software system, and describe the disastrous results of ignoring it. We will explain why usability has been neglected in current software system development approaches. In particular, we discuss the fundamental, fallacious belief that the user interface and the software system are independent concepts. Finally, we will reflect on methods for completely incorporating user-centered design into the system engineering lifecycle.

Sommaire

Dans cet article, nous introduisons l'utilisabilité comme un des critères importants de qualité d'un logiciel. Nous donnons aussi un apercu sur les conséquences néfastes de sa non prise en compte dans le cycle de developpement logiciel. Nous expliquerons pourquoi, actuellement, l'utilisabilité est négligée pendant le développement des logiciels. En particulier, contrairement à l'opinion répandue, nous démontrerons que l'interface utilisateur et le système logiciel sous-jacent sont des composants indissociables. En conclusion, nous exposerons les méthodes pour intégrer la conception centrée-utilisateur et l'utilisabilité dans le cycle de vie du logiciel.

1.0 Introduction

As a software system user/consumer, you may have experienced something like this: With the hope of becoming more productive, you buy and install a sophisticated piece of software on your desktop computer, PDA or mobile phone. Instead, you end up using only about 20% of its features, either because you are not aware of all the things it can do, or because you don't have time to learn them. This scenario illustrates some of the damage of unusable software.

A lack of usability can increase the time and cost of learning as well as technical support. It can decrease productivity and sales while increasing the cost of maintenance. A strong commitment to usability offers enormous benefits. Among the measurable benefits of usable systems, one can mention decreases in terms of costs and learning time, easier transition to new versions of a system, human performance, productivity enhancements, better quality of work, and fewer user errors in data entry [3].

Furthermore, several studies have shown that 80% of total maintenance costs are related to problems users have with what the system does and not with technical bugs [1]. Of the problems, 64% are with usability [3]. In a recent survey of 8 000 projects, the Standish Group found that lack of user involvement and incomplete user requirements represent the major reasons for project success or failure [6]. One of this situation's causes is that software engineering methodologies, when used for developing highly interactive software with a significant user interface, have a major limitation. Most of them do not propose any mechanisms for:

- Explicitly and empirically identifying and specifying user needs and usability requirements,
- Testing and validating requirements and user interface prototypes with end-users before and during development.

These are among the reasons why usability is becoming an increasingly critical software development issue. Usability assurance and user acceptance are about to become the ultimate measure for the quality of today's e-commerce web sites, mobile services and tomorrow's proactive assistance applications.

2.0 Usability: The Well-known Yet Oft-neglected Quality Factor

For an interactive software product, usability refers to its ease of use, and its ease of learning. Many definitions of usability exist, which sometimes makes usability a confusing concept. ISO alone proposes two different definitions for usability:

- ISO/DIS 9241-11 advocates that usability is a high-level quality objective, and that it is defined as: "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use".
- In ISO 9126 usability is seen as one relatively independent contribution to software quality. Usability is defined as: "A set of attributes of an interactive system that bear on the effort needed for use and on the individual assessment of such use by a stated or implied set of users".

Besides the conflicting definitions of usability within the software engineering and human computer interaction (HCI) communities, there are few integrated software quality models for objectively specifying and measuring our current meaning of usability. One of the ISO standards' weaknesses are that they are not well integrated into our day-to-day software quality assurance procedures and practices.

For example, some software managers will likely feel that their project can't afford so much time spent on usability requirements and user interface design. They will worry that the iterations of prototypes will never end, with "those HCI people" trying to make everything perfect. There are two solutions to this.

First, setting down measurable usability objectives, as part of the project plan, will decrease the project workload, not increase it. It is much easier to build close to the mark right from the beginning (thanks to effective user feedback throughout the process) and then tweak the project until it's correct, than it is to miss the mark by a mile and then try to push the project back on track at the end of the development cycle. If this seems obvious, ask yourself why so many developers wait until their project is nearly complete before they seek user feedback for the first time.

Secondly, overloaded managers should consider the long-term effect of quality work on the self-esteem (and hence productivity) of their developers. DeMarco and Lister [2] have a hypothetical manager saying, "Some of my folks would tinker forever with a task, all in the name of 'Quality'. But the market doesn't give a damn about that much quality - it's screaming for the product to be delivered yesterday..." DeMarco and Lister agree: "People may talk in glowing terms about quality or complain bitterly about its absence, but when it comes time to pay the price for quality, their true values become apparent." And continue on to say that "the client's perceived needs for quality in the product are often not as great as those of the builder," but that letting the builders of a product (the software developers) apply their own judgment as to when the software is ready for release will result in higher productivity in the long run.

3.0 The Fallacy Of A Cartesian Separation Between The User Interface And The System's Functionality

There is a common (false) conception that a software system's functionality exists independently of the user interface - in fact, there is no need for functionality except for what is needed by the user. If the user inter-

face doesn't provide access to a certain piece of internal functionality, that functionality is dead code that might as well not exist. The link exists along the reverse direction as well: a system with poor functionality will have a poor user interface.

The term user interface is perhaps one of the underlying obstacles in our quest for usable programs since it gives the impression of a thin layer sitting on top of the other software that is the "real" system. This dichotomy between the perceived situation and the real situation is explained by the peanut butter theory of usability. This is the specimen of software in which usability is seen as a spread that can be smeared over any software model, however dreadful, with good results if the spread is thick enough. If the underlying functionality is confusing then spread a graphical user interface on it… If the user interface still has some problems, smear some manuals over it. If the manuals are still deficient, smear on some training which you force users to take.

This fallacy dichotomy does not take into account the intimate relationship that exists between internal attributes and external factors that affect the usability of a system. As an example, the user and developer are both interested in the software's performance, but the user could see this attribute as response time to the event entered by him, while the developer thinks of it as data structure depth or path length. Furthermore, a requirement for quality in use may be that the system will increase the user's performance by 20% when doing routine tasks. If a search engine function is to give a fast response time, the information may need to be indexed in a certain way to support fast retrieval. Only by ensuring that goals at the internal functionality level mirror goals at the user level can this 20% performance increase be achieved.

4.0 Involving The User In The Software Development Lifecycle Is A Beginning

Most usability professionals agree on the basic approach to user-centered design. Key steps include requirements gathered through observation and interview, creating a conceptual design, iterative development, testing and refinement. While specific situations may call for different techniques and different levels of formality, the basic structure is generally similar. This commonality is the basis for the emerging ISO Standard 13407: Human-Centered Design Process for Interactive Systems. However, although some software engineering standards claim to have similar goals to those promoted in ISO standard 13407, in practice they often seem very different. This is because they are formulated using different terminology, notations and languages. An example of this would be the IEEE standards on software quality and the ISO collection on quality in use (see the IEEE-1061 Standard on Software Quality Metric Methodology and the ISO-9126 Standard on Quality Characteristics and Guidelines for their Use).

Too often, user-centered design remains the province of visionaries and a few enlightened software practitioners and organizations such as IBM, Microsoft and SUN, rather than the everyday practice of programmers and analysts. One barrier to the wider practice of user-centered design is that its structure and techniques are still relatively unknown, underused, difficult to master, and essentially inaccessible to small and medium-sized software development teams and common developers. While software developers may have high-level familiarity with such basic concepts as requirements analysis and usability testing, few understand the complete process at a level that allows them to incorporate it into the larger software development lifecycle.

5.0 Moving From Technology-driven To Human-centered Engineering Practices

User-centered design is a philosophy opposed to the system-driven development philosophy that is the traditional way of seeing and doing things in software development. This philosophy consists of involving the software's end-users in all of its development stages [5]. User-centered, or human-centered, design is the direction in which we want software development to evolve, but it has yet to become established practice. Hopefully, it will become the recognized, accepted way of doing things. However, dislodging the system-oriented approach will take an enormous amount of effort or a miracle. This miracle may be on its way thanks to new technologies and decentralized software development.

It is important to use the term user-centered design unequivocally. It is a bit unfortunate that for the software engineering community, usability engineering has become the way of thinking about user-centered design. Usability engineering focuses on requirements and evaluations, thus preserving a technical, engineering-oriented attitude to software development. User-centered design, on the other hand, addresses designing with the users. Figure 1 clarifies the differences between human-centered and technology-driven development. It also illustrates some avenues for bridging the gap between software engineering and UCD practices.

6.0 Establishing Usability In The Software System Engineering Lifecycle

Engineering a product for usability requires attention to the user interface but also to all the other elements that might affect usability including: user manuals, training materials, help system, technical support as well as installation and configuration procedures. It takes a shift from the waterfall development model to an interactive process that comprises the following milestones:

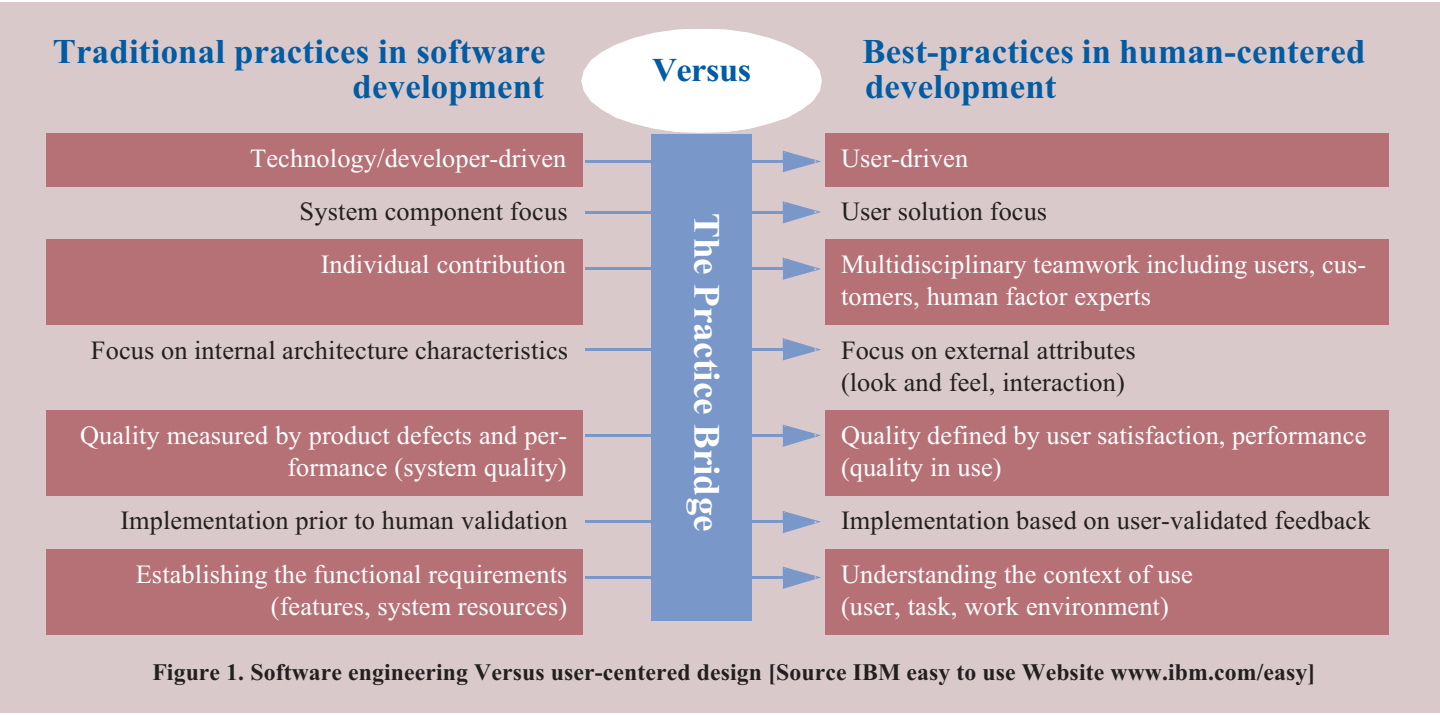

Figure 1. Software engineering Versus user-centered design [Source IBM easy to use Website www.ibm.com/easy]

- Analyzing and specifying user needs and requirements. Besides giving details on the functional requirements, these also consist of collecting information about user personas and their tasks, as well as the technical and organizational environment in which the system will be used.
- Using digital images, sound, video and animations to develop proofs of concept, design solutions and prototypes. Prototypes may range from simple paper mock-ups of screen layouts to prototypes with greater fidelity, which run on computers.
- Planning and conducting usability evaluation and user-oriented tests for collecting user feedback and understanding user behaviors. Here we can use an audio and video monitoring system for conducting ethnographic interviews and online customer satisfaction surveys. We can also conduct performance measurements, where the users attempt to accomplish "real world" tasks, using a prototype or the final system. The quantitative feedback from these empirical studies are then transformed into insights and patterns that can be used to develop the improve the original design.

Figure 2 describes the main activities suggested by the ISO 13407 standard on human-centered processes for interactive systems. Constantine (1999) and Mayhew [4] both proposed a detailed development lifecycle including these activities.

The only presently feasible approach to successful design is an empirical one, requiring observation and measurement of user behavior, careful evaluation of feedback, insightful solutions of existing problems, and strong motivation to make design changes. User-derived feedback about ease of use and ease of learning is collected directly and/or indirectly from users, and then transformed into design recommendations, decisions, principles, guidelines, design patterns and look and feel guidelines that can be used as proven design solutions to common user problems, or as best design practices.

7.0 Usability Versus The Other Quality Attributes And Safety In Particular

As we have already mentioned, usability is intimately coupled with other software quality attributes, including safety and security. The Therac-25 device is a perfect historical example of this intimate relationship.

This appliance was a cancer irradiation device whose faulty operation led to a number of deaths. Eleven Therac-25s were installed in the US and Canada. Six accidents involving massive overdoses to patients occurred between 1985 and 1987. It may seem intuitive that a device that is easy to use and learn is safer than one that isn't, but this is not always the case. One of the safety features in the original Therac-25 design was that all the settings for the device had to be entered through a terminal, as well as on a control panel. Users as well as developers saw this as redundant, and the original design was changed before release so that the settings could be entered on the terminal alone. Using the new user-friendly GUI, once the settings were accepted by hitting the return key, the user was asked to confirm that the settings were correct - by hitting the return key again. This extra step was considered a replacement for the control panel, and in the opinion of the developers it would increase the system's ease of use while reducing its complexity.

Unfortunately, users started pressing the return key twice in succession, as a reflex. With repetition, the action became like double-clicking a mouse and the machine's settings were never really reviewed. Because of a fault in the Therac-25's software, some data entries weren't properly recorded. The fault was a race condition created because proper resource locking of the data wasn't exercised. Since the crosscheck in the user interface had been removed, the fault was never detected in time to save lives. Here was an example of a software system where the design was altered to favor usability, but the safety of the device was fatally compromised.

The story of the Therac-25 holds many powerful lessons, including:

- Designing the correct user interface for a system is, contrary to popular opinion, very difficult. It requires research, user validation and the careful balancing of many trade-offs. The Therac-25's human-computer interface required more thorough thought than it received.
- The inseparability of the system and the user interface. A hastily improved user interface could not cover up fatal flaws inside the software system.
- Better usability did not automatically equate to better safety. In fact, in this case ease-of-use and safety were trade-offs of each other. Better user validation would have revealed the error in allowing return key double-clicks.
- Usability is one quality factor among many. In this case, safety was of critical importance, and more essential than ease-of-use.

The most important lesson we can pull from the tragedy of the Therac-25 is this: the deaths due to the irradiation appliance could have been prevented (in spite of the internal system flaws) had there been a greater emphasis on user validation and feedback. Had the potential users (doctors and nurses) been consulted throughout the development process, the system engineers would surely have had an easier time concluding that either (1) The system was better off retaining the control panel in favor of safety, or (2) A confirmation mechanism other than a second return key press was required in order to ensure that the data entries were reviewed. However, because user validation and feedback was left to the end of the process, these important conclusions were never reached.

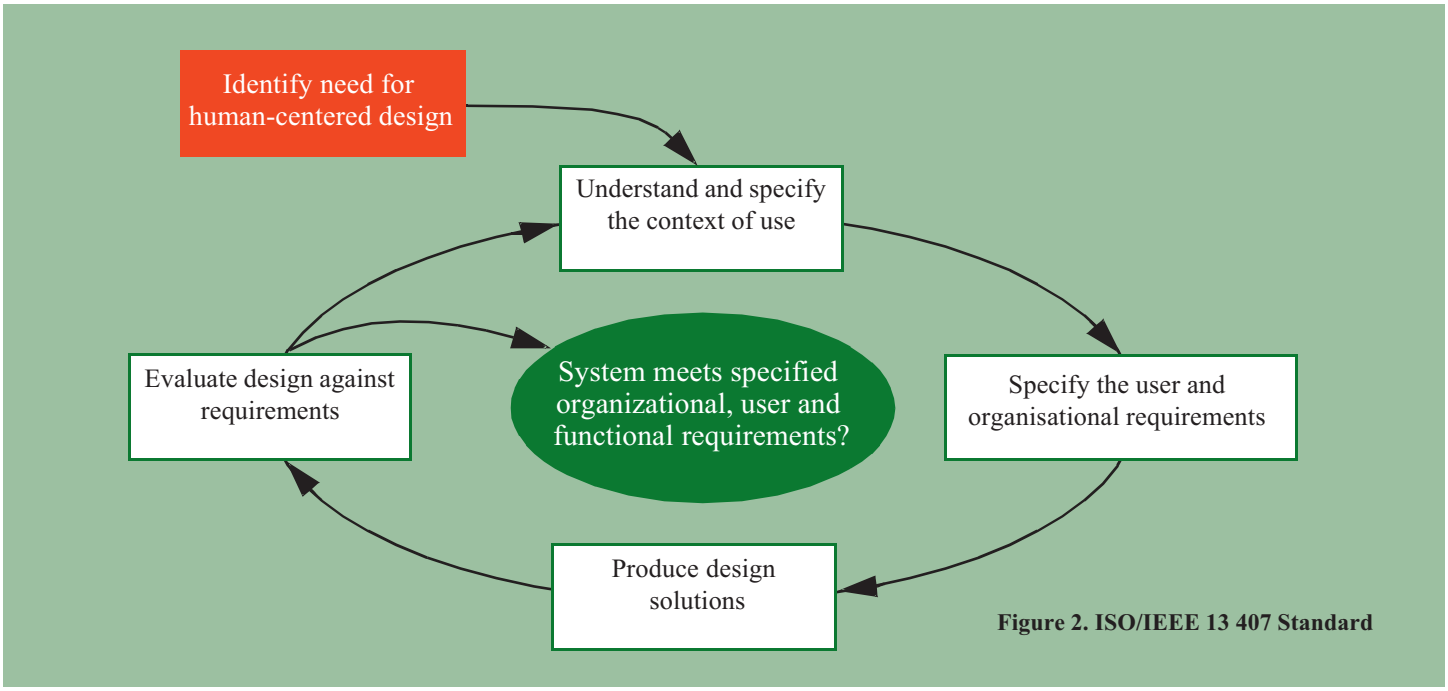

Figure 2. ISO/IEEE 13 407 Standard

Usability..., *continued from previous page*

8.0 Concluding Remarks

A successful usability development approach can entail setting up environments and methods to monitor users doing things to better understand how to help them work well; it can include developing methods to normalize user input without bias; and perhaps most importantly, it can facilitate the creation of interfaces that make good use of the gathered information. In any case, it is also pertinent that users be involved in every step to ensure that it's their input that is being reflected, and not the opinions of those applying the usability engineering.

It is now acknowledged that software engineering as an engineering discipline involves the development of software through accepted practices to facilitate economic success. It is important that it be recognized early on that usability engineering is a key component to meeting the above description. Hopefully, much emphasis will be placed on this aspect of software engineering in the near future, and more importantly, corresponding pressure will be applied to create the appropriate courses at the graduate and undergraduate levels in order to supply the market with appropriately equipped software engineers.

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Self-Erecting Inverted Pendulum, *continued from page 19*

the motor voltage after this disturbance do not peak much over 4 V at times. The response of the motor is the important factor for this plot seen. The motor does not begin to generate much driving force until it nears the ±4 V range.

8.0 Conclusion

Image of the pendulum

The self-erecting inverted pendulum has been manufactured for a small cost and experiments have shown promising results. This system can be used as an educational tool for helping understand model dynamics and controller response.

Suggested improvements for this system would include a motor with an improved response. This would increase the robustness of the system and enhance disturbance recovery and swing up.

After many experimental tests the repeatability of the swing up controller is less than ideal. Since this controller is open loop, any disturbances such as slight bends in the electrical harness attached to the cart create friction causing the system to respond differently each time. Improvements could be implemented by designing a closed loop controller for the swing up.

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