

Emerging Disciplines of Engineering



Peter M. DeVita,
P.Eng., M.A.Sc., M.B.A.,
MCIPS, MADR, F.E.C.

E-mail:

peterdev@rogers.com

Emerging Disciplines of Engineering-topics

1. Meaning
2. Unique challenge for profession
3. First response to these issues – Software Engineering
4. Licensing mandate implications
5. Short history of new disciplines
6. Recent PEO work
7. What have we missed?
8. Specialization concept – closely linked idea
9. Where do we go from here?

1. Meaning of Emerging Disciplines

- ▶ Emerging Disciplines

Represent new areas of practice that have grown sufficiently in their bodies of knowledge and areas of practice to warrant unique programs of study and actions by PEO to establish effective Licensure.

2. Emerging Disciplines of Engineering - a Unique Challenge

- A. Rates of Growth
- B. Only profession where new technology results in new areas of practice;

Technological Innovation and the Main Waves of Innovation - Engineering driven

1. **Industrial Revolution** - from 1780s -1840s - *fuelled by steam power*
2. **Railway Age** - from 1840s -1890s
3. **Electrical and Automotive Age** - from 1890s -1950s - *was driven by electric power and the car.*
4. **Information Age** – 1960's to present
5. **Bio-Chemistry age** ??? – Genome (1990's) and on

Technological Growth

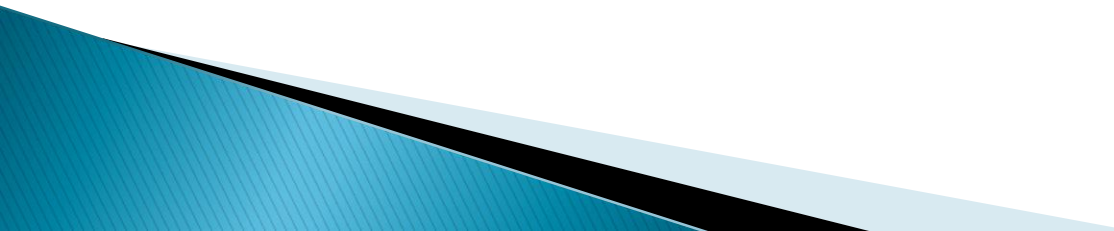
- Ancient denial

- ▶ "Inventions have long since reached their limit, and I see no hope for future development."
- ▶ Sextus Julius Frontinus, military Engineer, Governor of Britannia, 73-77 AD

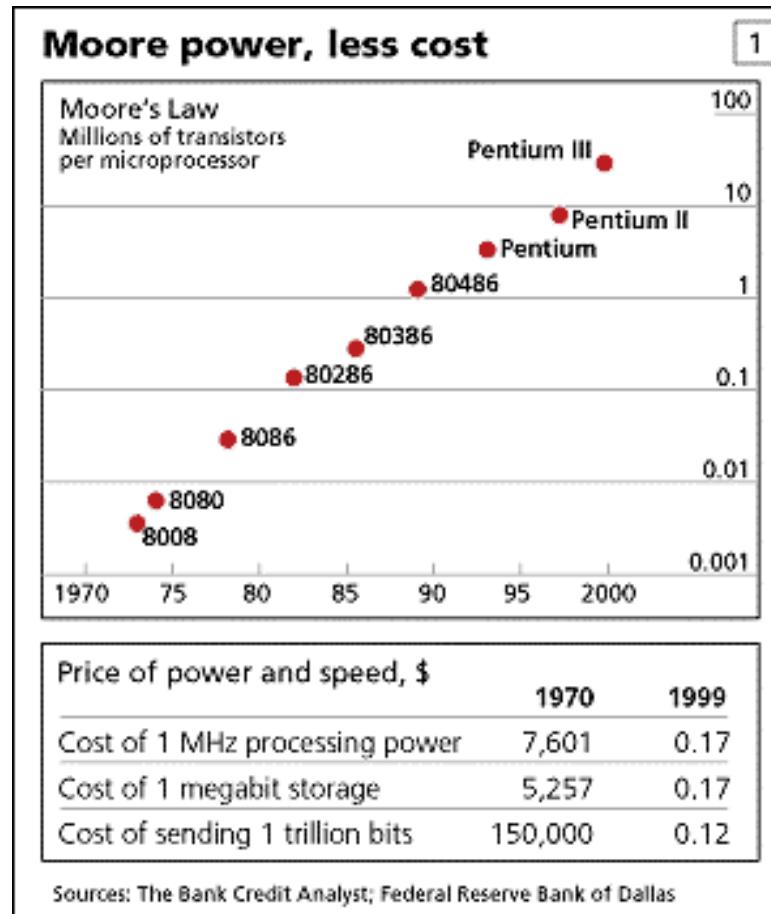
Technological Growth - more recent denial

- ▶ "Everything that can be invented has been invented."
- Charles H. Duell, Director of US Patent Office, 1899.

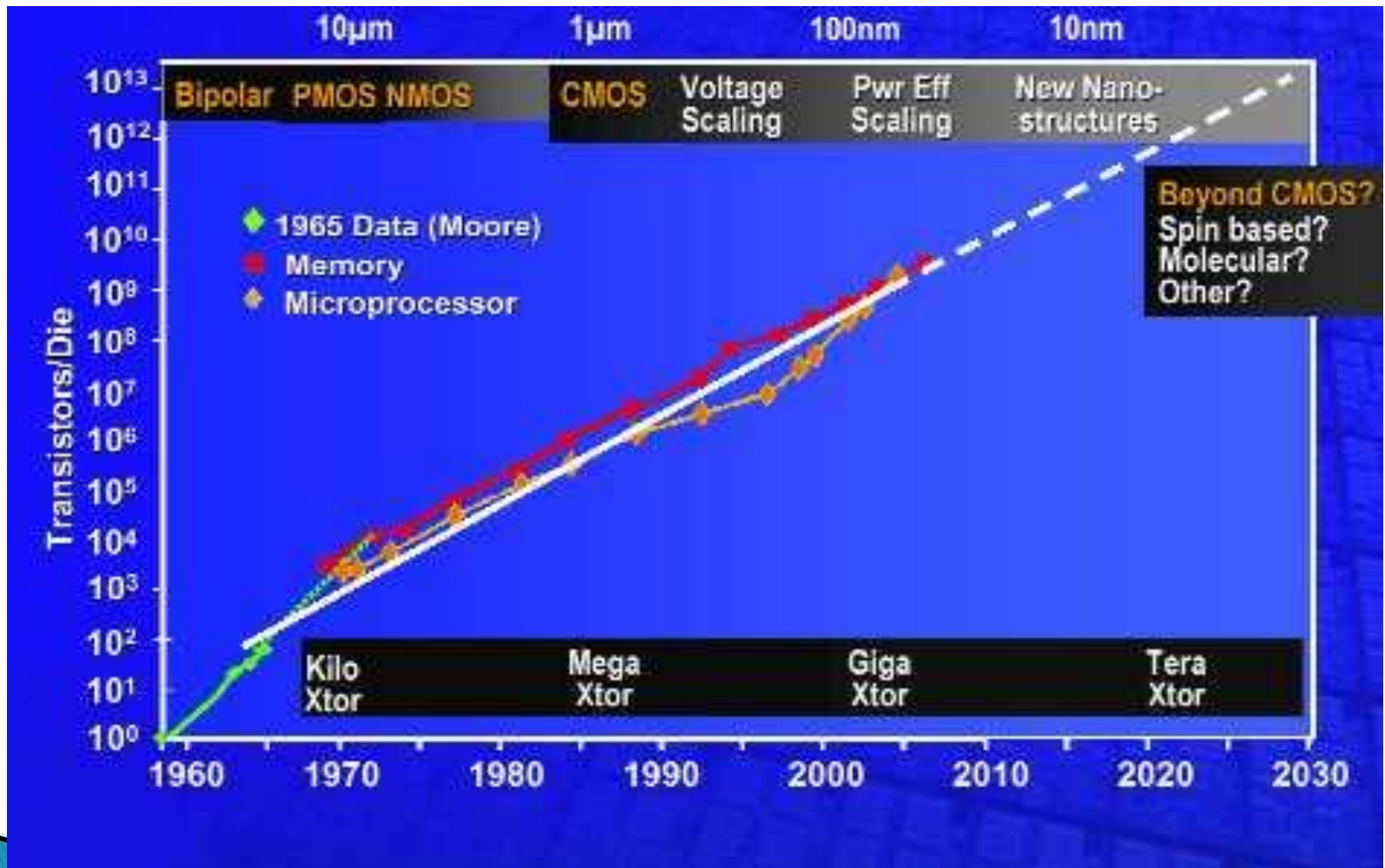
Technological Growth - last century majors

- ▶ 1902 Einstein's - Relativity
 - ▶ 1910- Bohr, Planck & others
- Quantum Physics pre WW1
 - ▶ 1952 - Bell Labs - the transistor
 - ▶ 1974 - Intel - the 8080 microprocessor
 - ▶ 1990's - the Genome
 - ▶ etc.....
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Accelerating Pace of Change



Projection of Moore's Law



Accelerating Pace of Change

Another growth rate statistic:

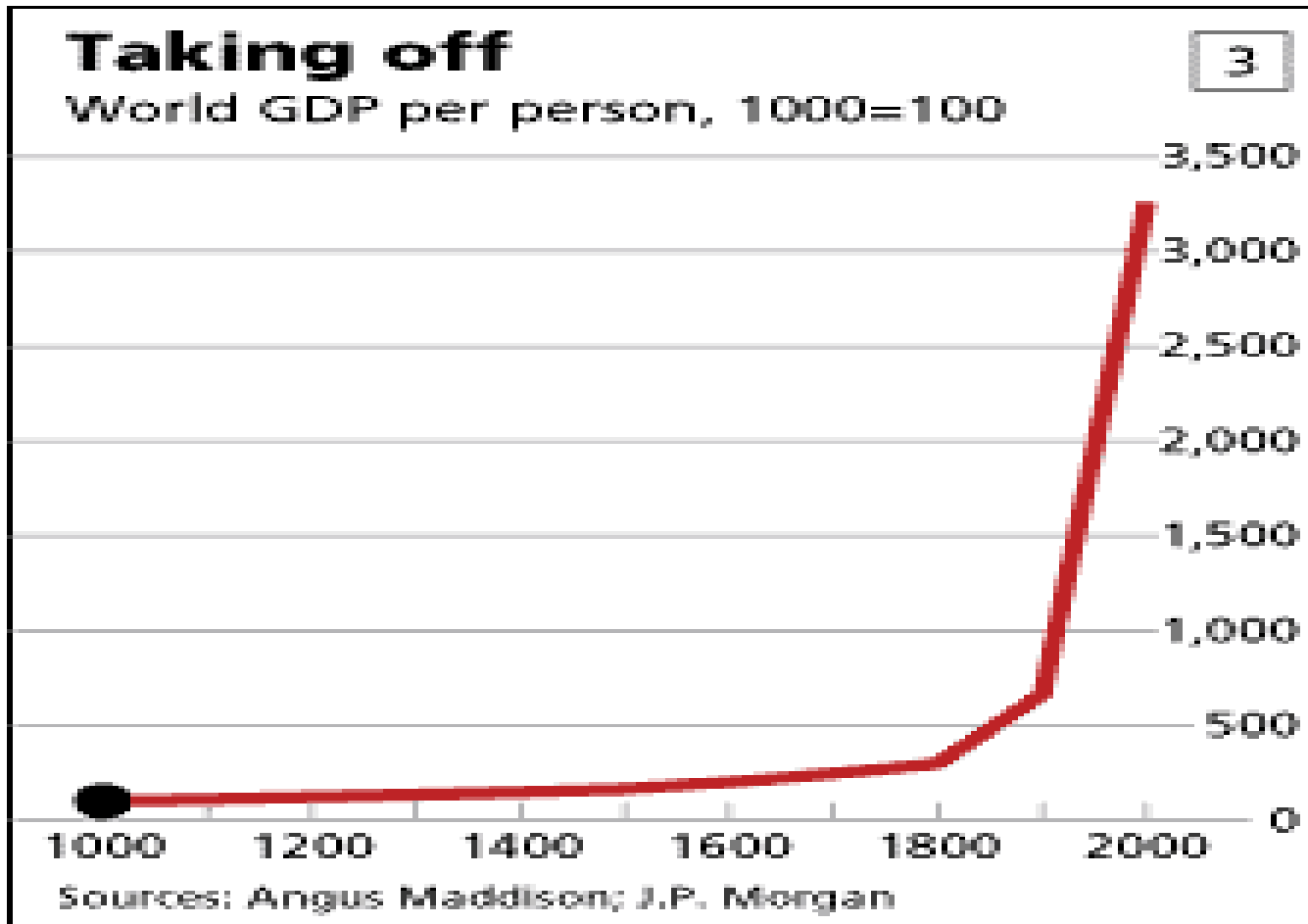
- 90% of all scientists that have ever lived are alive TODAY.

Accelerating Pace of Change

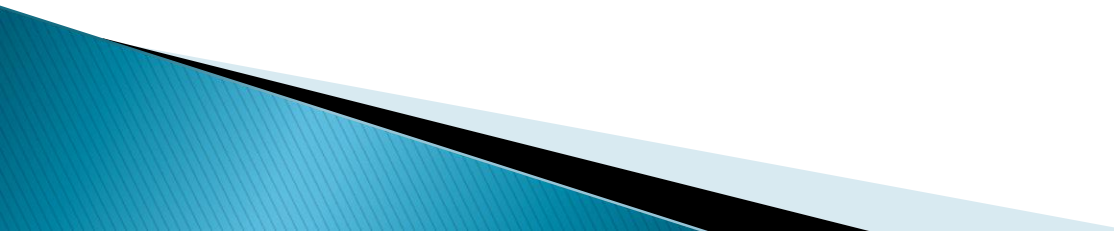
Technology Diffusion Rates

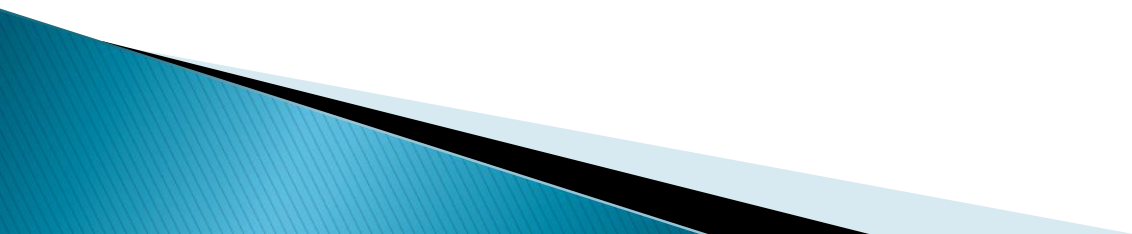
- 1900: 46 years for 25% population to adopt electricity
- 1990: 7 years for 25% population to adopt the Internet

Accelerating Pace of Change



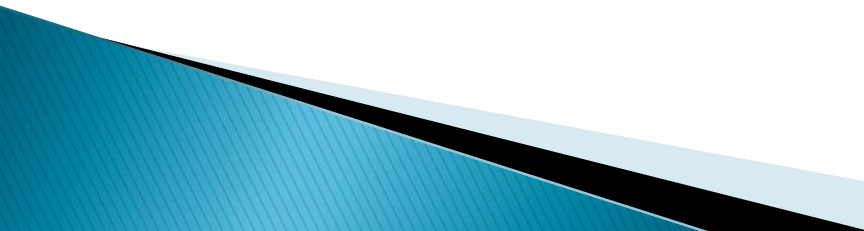
Technological Growth - Challenge to Engineers

- ▶ Technology growth DRIVES new Disciplines
 - ▶ Licensing a new Discipline is equivalent to setting up a new profession
 - ▶ In the past, we have under-estimated the significant challenges created by Emerging Disciplines to the Engineering Profession
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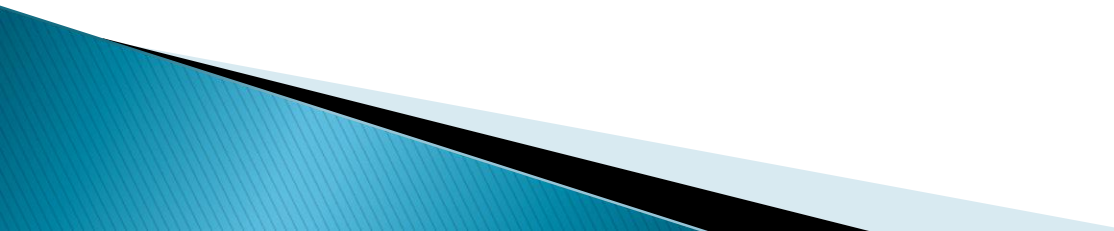


3. First response to these issues

Software Engineering

- ▶ 1990's growing awareness of new areas of practice and mis-uses of the use of the word 'engineering'
 - ▶ Software impacting all disciplines of engineering
 - ▶ Has been taught in Engineering schools since the 1960's
 - ▶ Growing recognition of severe public risks in some areas of practice
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Software Engineering

- ▶ An Emerging Discipline – **wide** recognition in Engineering Profession by ~1993
 - ▶ 1st steps to ‘protect’ this practice concentrated on the Engineering title with Official Marks owned by CCPE
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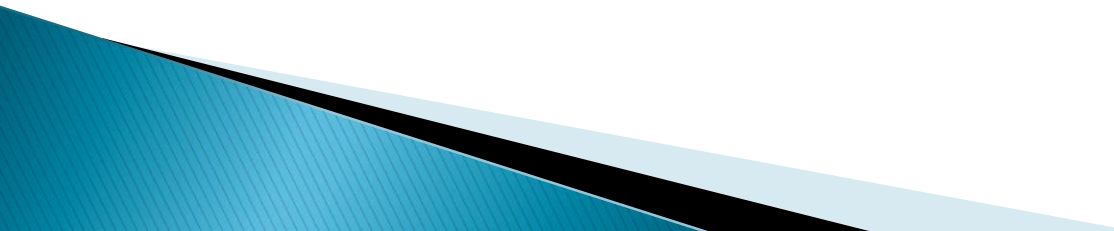
Major Action

– Case in Supreme Court of Canada

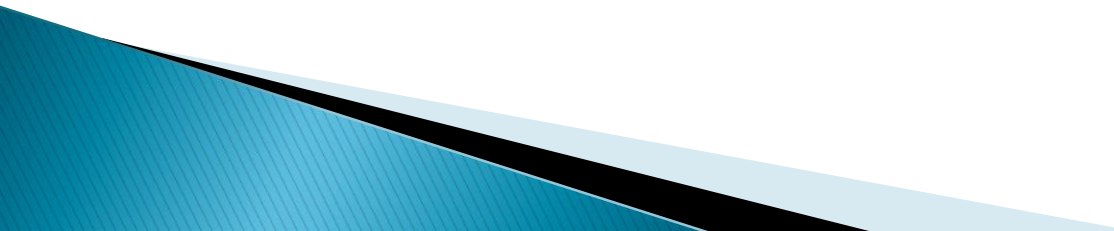
- ▶ Jun 2, 1997: CCPE & APEGN serve Memorial U. With statement of Claim to stop use of term 'Software Engineering' for a program in the Department of Computer Science
- ▶ July 1997: AUCC joins in to support MU
 - AUCC represents all 89 Canadian Universities
- ▶ Sept 1999: **case suspended** after over \$1 million spent in legal fees

One key point

M.U. and AUCC's defence/counter was:

1. **The Engineering profession had delayed more than 30 years to regulate Software practice as an engineering discipline and therefore has lost the right to use of this title.**
 2. The profession was attaching the Universities rights to 'academic freedom'
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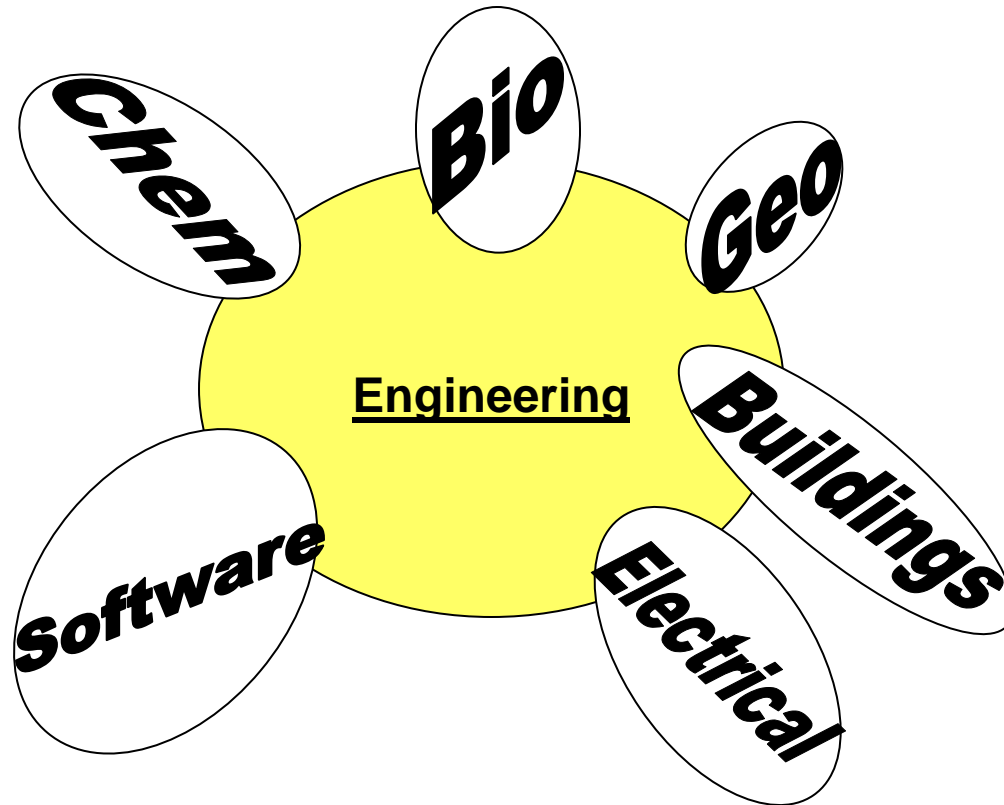
Software Engineering Lesson

- ▶ The Profession cannot do nothing in the light of new emerging practices. The Profession must act.
 - ▶ It must either fulfill its mandate to properly License new areas or relinquish its authority to do so to some other organization.
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Technology Growth Challenge

- ▶ Building Canada is the super-ordinate goal that we ALL seek
- ▶ Hence, co-operation with related practices makes most sense

Disciplines and Overlaps



4. Licensing Mandate Implications

PEO Act - Principle clause

“The principal object of the Association is to regulate the practice of professional engineering and to govern its members, holders of certificates of authorization, holders of temporary licences and holders of limited licences in accordance with this Act, the regulations and the by-laws in order that the public interest may be served and protected.”

What is a Licence?

- ▶ ***“A license is an exclusive right to practice an occupation.”***

Statement in Parliament by Honourable Roy McMurtry, AG in 1983

Justification for Licensure

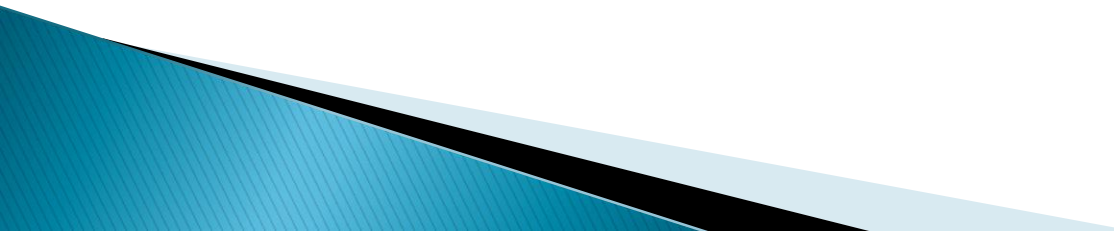
Nov1983 - Quote from AG

*“As a general principle, every person should be free to utilize his or her abilities, education, training, and experience in earning a livelihood. Therefore, it is wrong to create a restriction on this general principle by establishing licenses, **unless this legislature is satisfied that licensing is necessary to protect the public.**”*

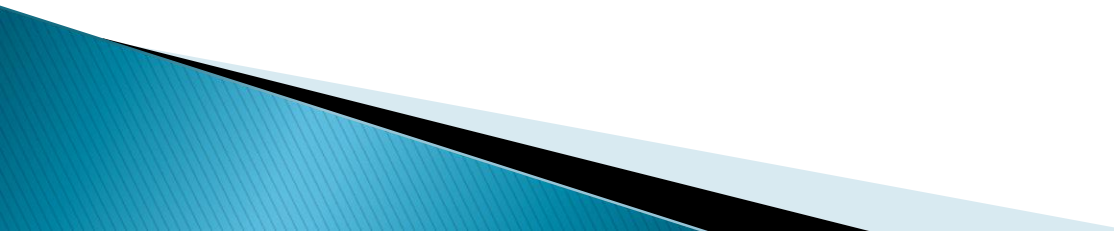
Nov1983 - Quotes from AG

- ▶ “The Professional Organizations Committee recommended that no new occupational licensing should be created until a public inquiry establishes the need for restricting access to an occupation to protect the public.
- ▶ In essence, this was the recommendation of the McRuer Report as well as the Professional Organizations Committee”

Profession Must Act

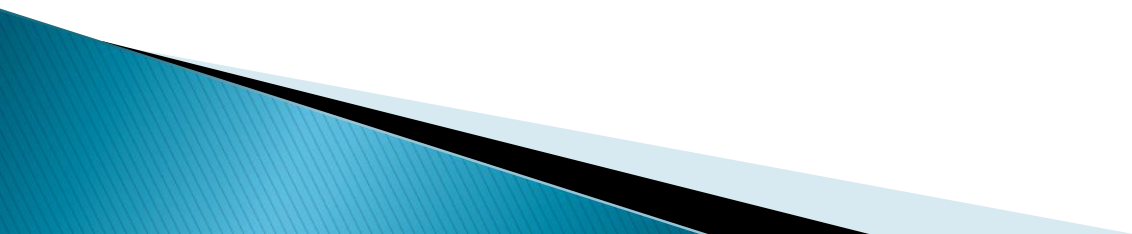
- ▶ Members of a Profession must make the case for Licensure
 - ▶ It is extremely unlikely that politicians will spontaneously discover that a new practice must be Licensed to protect a wider Public Interest.
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Serve and Protect the Public Interest

- ▶ How do we introduce new areas of practice that serve the Public Interest?
 - ▶ How do we ensure that these new areas also protect the Public Interest?
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The Most Significant Challenge

- ▶ Though the initial identification of an ED may be illusive, once discovered, the process of creating the CBOK and a curriculum of study is reasonably well understood.
- ▶ The most significant challenge is 'closing' this new practice area; i.e.: establishing *exclusive rights to practice*.



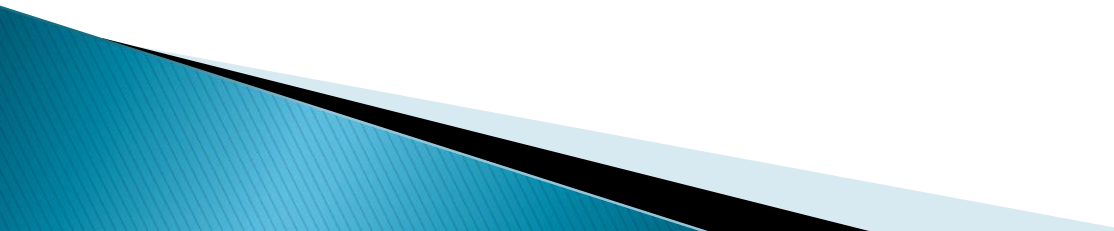
5. Short History of 'New Disciplines'

UK lead the way (Scotland)

- ▶ Civilian Engineers: Institute of Civil Eng – ICE (UK)- 1818,
- ▶ Mechanical Engineers: IMechE- 1847,
- ▶ Electrical Eng: IEE/IET-1871,
- ▶ Chemical Eng: IChemE- 1922,

Each of these represents a 'new' discipline at the time started

6. PEO Work

- Software Engineering - Council motion Dec 1999 (PEO working with CIPS since 2002 re practice issues)
 - Bio-Engineering (Nov 2001)
 - Nano Molecular Engineering (2010)
 - Coming is Communications Infrastructure Engineering
 - What else next?
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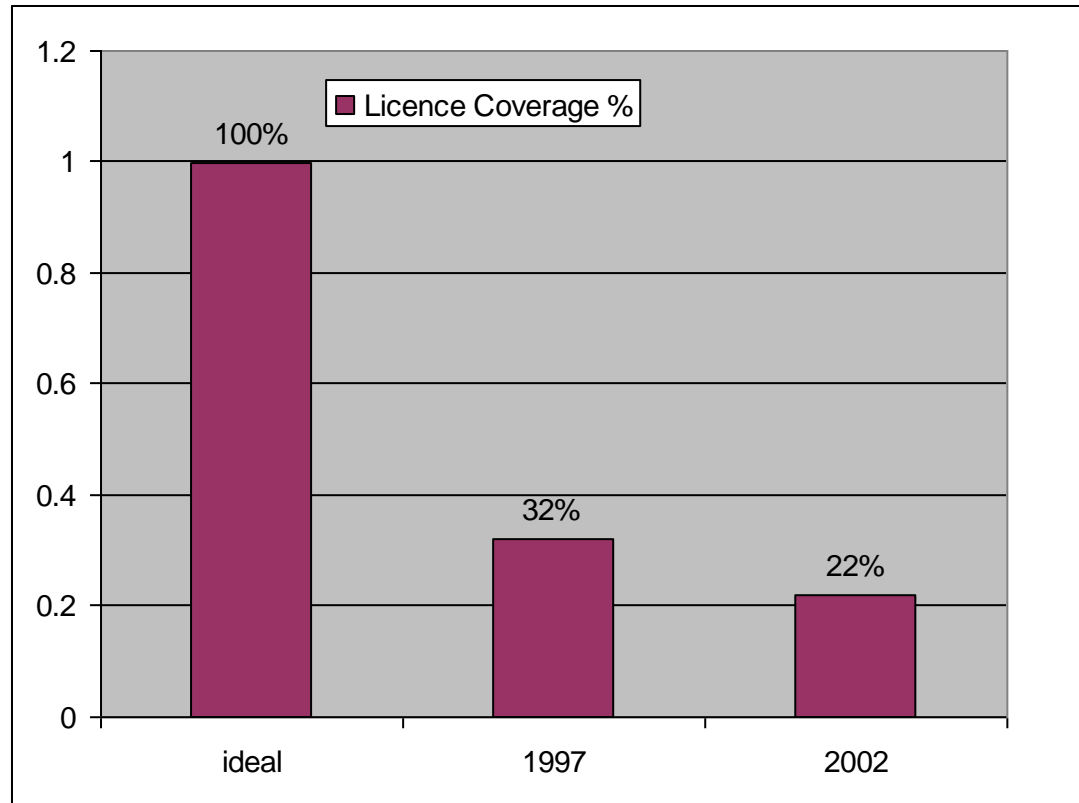
PEO Work

- ▶ The Emerging Disciplines continues to evolve and grow in its sophistication and methodology
 - Phase 1 reports: focus on Core Body of Knowledge
 - Phase 2 reports: focus on establishing rights to practice for new area

7. Emerged Disciplines?

- ▶ What have we missed?
 - Electronic engineering is multiple areas – controls, semiconductors, etc
 - Chemical Engineering mostly in processing – drugs & oil
 - High tech mechanical engineering (robotics)
 - Industrial Engineering
 - Others ?

License Coverage Rate



Capture/Uptake Rates

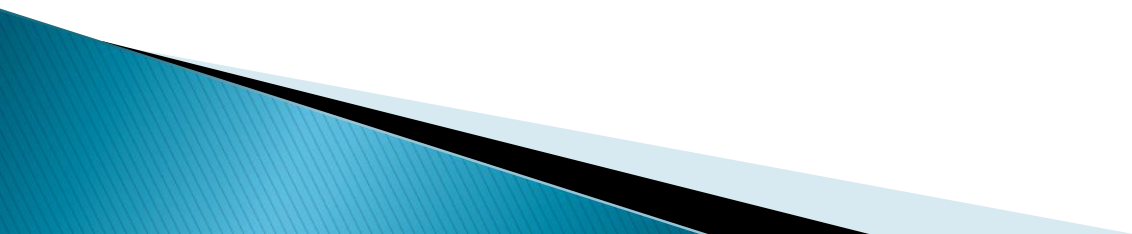
- ▶ 1997 - average of 60% of Grads obtain their P.Eng.
- ▶ 2002 - dropped to 53%
- ▶ In high tech,
only 40% obtained their P.Eng. in 1997
dropping to below 20% by 2002

8. Specialization

- ▶ One way to partition the problem of many disciplines within the profession (over 30 and growing)

Specialization is closely linked idea to Emerging Disciplines concepts –

1. PEO regulations to define scope of practice,
2. Designation for reference (EG: BDS, or SE for Software Engineer)
3. legislation referencing the designation to establish rights to practice



9. Moving Ahead

▶ Short Term

- Continue with Emerging Discipline groups

▶ Longer Term

- Create Emerging Discipline (standing) Committee with mandate:

1. Horizon watch for new areas and then create working groups of specialists as necessary;
2. Deal with general philosophical question of how to cope/resolve the growth issues.
3. Provide Council with a report and recommendation on what to do about 'emerged Disciplines'

Emerging Disciplines of Engineering

- ▶ That's it for now....

- ▶ Questions?

Emerging Disciplines of Engineering - summary

1. Meaning : new areas of engineering practice
2. Rates of growth – unique challenge for engineering profession
3. First response to these issues – Software Engineering
4. Licence mandate – implications
5. Short history of new disciplines
6. Recent work in PEO
 - Software Engineering with CIPS
 - Bio-Engineering
 - Nano Molecular Engineering (2010)
 - Coming is Communications Infrastructure Engineering
 - What else?
7. What have we missed?
 - Electronic engineering is multiple areas – controls, semiconductors, etc
 - Chemical Engineering mostly in processing – drugs & oil
 - High tech mechanical engineering (robotics)
 - Industrial Engineering
8. Specialization concept – closely linked ideas
 - –PEO regulations to define scope of practice, -designation, -legislation ref designation to establish rights
9. Moving forward – creation of E.D. Committee -Mandate
 - Horizon watch for new areas of practice that impact the public interest
 - Deal with general philosophical issue – how might we globally deal with emerging areas of practice and establish full licensure without the need to define each new discipline?