Tacit Knowledge Emergence

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Outline

- Tacit Knowledge Transfer Failures
- The Carpenter's Rule
- What is Mastery? Who Cares?
- Industrial Needs. Professional Development
- CANTEACH, UNENE and all that
- Stewardship
- Tacit Knowledge Emergence

Definition

- Tacit Knowledge is “knowledge that we have without knowing we know it and that once we know we know it, it becomes harder to know how we know what we know”.
- “We know more than we can tell” – Polanyi. [Smith 2003]
- We learn by doing. Knowledge is not a thing; it is a process.

Tacit Knowledge Transfer Failures

- Review in Norway [Nilsen 2005] reveals:
  - Most efforts at Tacit Knowledge transfer failed.
  - Main conclusion: No consensus on how to do it, what the consequences [of the demographics] might be and what should be done about it.
  - Knowledge assets are not taken into account in financial book keeping *[hence not properly valued].*
- In this room, we are in danger of losing 400x20=8000 person-years of tacit knowledge unless 'shift happens'.

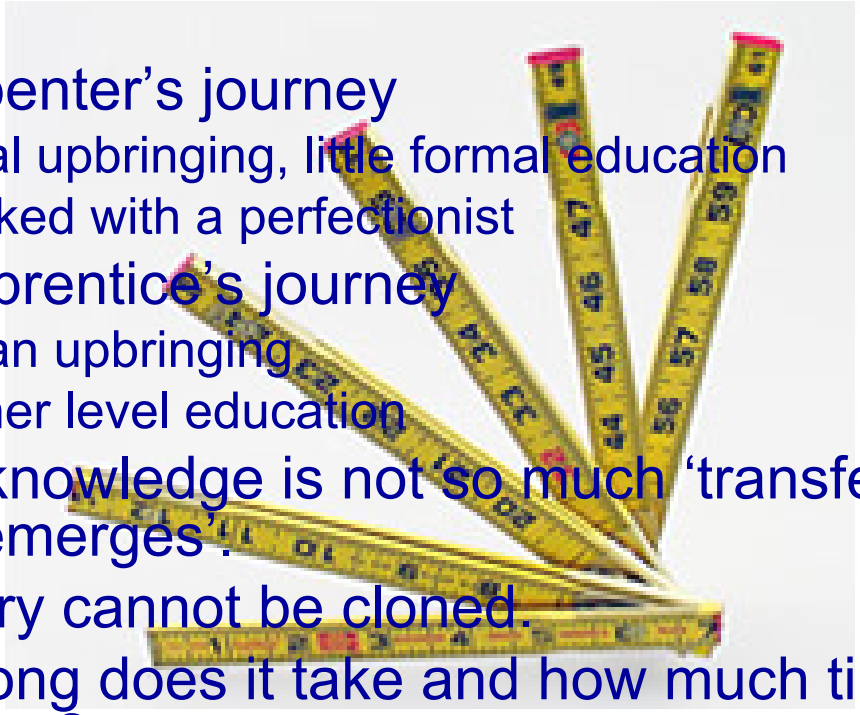
Pop Quiz

- Think of the things that went very wrong in your organization in the past.
  - Isotope business, MAPLE, feeder thinning, Darlington fuel failures, Pt. Lepreau plywood dam, Bruce A drum humping, ….
  - Main cause?
    - Lack of explicit scientific and engineering knowledge? Lack of research?
    - Or improperly implemented knowledge?

What was learned in Norway?

- Knowledge is not really the asset, but the people owning the knowledge and able to exploit it are the asset.
- Knowledge is not only explicit, but also implicit and tacit, actually it could happen that the most valuable knowledge is tacit and so people started to suggest that an important part of knowledge could never be codified.
- Knowledge is extremely dynamic, technology often ended in creating repositories difficult to update.
- Instead of managing knowledge it is necessary to look at the knowledge process.

The Carpenter's Rule



- A carpenter's journey
  - Rural upbringing, little formal education
  - Worked with a perfectionist
- An apprentice's journey
  - Urban upbringing
  - Higher level education
- Tacit knowledge is not so much 'transferred' as it 'emerges'.
- Mastery cannot be cloned.
- How long does it take and how much time do we have?

Master your profession…

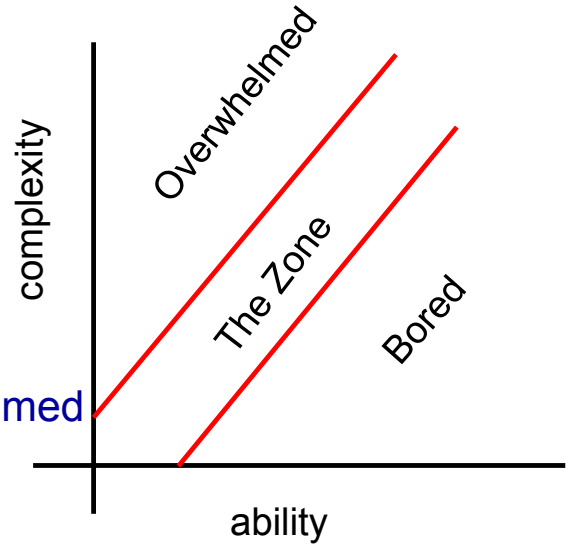
- How long does it take?
  - About 10 years.
- And how much time do we have?
  - The average experienced person in this room has about 10 years left.
  - They are not available to mentor.
- We have not articulated what we need to transfer, we don't know how to do it and we have little time anyway.
- That, I suppose is the challenge that this session is referring to.

What is that Mastery mindset?

- It's that feeling and mindset when you are 'into' whatever you are doing and lose track of time.
  - You enjoy the process and it is more like play than work.
- People talk of being
  - in the groove
  - in the sweet spot
  - in the zone
  - in the flow
- The literature refers to this as 'Flow: the optimal experience'
- This is joy. It applies to human interaction as much as it does to work and play activities.

How to get the flow experience?

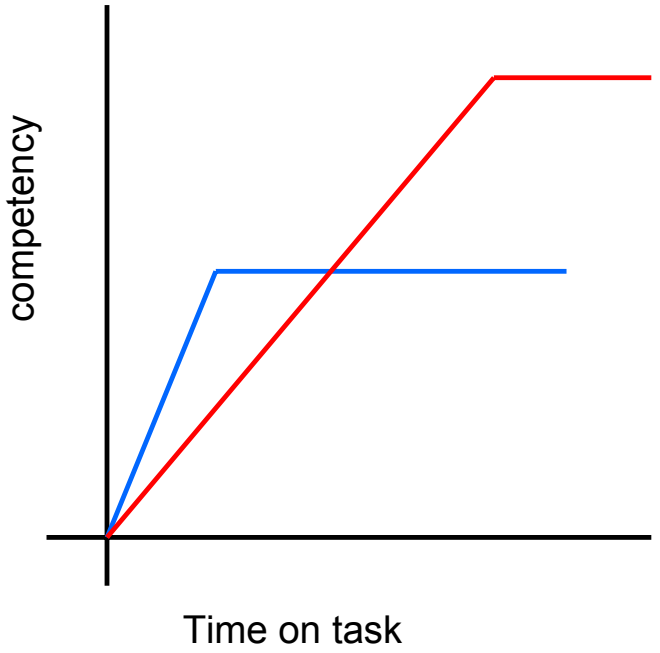
- Be in the now
  - Focus on the job at hand
    - Need to remove distractions
  - Proceed at the optimal pace
    - Too slow and you get bored
    - Too fast and you get overwhelmed
  - Strive for quality
    - Master the task at hand



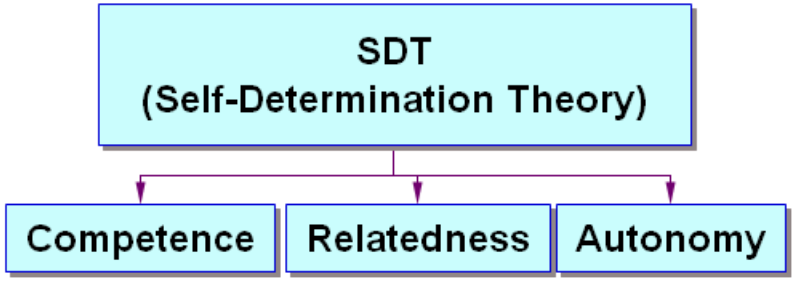
- So this is what you do: proceed with a sense of quality. Care.
- More than anything else, it is a state of mind.

The tortoise and the hare

- Some people learn slower than others.
- Some people have lower ultimate capability than others.
- But a slower person can have higher ultimate capability.
- Often, a person is slower because he or she is thinking more deeply. It takes time to integrate new ideas into what you already know and believe.
- So don't be swayed off your path by the apparent speed of others.



When are people motivated?



A person is motivated to do something if:
- she is good at it,
- it is meaningful or matters in some way, and
- if she has decided this herself.

CANTEACH addresses all three aspects of motivation

CANTEACH aids the gaining of skills and competency
CANTEACH is all about CANDU, therefore is relevant
CANTEACH is freely available for when YOU want the info, therefore, YOU have control

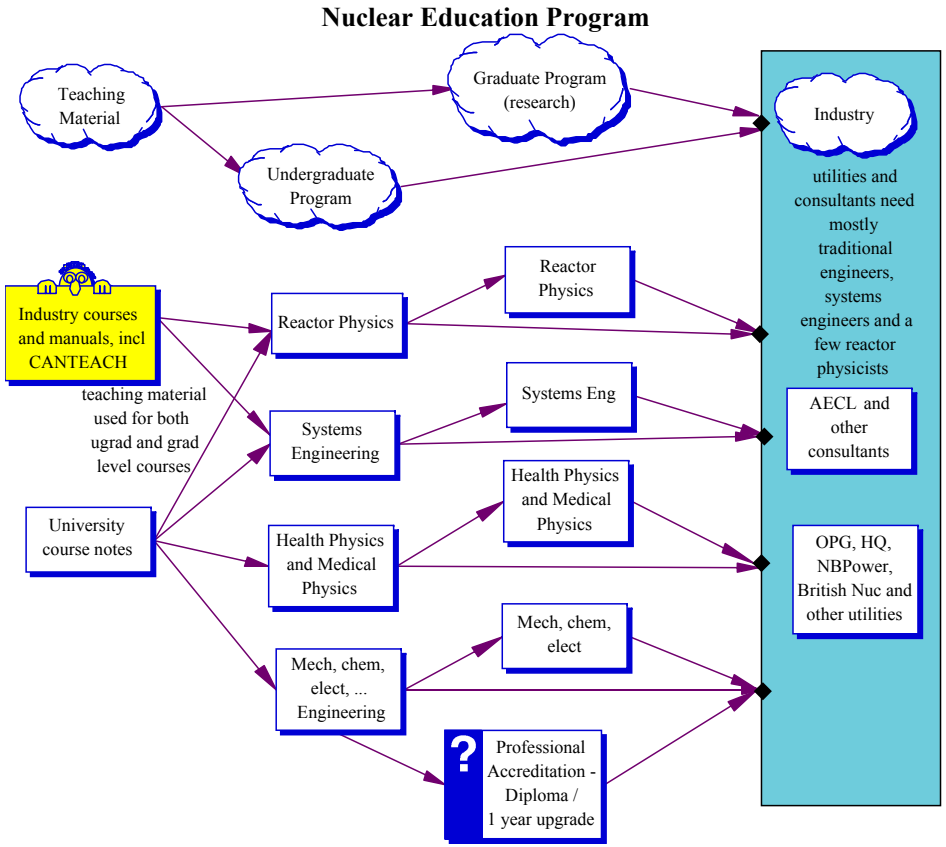
How this relates to learning

- Need to set up an environment and a mindset conducive to learning.
- Need time to learn
  - Space out the classes to give you time to think and integrate the new ideas into your current understanding.
  - Use e-classroom to bridge the gap between infrequent marathon sessions necessitated by geography.
- Master the pre-requisites
  - Take refresher courses.
  - Use the e-classroom and online courses.
  - Self-paced with checkouts.
  - Build your confidence.
- Mentorship and apprenticeship
  - Work with someone more experienced if you can.

How this relates to the workplace

- At work, you have goals and objectives to achieve.
- In ‘goal mode’ you work toward a future goal.
  - Enjoyment comes for that brief period after attaining the goal and before you realize that the next goal awaits.
  - That is a depressing and draining way to live.
- The irony is that mastery mode gives better results in the long term.
  - Mastery is empowering and energizing.
  - There is nothing to stop you from working toward goals while mastering the techniques and carrying out the tasks needed.
- Important side effects:
  - This is contagious – others will sense it and value it.
  - Remember, your company is seeking quality work and will reward quality.

What's the education situation?



What's the problem?

- Professionals come from the universities
  - Inadequate preparation for industry
  - Research emphasis over development and teaching
  - Lack of systems approach
  - Self-reinforcing myopia
  - No upgrade path for C students
  - Grades not a good measure of the person
  - System shuts out and destroys people
- University is not going to change its mandate or structure for industry
  - It is answerable to the public, not to industry

Where is industry in all this?

- Industry is faced with a huge hiring and expertise gap problem
  - They can ill afford the training cost
  - Industry time horizon is too short
  - Industry cannot give accredited courses
  - Big mismatch between what industry needs and what universities supply

What do we need?

- We are not going to change industry or the university mandates
- Therefore, need
  - Access to information
  - Professional development upgrade path
  - Access to mentors and apprenticeship
  - Better measures of the person
  - Remedial programs
  - Bridging programs
- And it all needs to be (and can be) done with a Mastery mindset.

Opening Supply Pathways

- PEO
  - Nuclear Engineering Syllabus prepared and accepted May 22, 2008
- Degree standardization globally
  - WNU Academic Council (UNENE is a member)
- International networking
  - WNU Summer Institute
- National networking
  - Get involved with the CNS
- What else can we do?
  - Let's look at some of the things already underway.

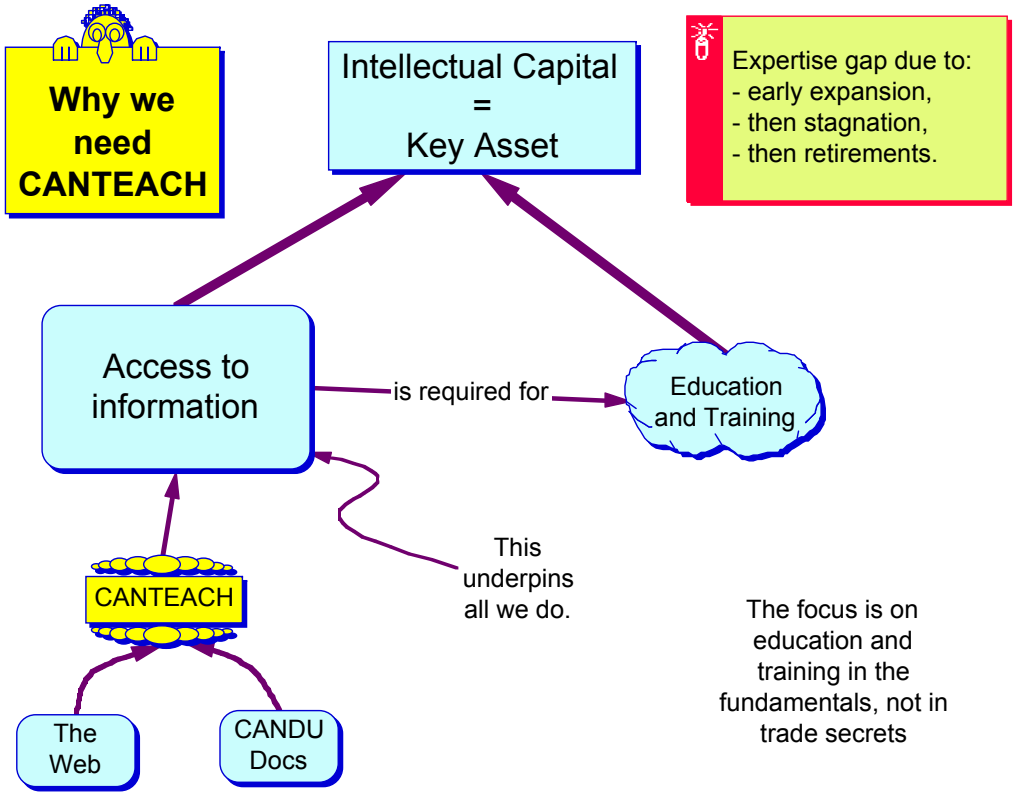
Canadian Initiatives

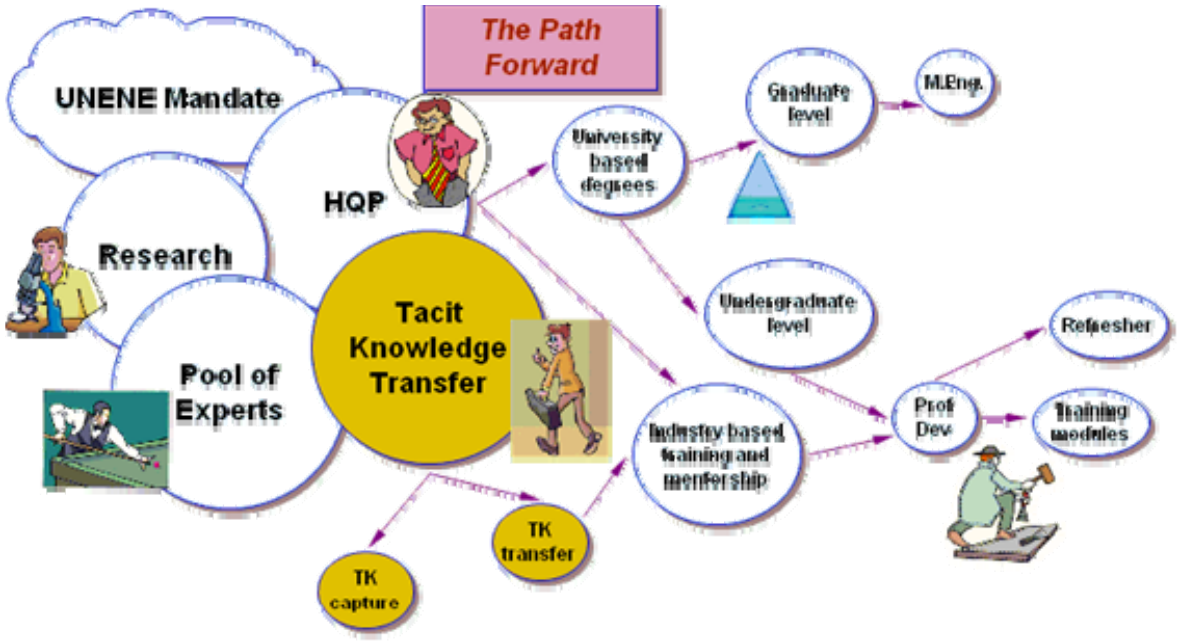
- In Canada, we have these uncoordinated nuclear elements:
  - CANTEACH – an open CANDU document repository (2001)
  - UNENE – a nuclear centre of excellence (2002)
  - NUCENG – an university based portal and repository (1998)
  - CNS – a society of nuclear individuals (conferences, bulletin, …) (1979)
  - COG – an industrial consortium of operators and designers (1984). Sponsors CANTEACH and member of UNENE
  - OCI - provides a forum for exchange of information related to technical and quality issues with particular regard to the potential impact of such issues on the supply base for its members' products and services.
  - Nuclear Canada portal – a wiki based portal to the Canadian Nuclear Enterprise.

Existing Networks

- UNENE – University Network of Excellence in Nuclear Engineering, Canada (2002)
- WNU - World Nuclear University (2003)
- ENEN - European Nuclear Education Network (2003)
- ANENT - Asian Network for Education in Nuclear Technology (2004)
- NTEC - Nuclear Technology Education Consortium (UK) (2005)
- RANSE - Russian Association of Nuclear Science and Education (2005)

CANTEACH Justification




The Path Forward
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University based degrees
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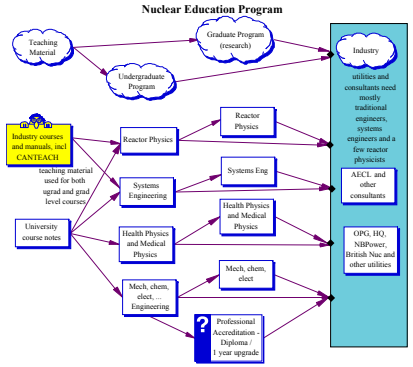
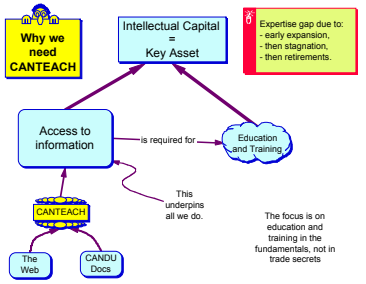
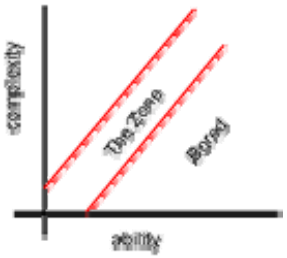
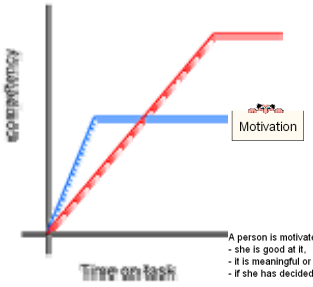
Industry based training and membership
Prof Dev
Refresher
Training modules
TK transfer
TK capture
Who does the knowledge engineering, education and training?
- in-house experts (intra and inter-company)
- consultants, profs, researchers
How do we do the knowledge engineering, education and training?
- need a more hands-on approach than classroom lectures

How do we do what we need to do?









SDT
(Self-Determination Theory)

Competence | Relatedness | Autonomy

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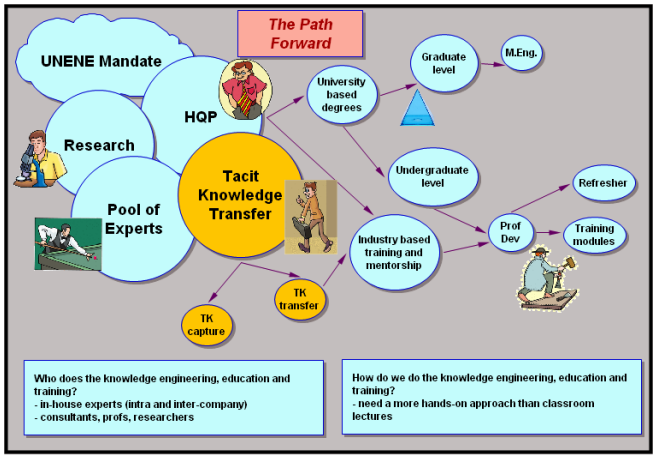
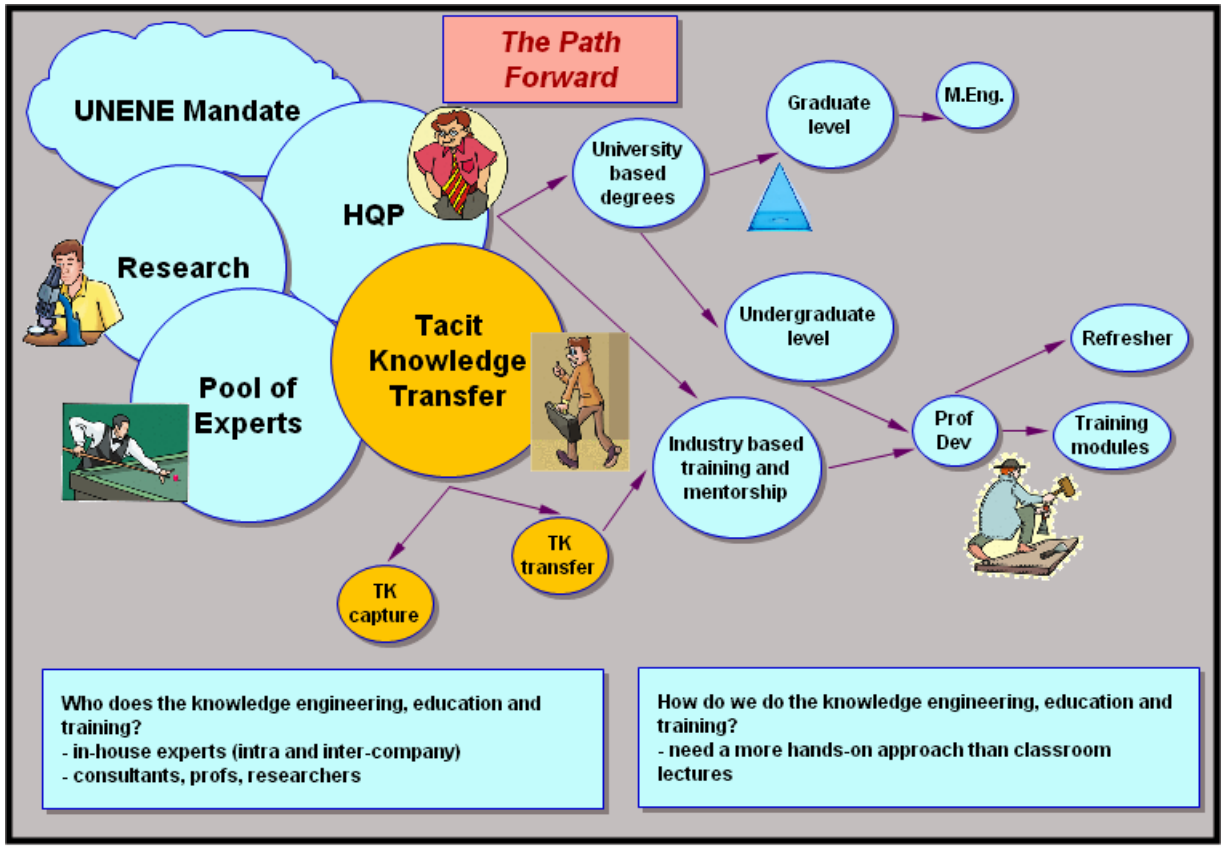


Some questions for you

- Who are the stewards of the discipline?
- What are we as individuals trying to do?
  - Be the best artists?
  - Or are we trying to further the art?
- What mindset will enable Tacit Knowledge to emerge?
  - I think it is the Mastery mindset.
  - Proceed with a sense of quality.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Questions?

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Further reading…

- Smith, M. K. (2003) 'Michael Polanyi and tacit knowledge', *the encyclopedia of informal education*, www.infed.org/thinkers/polanyi.htm.

- "Knowledge Management in Nordic NPPs: Summary report of the findings from the workshop", by Svein Nilsen, Institute for Energy Technology, Halden, Norway, Nordic nuclear safety research, NKS-102, ISBN 87-7893-161-4, April 2005. http://www.nks.org/nordisk/R-delen/resultater.htm

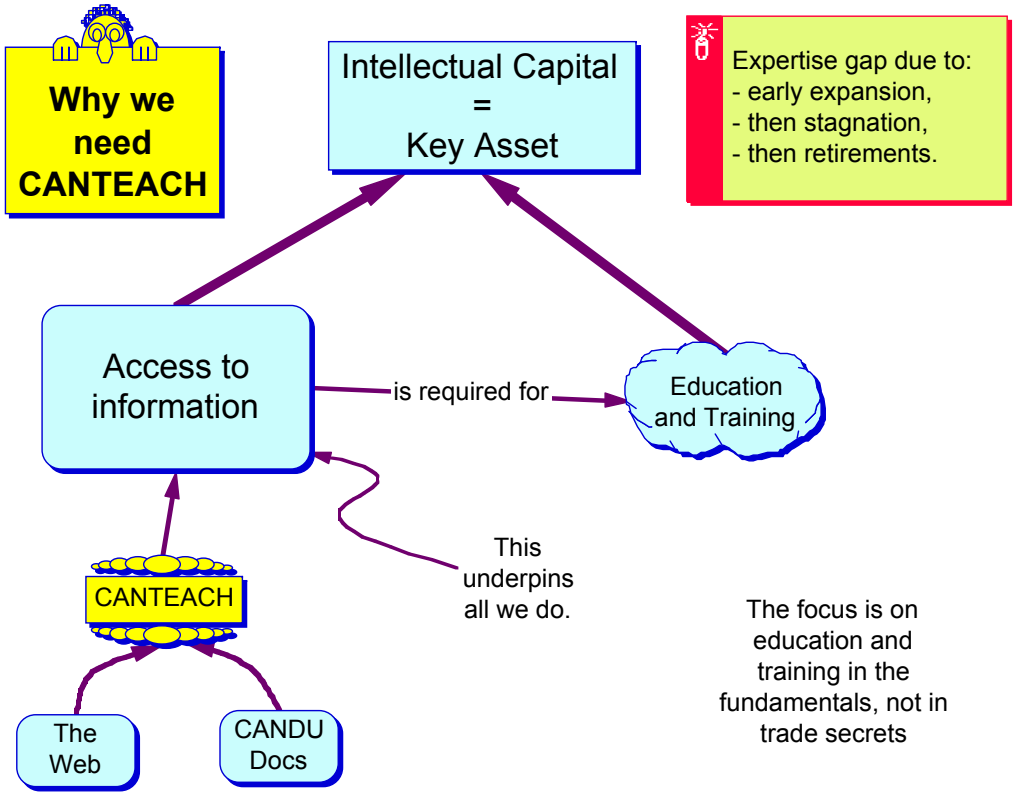
- "Flow: The Psychology of Optimal Experience" by Mihaly Csikszentmihalyi found at http://www.siliconyogi.com/andreas/it_professional/sol/complexsystems/FlowThePsychologyofOptimalExperience.html

- "Mastery: the Keys to Success and Long-term Fulfillment" by George Leonard found at http://www.vnoel.com/content/view/137/54/

CANTEACH Target Audience

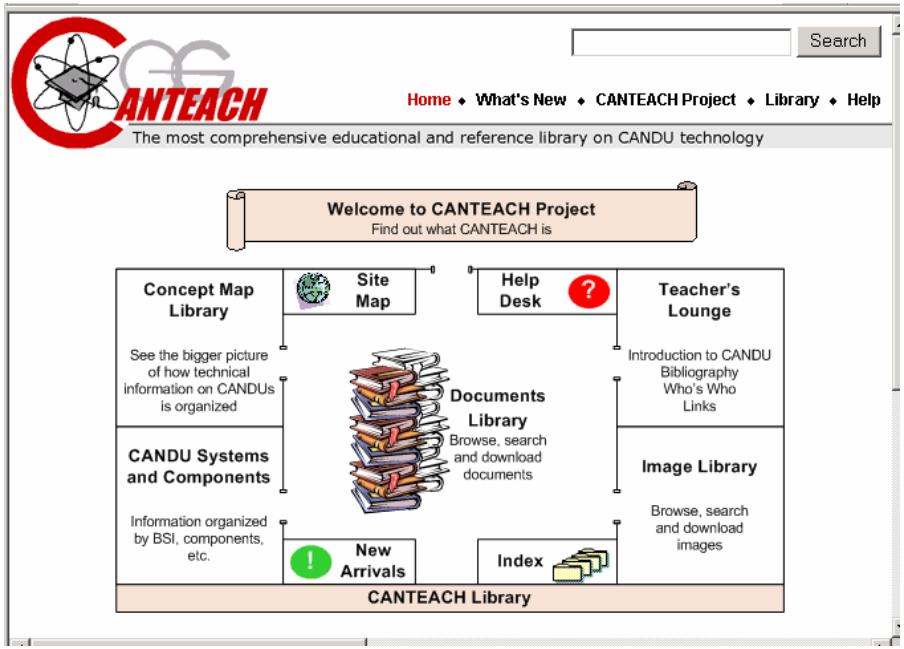
- **Mission** To preserve technical knowledge of CANDU nuclear-electric generating system for use by present and future members of the CANDU community.
- **Mission** To train Highly Qualified Personnel.
- Thus target audience is primarily at the level of the working professional.
  - ***NOTE:*** ***<u>This target, as it turns out, leads to the identification of a serious problem that needs to be addressed.</u>***
- Aimed at capturing Know-how and Know-why.

CANTEACH Justification



CANTEACH Web Site Tour

http://canteach.candu.org



UNENE

University Network of Excellence in Nuclear Engineering

- CANTEACH is about info. Low budget ($100k/yr)
- UNENE is about delivery ($3M/yr).
- UNENE generates Highly Qualified Personnel.
- Hope to make CANTEACH the repository for UNENE.

What is UNENE?

- UNENE = University Network of Excellence in Nuclear Engineering
- UNENE is an industry driven alliance of prominent Canadian universities and nuclear industry

UNENE has three distinct objectives:

- Enhance the supply of highly qualified graduates in nuclear engineering and technology.
- Reinvigorate university-based research and development in nuclear engineering and technology focusing primarily on mid to longer term research.
- Create a group of respected, university-based, nuclear experts for public and industry consultation.

Current Industry Membership

- Ontario Power Generation (OPG)
- Bruce Power (BP)
- Atomic Energy of Canada Limited (AECL)
- CANDU Owners Group (COG)
- Canadian Nuclear Safety Commission (CNSC)
- Nuclear Safety Solutions (NSS)

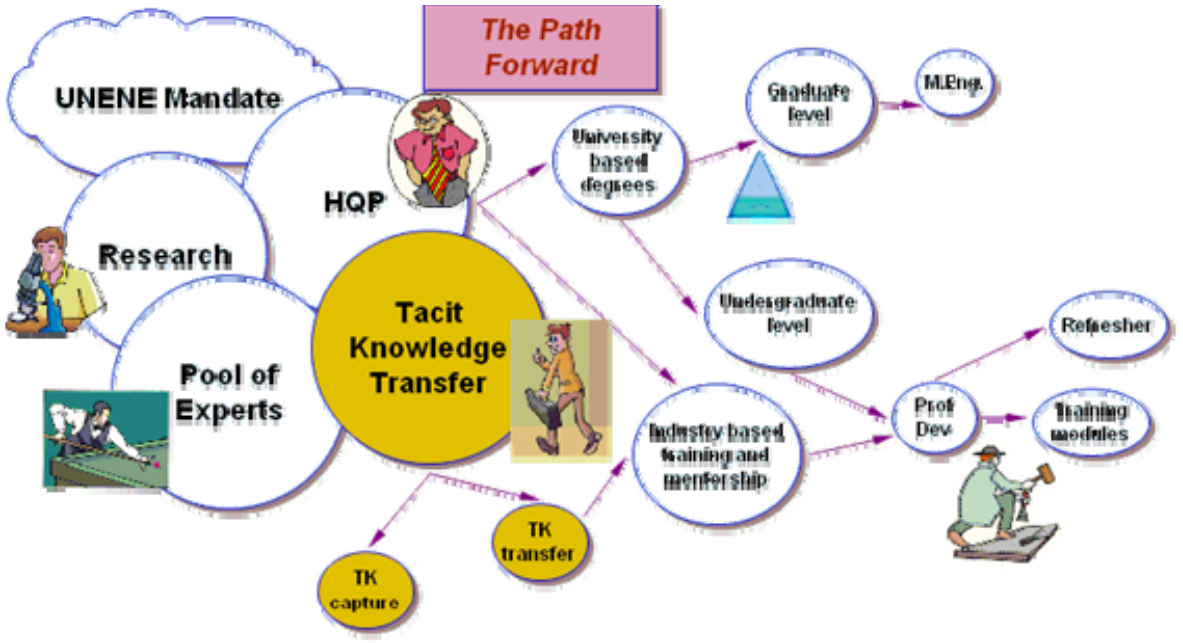
University Members

- McMaster University
- Queen's University
- University of Toronto
- University of Waterloo
- University of Western Ontario
- University of Ontario Institute of Technology
- Ecole Polytechnique
- University of New Brunswick
- Royal Military College
- University of Guelph

First Phase Funding

- Cash Funding (first phase)
  - Industry: $ 7.8 M
  - Universities: $ 0.81 M
  - NSERC: $ 7.12 M (estimated)
  - *(Not including other nuclear research chairs and programs)*
- Other In-kind Support:
  - Industry and Universities: $4.97M

Total impact ≥$20.7M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UNENE Web Site Tour

http://www.unene.ca

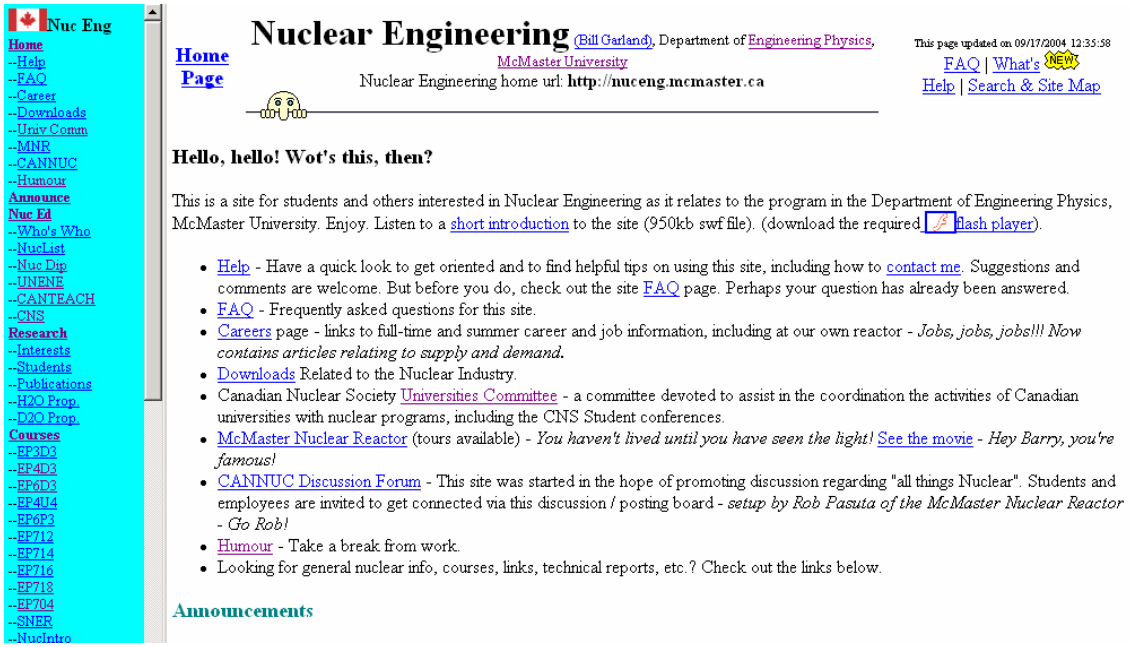
NucEng

Nuclear Engineering at McMaster University+

- CANTEACH is about info.
- UNENE is about delivery.
- NucEng is about students.
  - Courses
  - Who's Who
  - Careers
  - Links
  - Forums and List servers

NucEng Web Site Tour

http://www.nuceng.ca



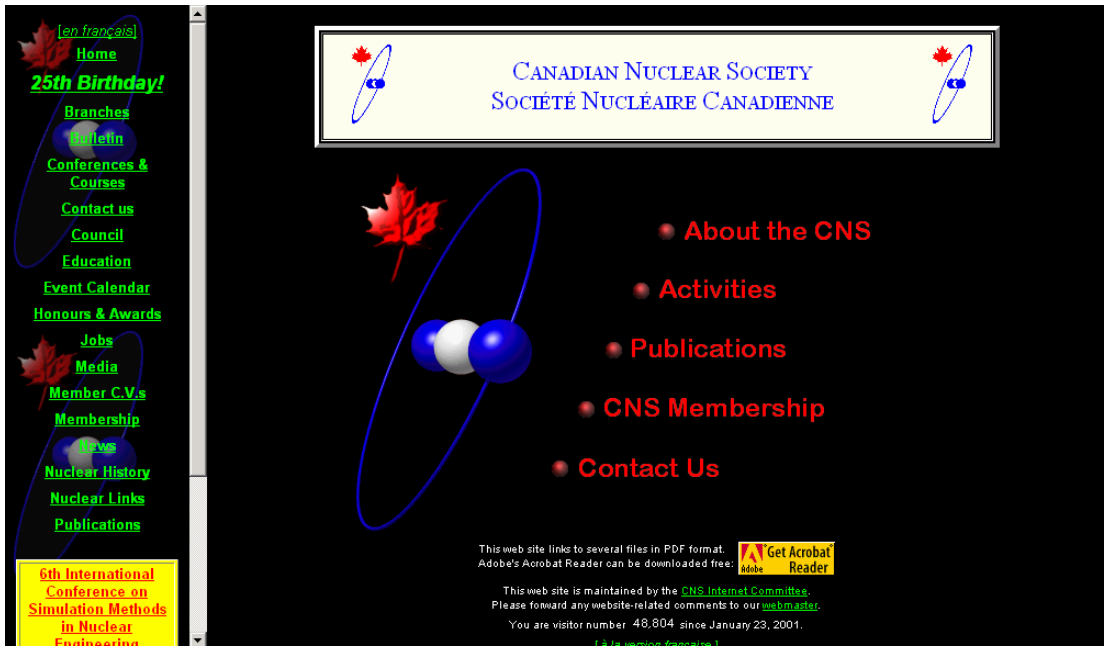
CNS

Canadian Nuclear Society

- CANTEACH is about info.
- UNENE is about delivery.
- NucEng is about students.
- CNS is about professionals as individuals.
  - Seminar type courses
  - Conferences
  - Fellowship and contacts
  - Forums and List servers

CNS Web Site Tour

http://www.cns-snc.ca



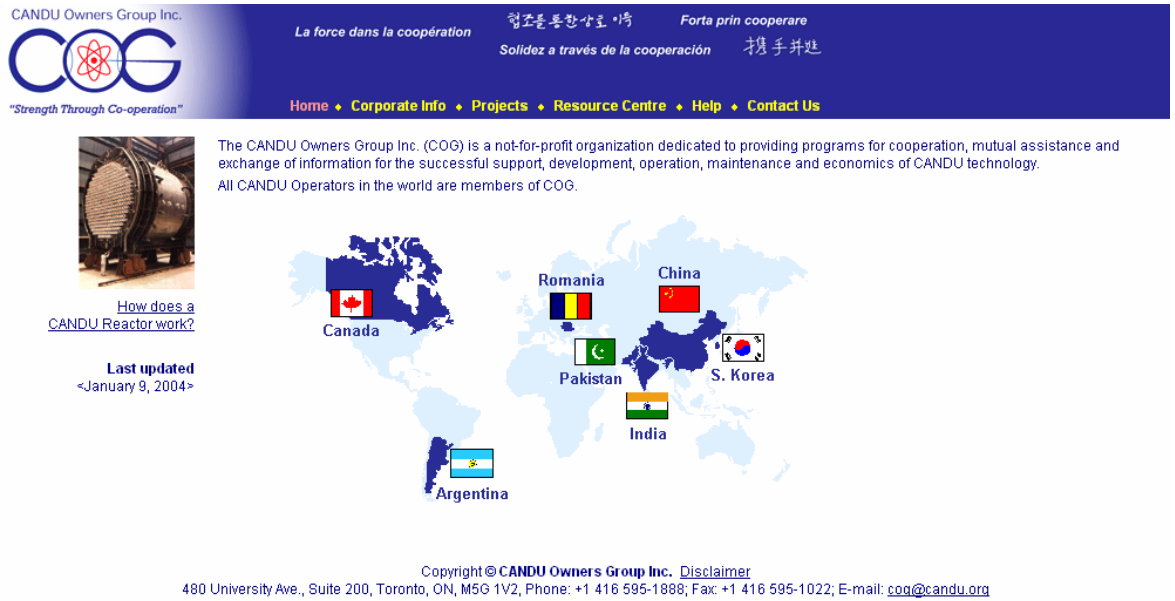
COG

CANDU Owners Group

- CANTEACH is about info.
- UNENE is about delivery.
- NucEng is about students.
- CNS is about professionals as individuals.
- COG is about industrial partnerships in R&D
  - Shared R&D cost
  - Shared R&D facilities
  - Creation of and access to closed information databases

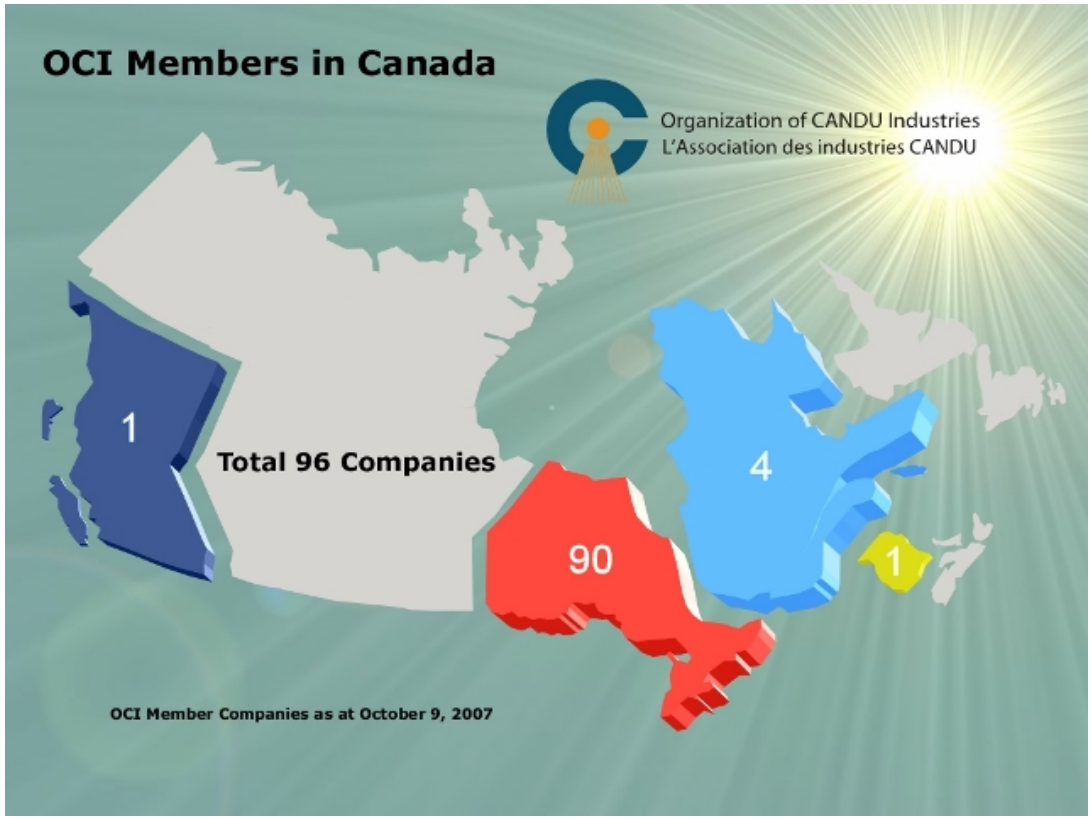
COG Web Site Tour

www.candu.org



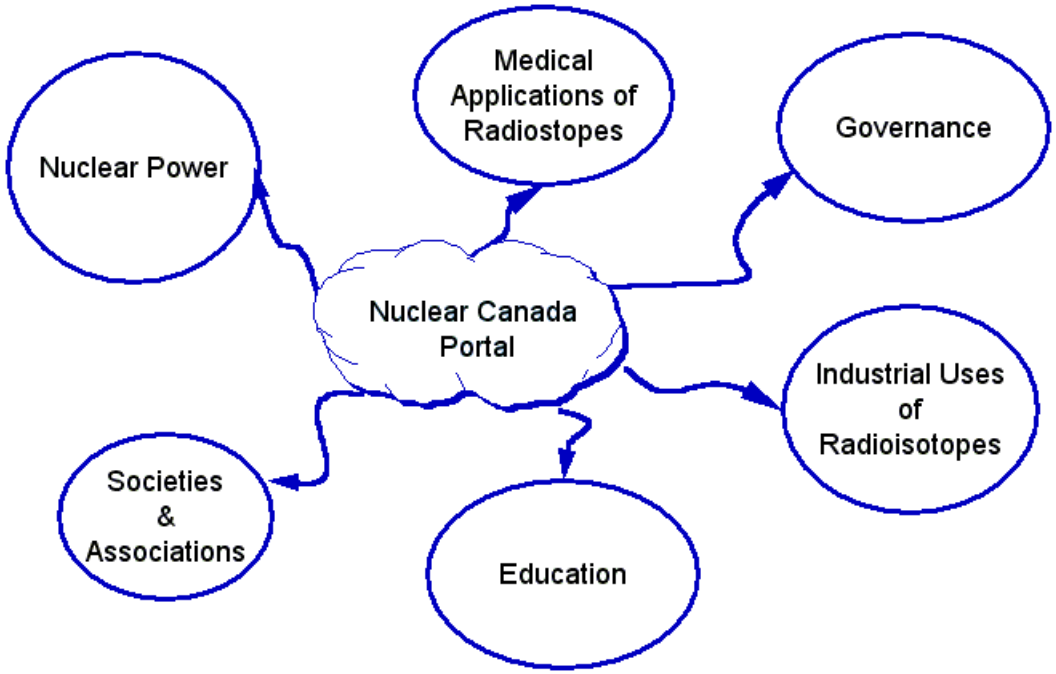
OCI – Organization of CANDU Industries

http://www.oci-aic.org/



Nuclear Canada Portal

www.nuclearcanada.ca



Where does the portal fit in?

- The portal needs to provide access to information on
  - Documentation (technical and otherwise)
    - Education and training based
  - Education and training programs
    - Emphasis on professional development
  - Information on education and training opportunities such as
    - Scholarships
    - Reciprocal agreements and exchanges
    - Etc.
  - Promotion of International accreditation
    - Provide information on what we should measure, etc.
  - Web enabled learning