Adding Value:

Recognizing the Link Between Engineers and Municipal Finance and Governance

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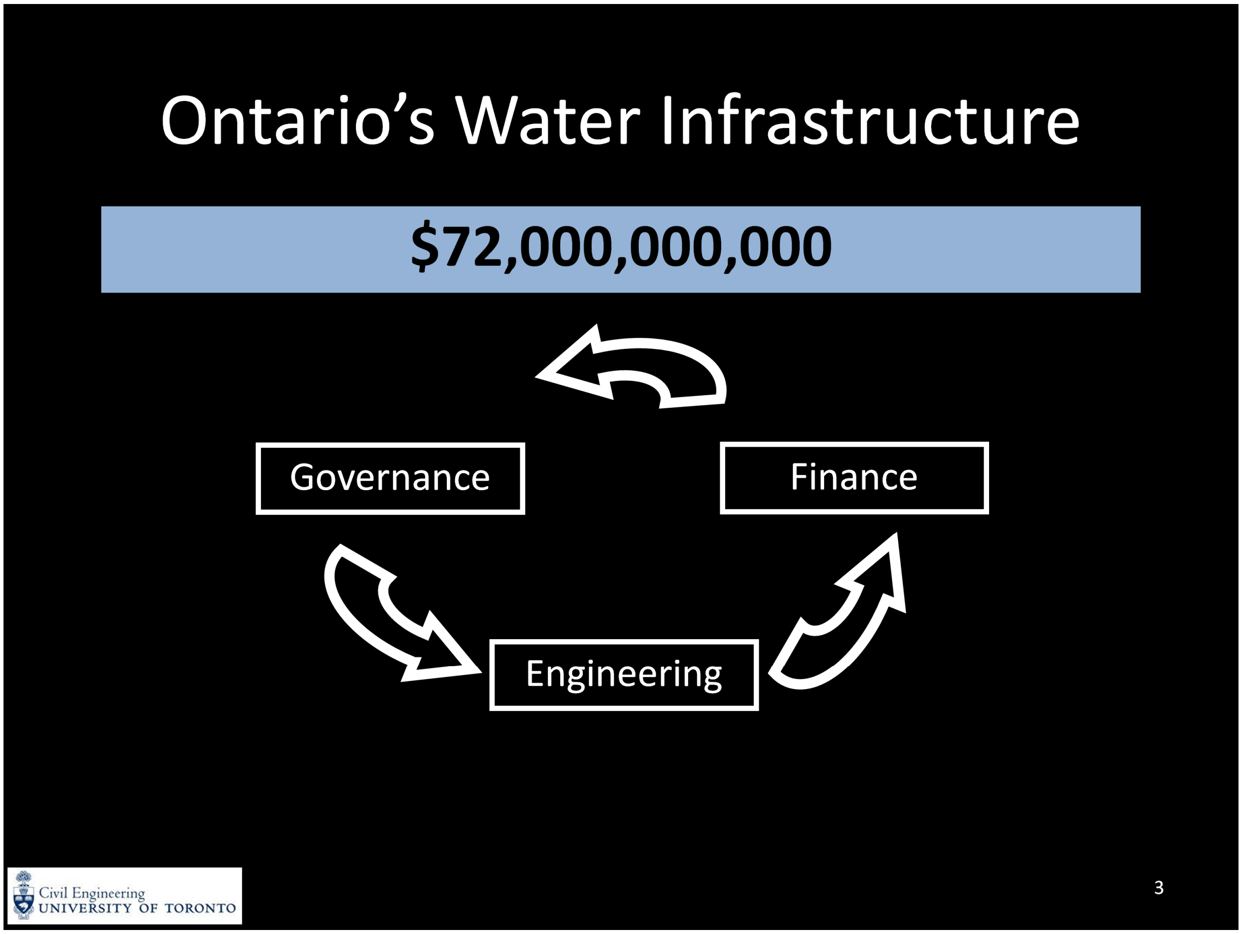
This presentation provides an overview of the link between engineering and municipal finance and governance in the context of the Ontario water sector.

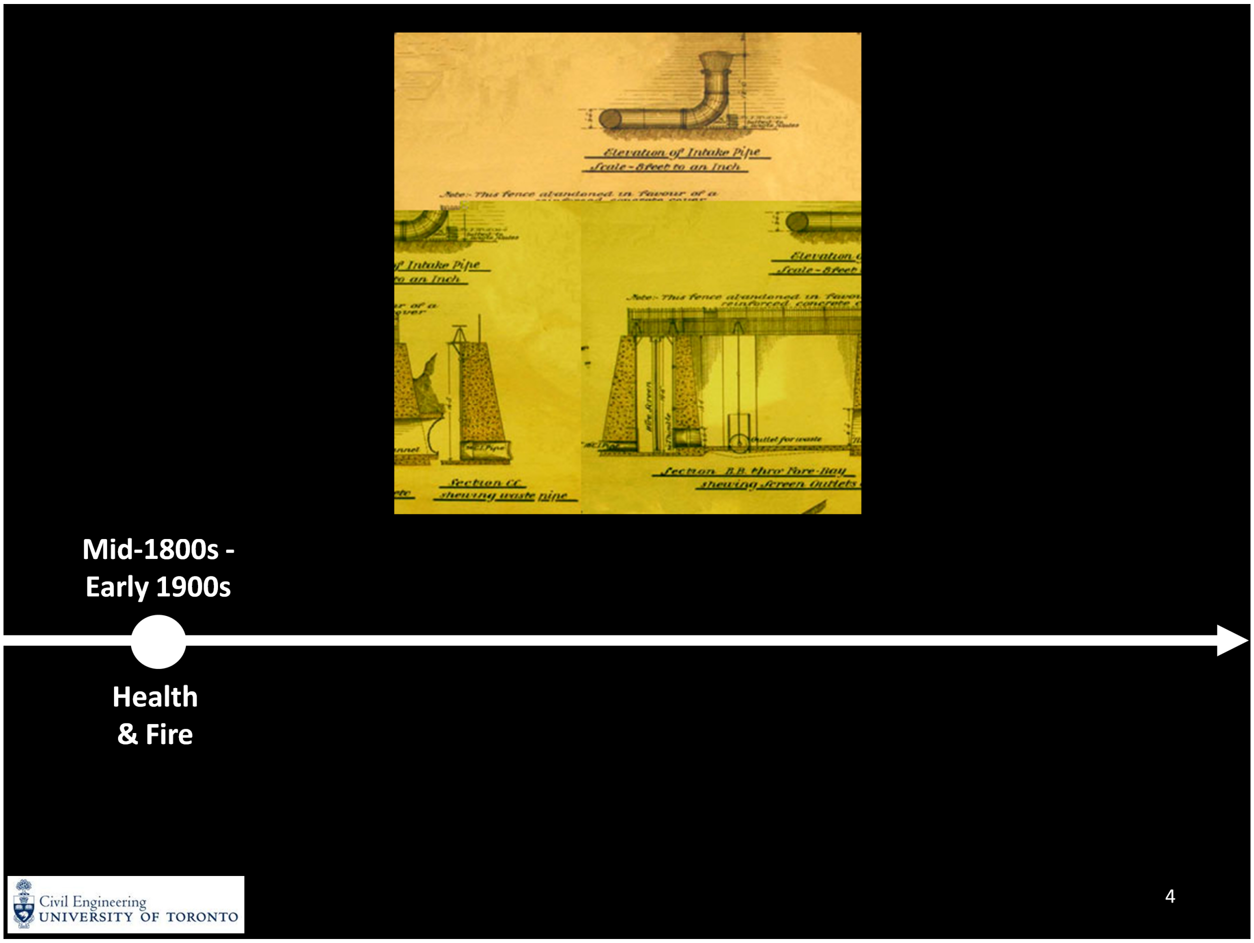
Overview

- Water infrastructure in Ontario
- The history of Ontario's water infrastructure
- Outcomes of Ontario's water infrastructure history
- Adding more value to infrastructure through engineering and engineering approaches



Ontario's water and wastewater assets are worth an estimated $72,000,000, which includes treatment plants, distribution systems and collection systems (Swain et al. 2005). The City of Toronto alone is responsible for 5,850 km of water mains, which is roughly the distance from the east to the west coast of Canada (City of Toronto 2012).

Much of the decision-making regarding what to build, where to build it and at what level of service to build it at has been associated with government and governance at all levels. In terms of financing, all of this water infrastructure had to be paid for, is paid for and will have to be paid for by all levels of government and users. In addition, all of these systems had to be planned and designed, and many of them have undergone or will undergo rehabilitation, replacement and/or expansion. The history of Ontario's water infrastructure can be relayed as a tale of these three components (governance, financing and engineering) and how the interplay between them has led to what we know today as Ontario's water infrastructure.



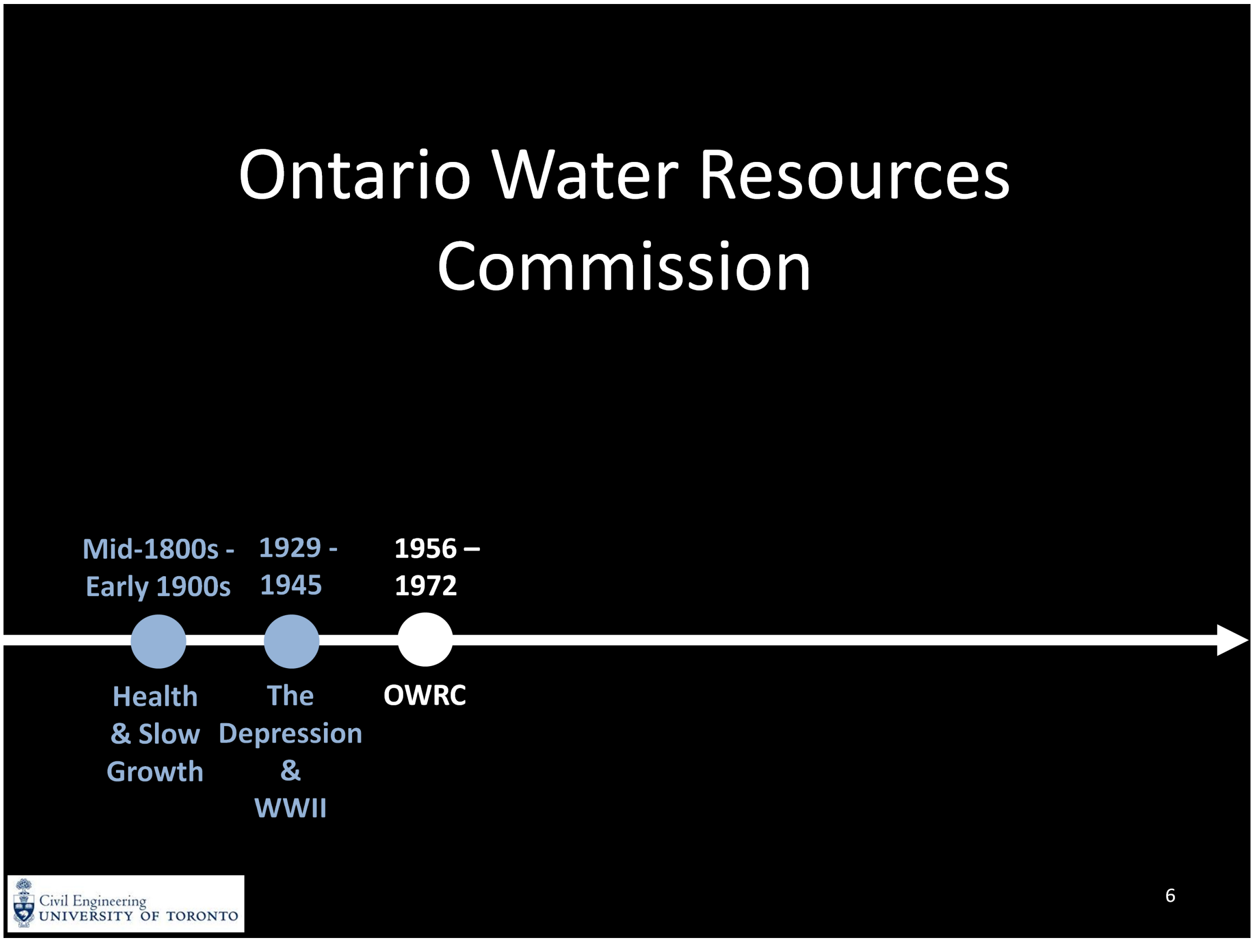
In the mid 1800s to early 1900s, there was a growing recognition that water and health were related. Water related outbreaks of typhoid and cholera prompted piped water supply development. For example, a typhoid outbreak in Thunder Bay prompted a switch in water supply accompanied by the building of a system of conveyance around 1900 (see photo above). Another motivating factor for water supply development was for the extinguishing of fires.

At this time, engineering designs were approved by the Provincial Board of Health. At first, systems were privately developed and owned, but concerns about water contamination, higher costs and inadequate fire supplies caused the systems and their development to be under public responsibility. In 1943, municipalities were granted the right to charge user fees to cover the costs related to water provision.

Photo credit: http://dcnonl.com/article/id44990/water

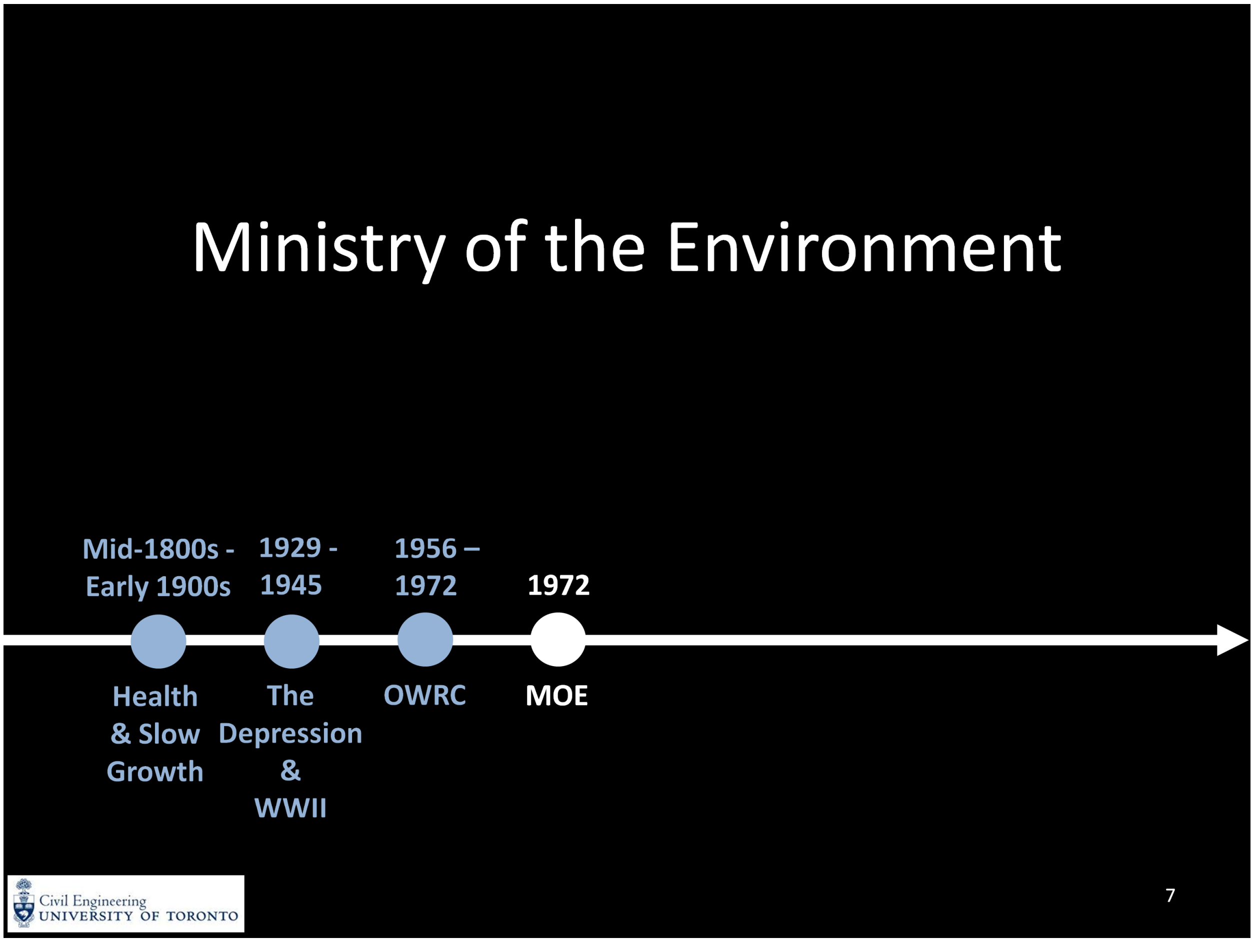
Much of the expansion of water supply systems in Ontario came to a halt with the onset of the Great Depression, which was followed by World War II. After the war, Ontario's population multiplied, eventually leading to issues of inadequate water supply. At the same time, capital costs increased and interest rates rose, which made financing of the expansion of water supply systems difficult for municipalities.

Photo credits (left to right):
http://www.blogto.com/city/2010/10/nostalgia_tripping_the_great_depression_in_toronto/;
http://www.britannica.com/EBchecked/media/108377/US-Marines-moving-supplies-and-weapons-during-the-battle-for



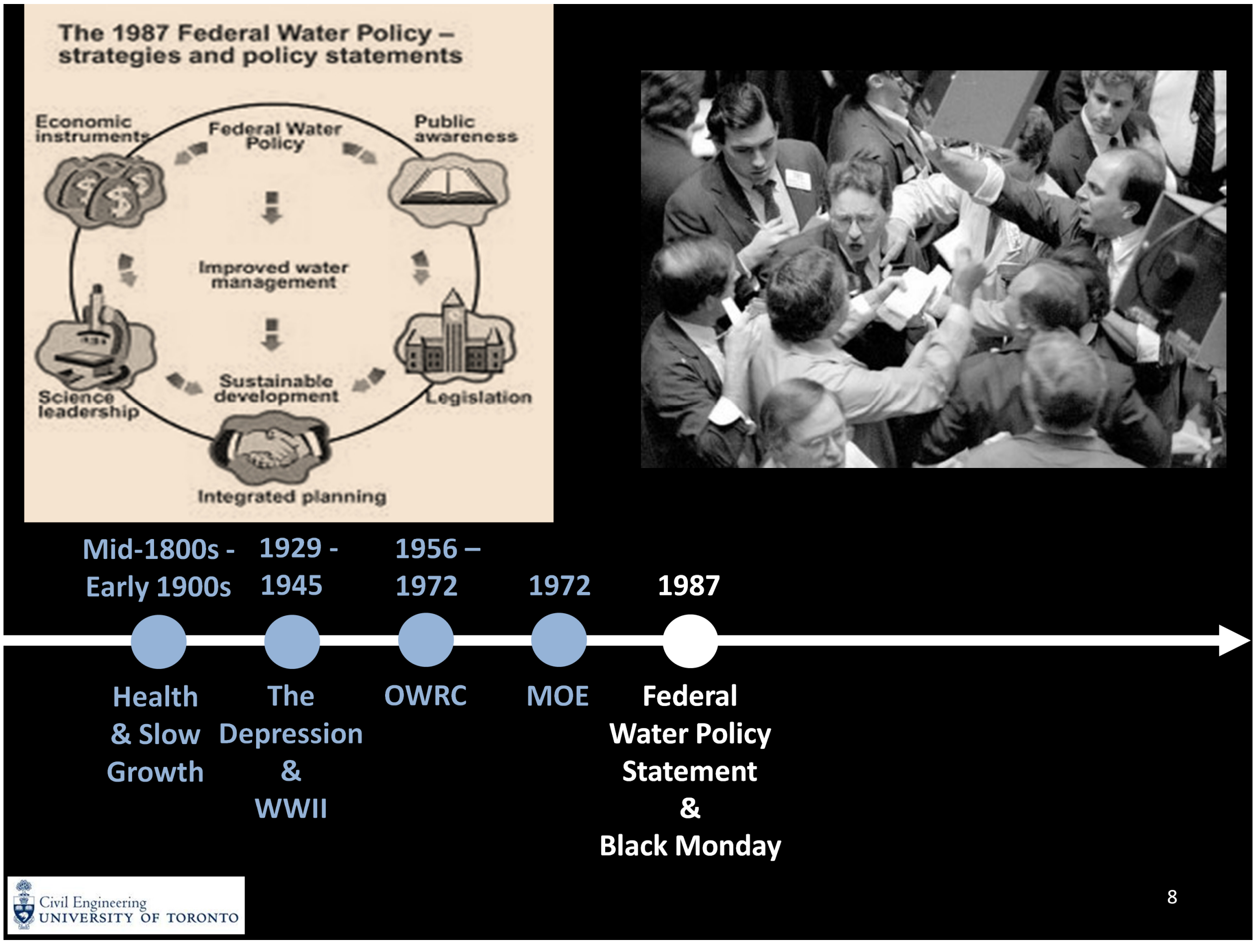
Recognizing that this situation was a threat to post-war economic development in the Ontario region, the Province created the Ontario Water Resources Commission (OWRC) as part of the *Ontario Water Resources Commission Act* of 1956, which was a government agency that reported to the Department of Health. The OWRC provided relief in the form of the planning, construction, and operation of municipal water supply and sewage systems. In addition, municipalities were able to borrow for capital expenditure at low interest rates from the provincially-backed OWRC and partial federal funding occurred through the Central Mortgage and Housing Corporation.

Over its 16-year lifespan, the OWRC helped build, finance and operate hundreds of water supply and sewage system in Ontario and became a world recognized centre for water research. The OWRC worked closely with consulting engineers to plan and design these systems, which contributed to an increase in the number and size of water-related engineering consulting firms in the Ontario. Well know engineering consulting firms such as Gore & Storrie, Proctor & Redfern, R.V. Anderson Associates Limited, Dillon Consulting, MMM Group, James F. MacLaren Associates, and J.L. Richards were created around this time.



In 1972, the OWRC was dissolved into the newly created Ministry of Environment (MOE). With a broad set of responsibilities the MOE was limited in its capacity to carry on with same level of water system research and development that characterized the OWRC. In addition, the OWRC was largely made up of sanitary engineers, who had very good working relationships with the water-related consulting engineering firms in the Province. With the dissolution of the OWRC, this engineering expertise and links to the engineering consulting sector diminished.

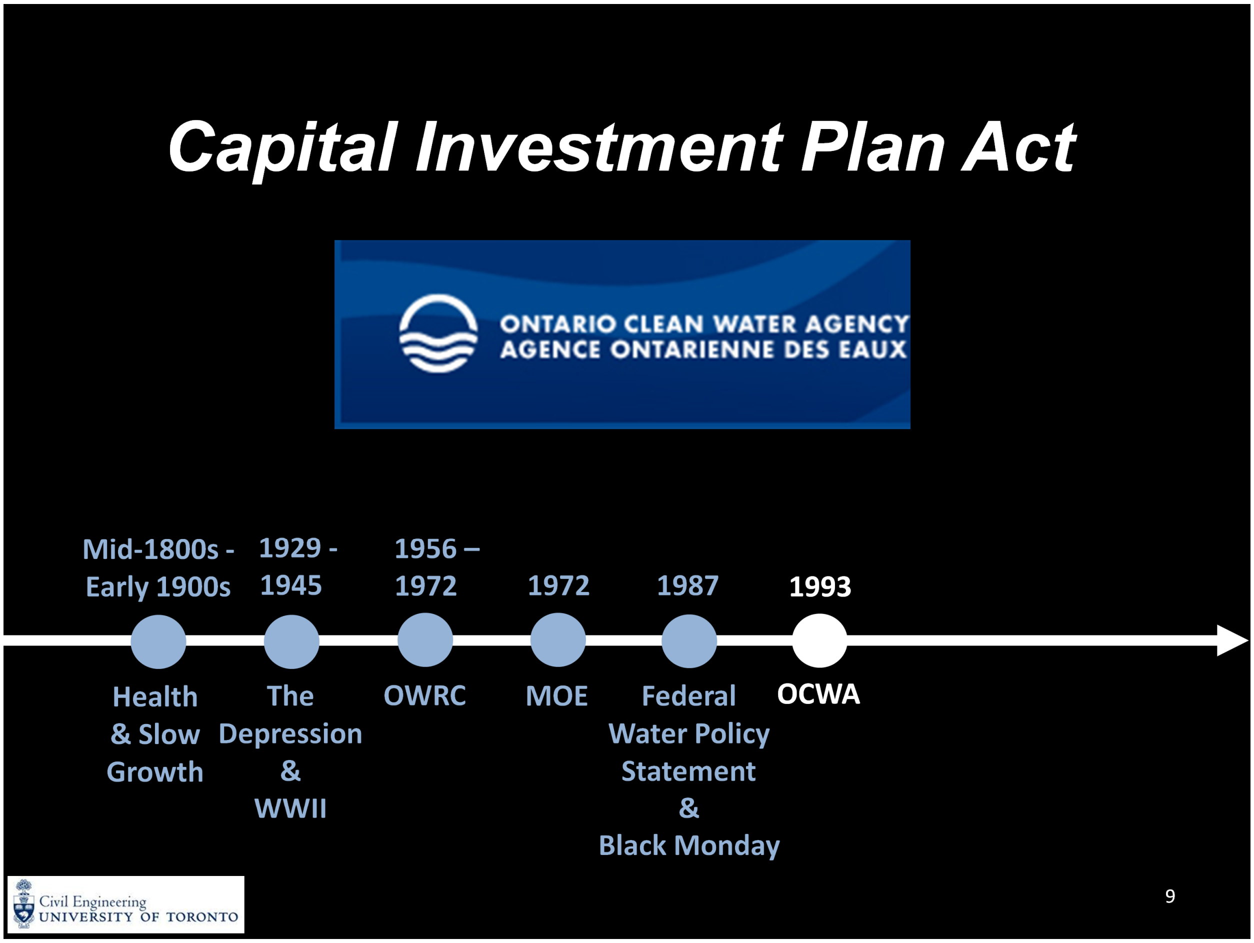
Although government responsibility for water-related planning was less pronounced, there was a simultaneous rise in concern for the environment by the media and the public. This concern, combined with continued water supply system development funding from the Central Mortgage and Housing Corporation, led to further system development. In addition, new advances in contaminant testing led to revised water quality standards in the US and to the development of water quality guidelines in Canada and water quality objectives in Ontario, thereby motivating innovations in treatment systems.



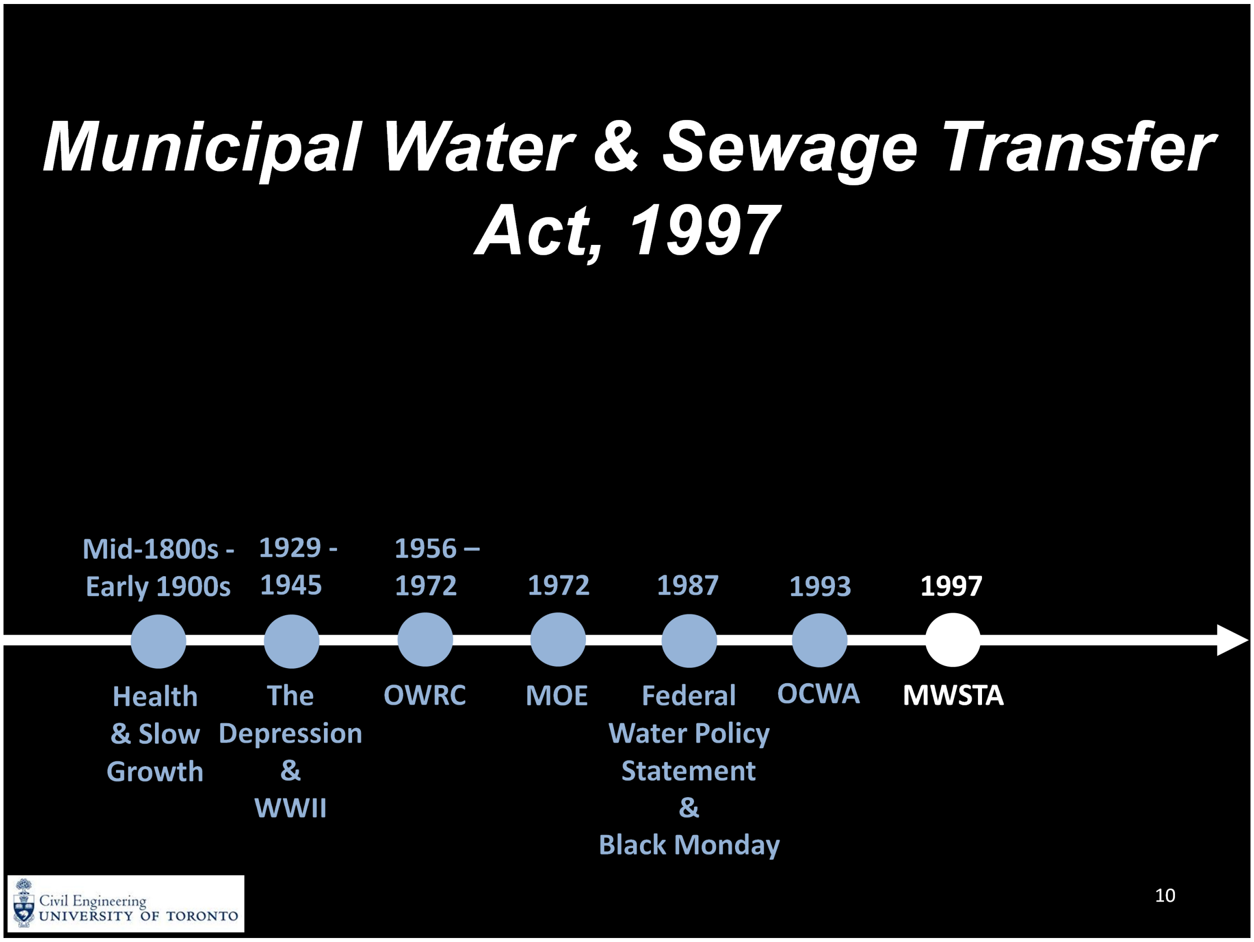
Concern for the environment and water quality continued to allow for system development and improvement, thereby allowing engineering consulting firms to benefit from a healthy project market. In the mid-1980s, there was an inquiry that led to a Federal Water Policy statement, which recognized that water is part of a healthy environment and economy. Five strategies were recommended: realistic pricing, scientific leadership, integrated planning, legislative renewal and public awareness. Some consider the 1987 Federal Water Policy statement to be the high point of Canadian federal interest in and action on meaningful federal water policy.

Unfortunately, the Federal Water Policy statement was closely followed by Black Monday, which eventually led to a recession in Canada. Focus quickly shifted from the environment to the economy, leading to less government spending on infrastructure. From 1990 to 1995, the Ontario consulting industry shrunk by 3,000 individuals (approximately 23% of the total) (Powell 1995). Engineering consulting firms adapted by expanding to foreign markets and offering additional services, such as management/risk/financial/human resources consulting and contracting (Angus 1995). With a decrease in demand for projects and an increase in supply of consulting firms, a buyer's market was created. These conditions, combined with tighter government budgets, led to the favouring of a price-based commodity market for engineering services, characterized by lower barriers to entry, increasing competition, declining prices and declining profit margins.

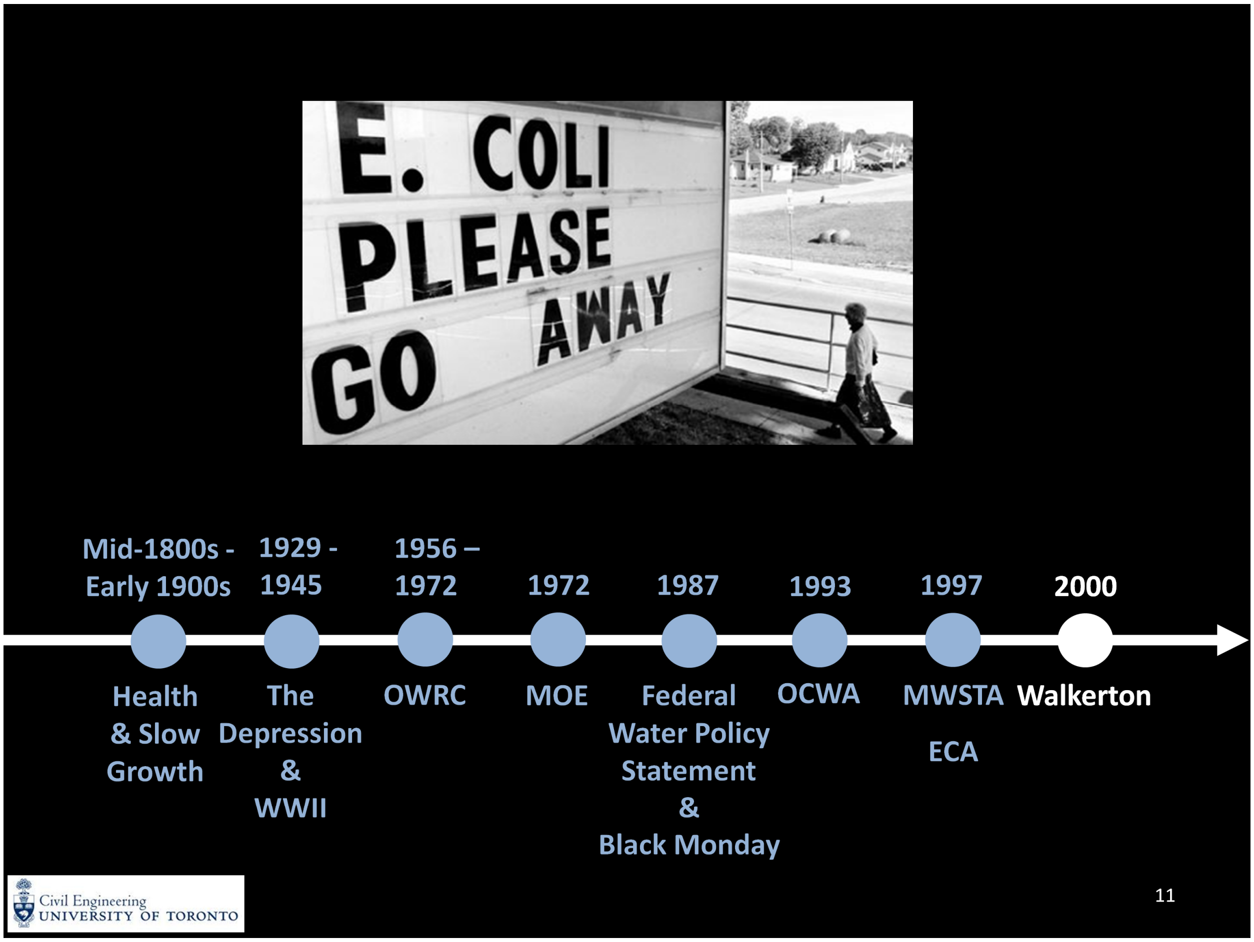
Photo credits (left to right): http://www.ec.gc.ca/eau-water/default.asp?lang=En&n=3DC41CC0-1; http://american-business.org/2354-black-monday.html



The MOE suffered from a conflict of interest; the Ministry was both a regulator of water systems and an owner/operator. This led to the *Capital Investment Plan Act* of 1993, which led to the creation of a crown corporation known as the Ontario Clean Water Agency (OCWA). The MOE continued to regulate water systems in the Province, while OCWA took on the responsibility of ownership and operation of those water supply systems from the MOE. Over time, OCWA became increasingly challenged by a declining operating budget and diminishing access to useful capital grants (Swain et al. 2005).



In 1997, the *Municipal Water and Sewage Transfer Act*, transferred ownership of the OCWA-owned systems to the municipalities. At the time of transfer, many of the systems were nearing the end of their useful lives and the Province contributed minimally to the encouragement of long-term planning and investment in maintenance, repair and rehabilitation (Swain et al. 2005). The $200,000,000 transitional fund set up by the Province was exhausted within a three-year period (OSWCA 2012). Although the ownership of the systems was transferred, municipalities were free to contract out operations to OCWA or other services providers. Today, OCWA provides various services to over 180 clients (OCWA 2012).



In 2000, there was a fatal outbreak of waterborne illness in Walkerton, Ontario. This outbreak resulted in an inquiry, which led to drinking water quality-related regulatory change in the Province. These regulations have placed an additional, but necessary, burden on municipalities. The following is a list of newer regulations and regulation amendments that affect municipal water provision:

Safe Drinking Water Act, 2002: Requirements for system approvals, water testing, and operator training and certification

Sustainable Water and Waste Water Systems Improvement and Maintenance Act, 2009: Requirement for full-cost recovery and full-cost accounting (not yet enacted)

Nutrient Management Act, 2002: New regulations for farm-related contamination

Places to Grow Act, 2005: Municipalities must submit growth plans that conform with the provincial growth plan. These plans must incorporate infrastructure needs for growth and environmental and economic sustainability.

Environmental Protection Act: The Provincial regulator can inspect systems and take system samples if required

Water Opportunities & Water Conservation Act, 2010: Created the Water Technology Acceleration Project (WaterTAP), which supports research, development, commercialization, new technologies and innovation in Ontario's water sector.
Public Sector Accounting Board: As of 2009, the Public Sector Accounting Board has required governments to present information about the complete stock of their tangible assets and amortization in the summary financial statements.

OUTCOMES

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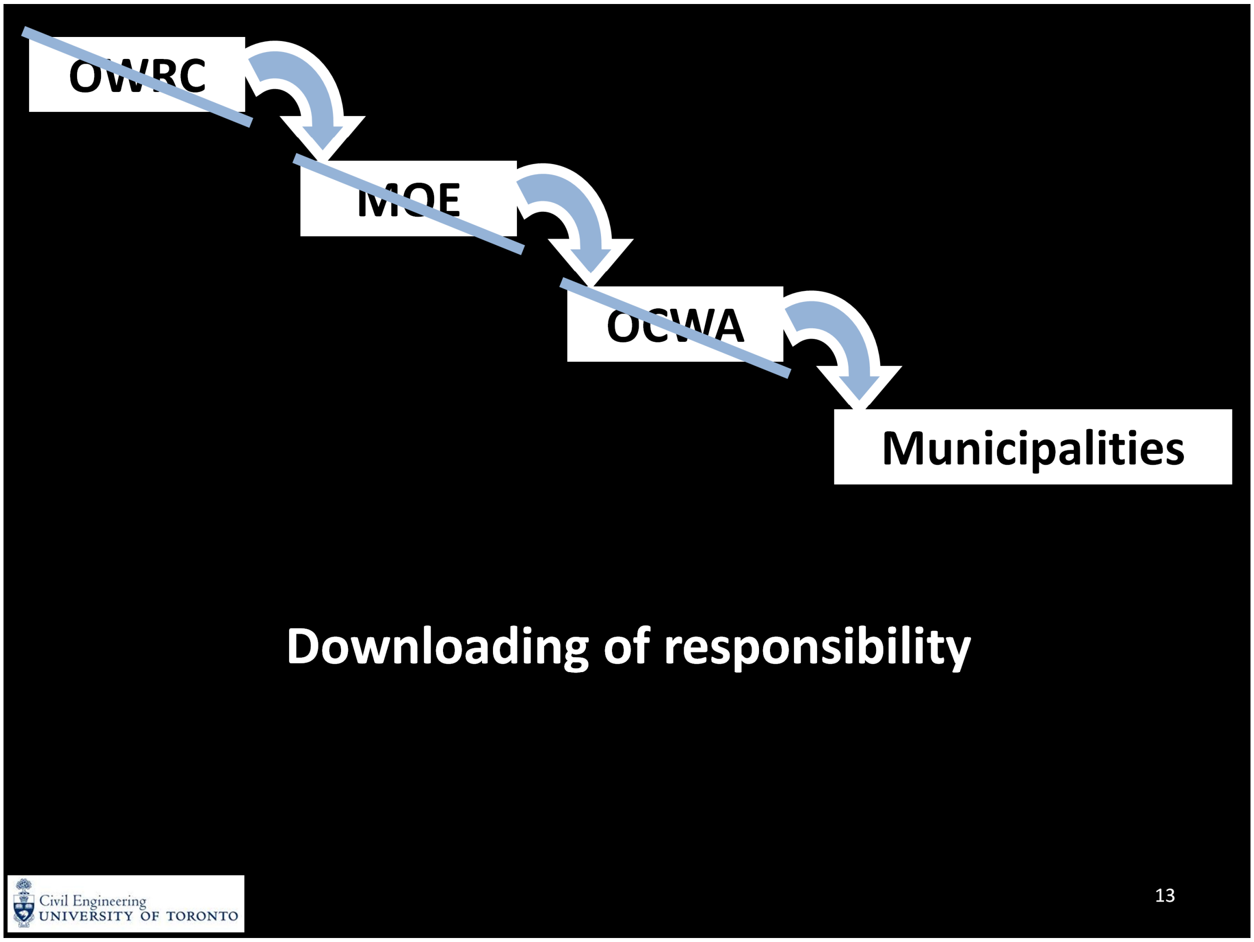
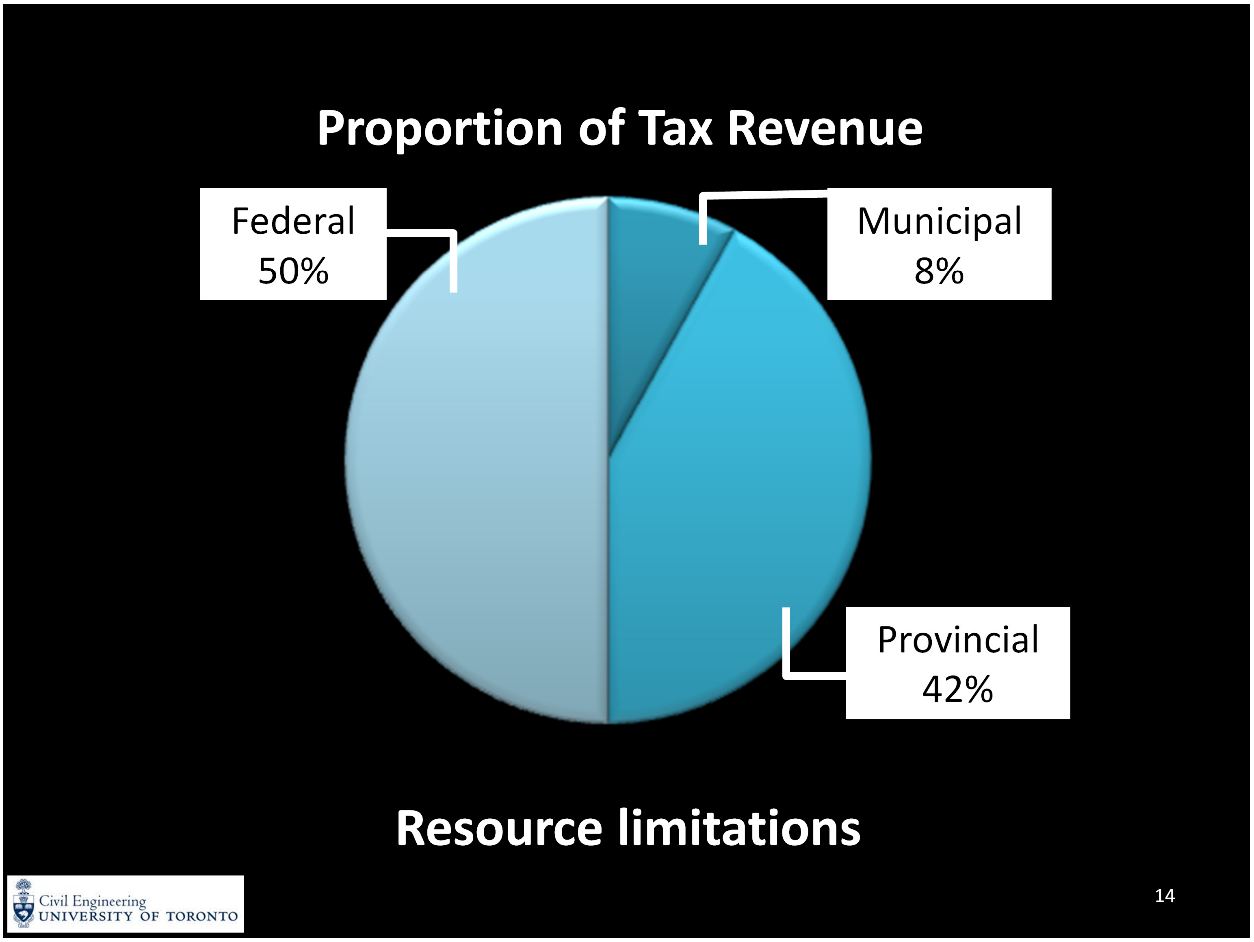
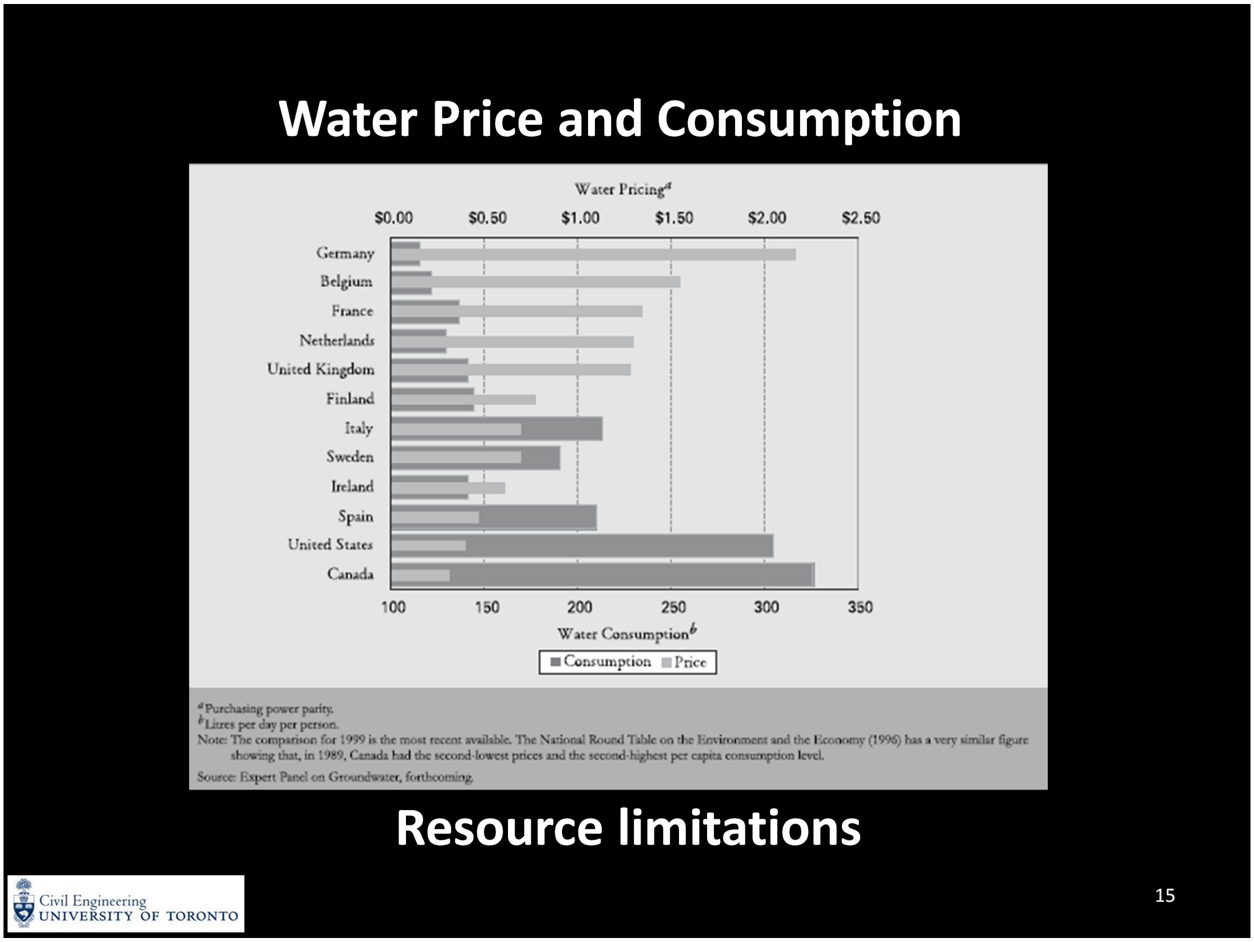


From the historical account above, it is evident that there has been a transfer (often referred to as downloading) of water provision responsibility from higher levels of government to municipalities over the years.



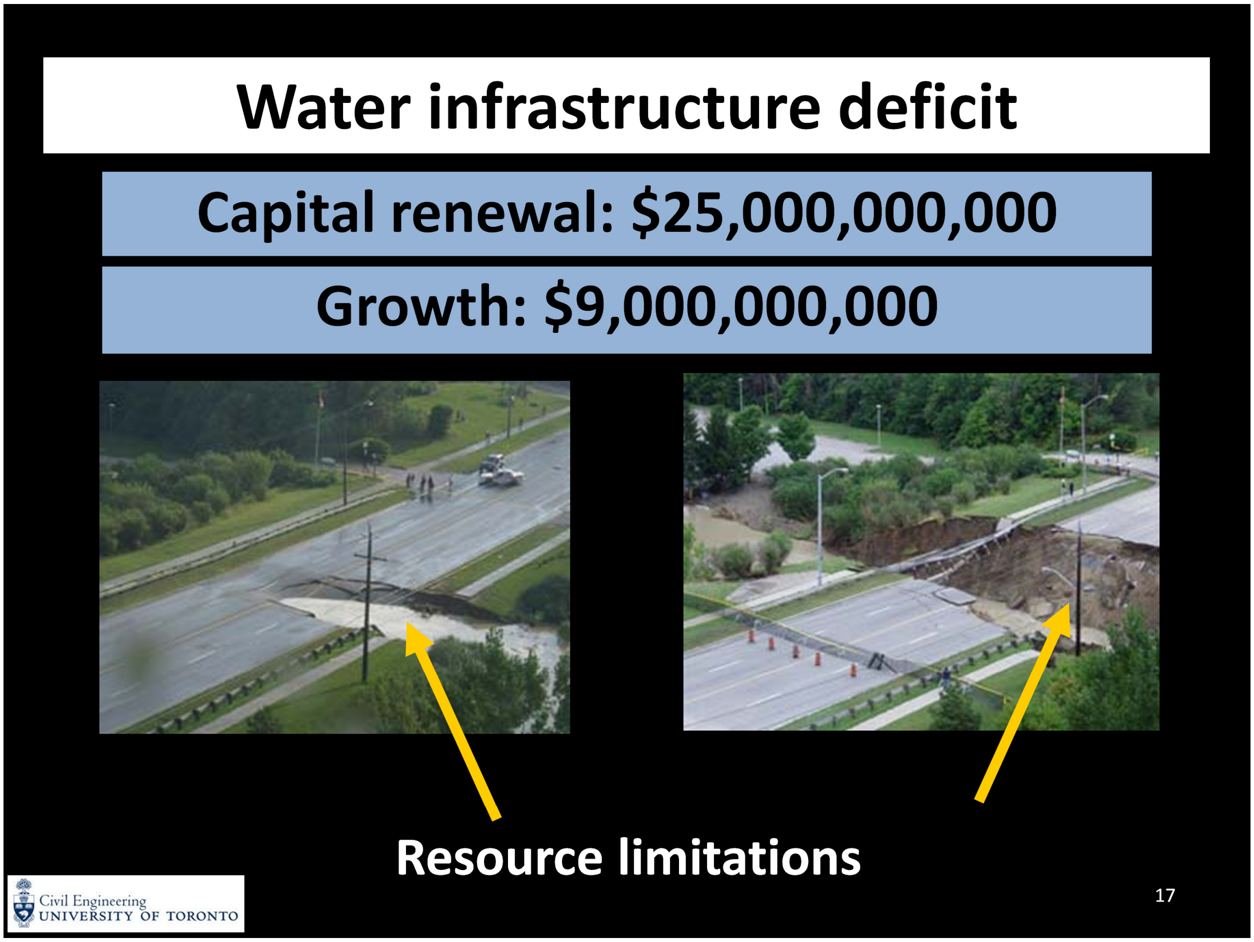
This downloading has come with few resources to take on the required responsibility. Municipalities generally pay for water infrastructure with user fees and/or property taxes. Property taxes are politically difficult to raise and are relatively inflexible when compared with other forms of taxation at higher levels of government. Municipalities receive 8% of tax revenue, while the provincial and federal governments receive approximately 42% and 50% of tax revenue in Canada (Mirza 2007).



In Canada, user fees also limit water infrastructure-related revenue because user fees are predominantly low. The above graph (Renzetti 2009), shows that the average price of water in Canada is much lower than in other countries, while consumption is much higher. The low prices have led to overconsumption, which requires larger systems and greater pumping energy expenditure over time. Renzetti (2009) argues that if prices were set according to the marginal cost of water provision, users would use water more efficiently and effectively.

Since this graph was created, water prices in many Canadian municipalities have been increasing, but are still considered to be lower than other comparable countries.

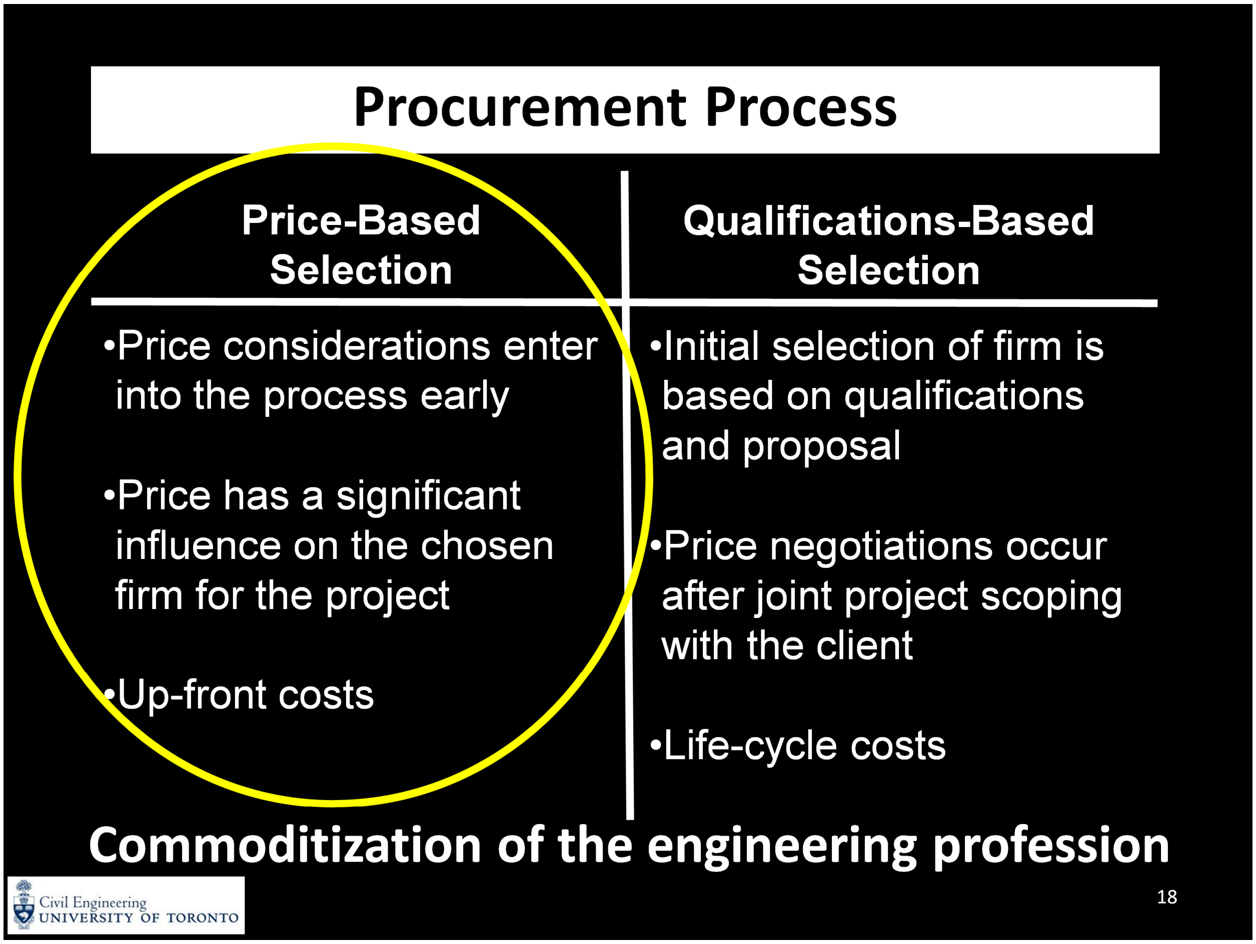
Federal and provincial grants and programs related to water infrastructure have been helpful, but some argue that their existence has led to deferred maintenance, system overbuilding, and pricing distortions (Swain et al. 2005). In addition, these grants and programs have been declining over the years, forcing municipalities to become less dependent on this source.



In Ontario, the drinking water and sewage infrastructure deficit is estimated to be $34 billion, with $25 billion required for capital renewal ($11 billion of this in deferred maintenance) and $9 billion required to expand systems to accommodate ongoing growth (Swain et al. 2005). If system needs are not addressed, systems will deteriorate, resulting in more serious failures more often and serious economic, health and environmental consequences.

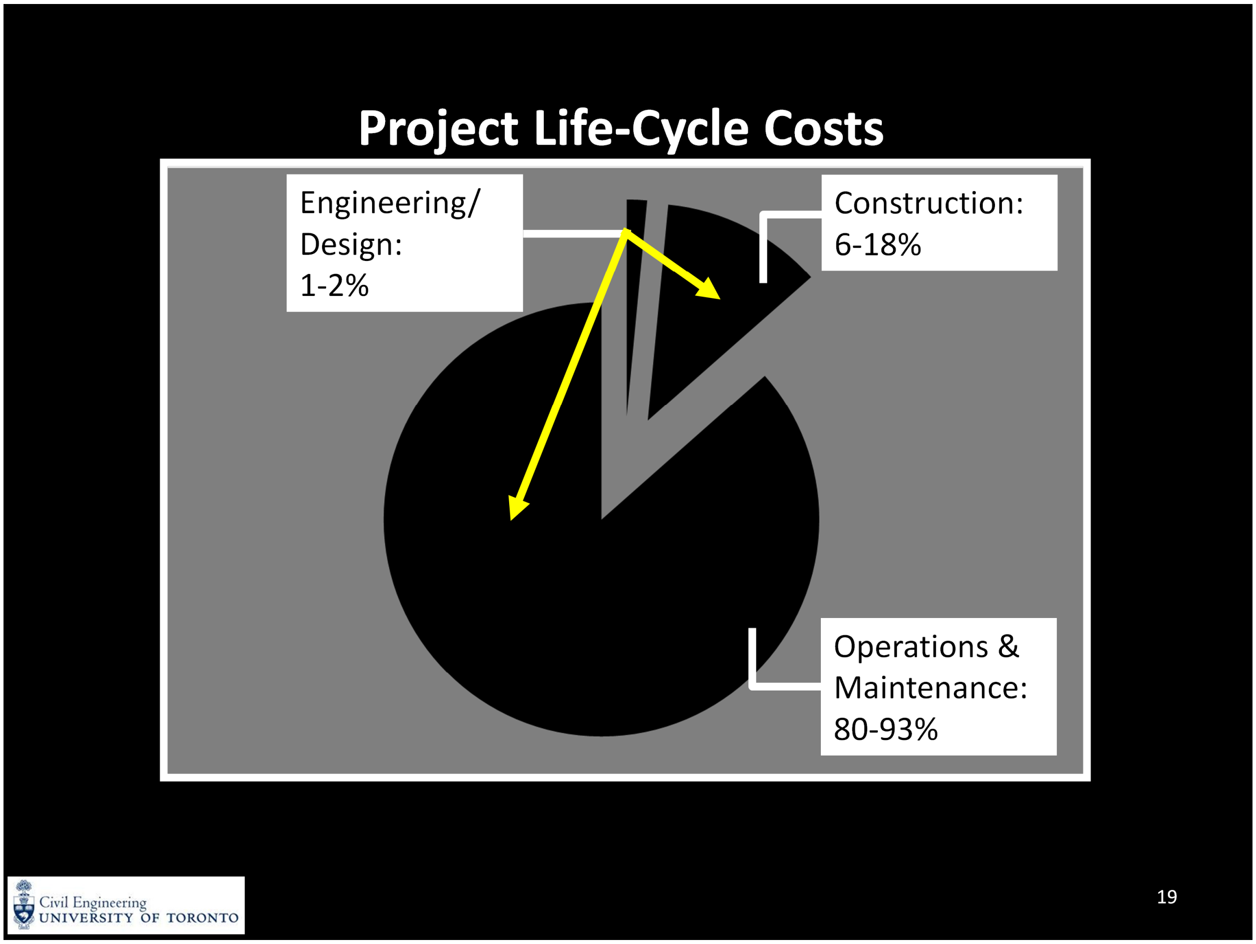
The photos above provide an account of an event on Finch Avenue in 2005 in which the stormwater infrastructure carrying creek water below the road was washed out during an abnormally heavy rainstorm.

Photo credit (both): http://jane-finch.com/pictures/flood2005.htm

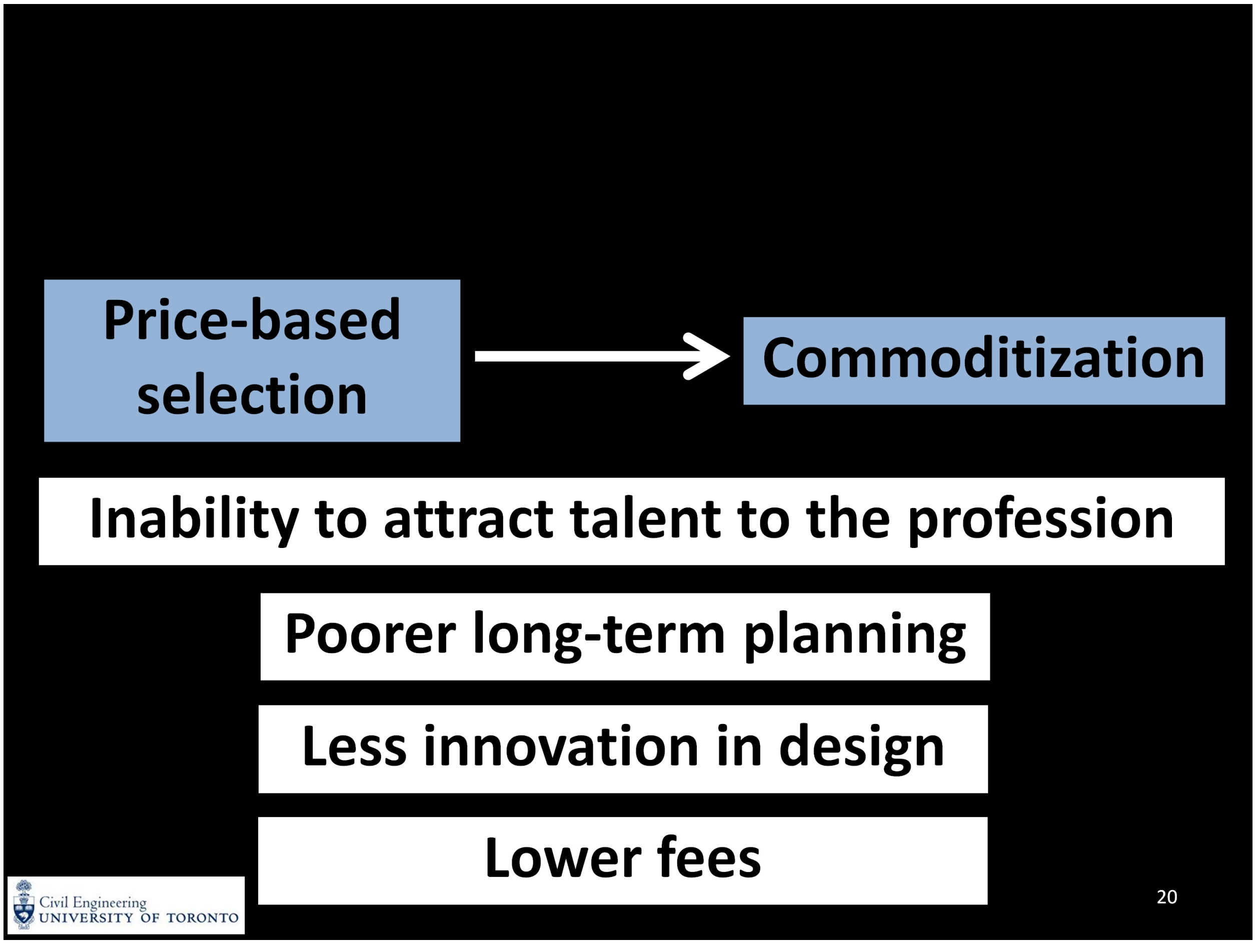


The history of water in the province has also affected engineering practice. Tighter provincial and municipal budgets over the years have led to a practice of price-based selection (PBS) in the procurement of public infrastructure projects, which is often referred to as low-cost bidding. With PBS, price considerations enter in the engineering consulting firm selection process early for a given project. Price has a significant influence on the chosen firm for the project and these prices typically only include up-front costs and not full life-cycle costs. Alternatively, qualifications-based selection (QBS) requires that the initial selection of the firm be based on the firm's qualification and project proposal. In QBS, price negations occur after joint project scoping with the client and life-cycle costs are considered in this process (Infraguide2006).

Applying PBS to the selection of engineering consulting firms for water infrastructure projects leads to commoditization of the engineering consulting profession. Commoditization is a process wherein a market based mainly on the matching of the unique skills of a given firm with a given project transitions into a commodity/price-based market, where firms are chosen mainly on their ability to provide the lowest price for a given project.

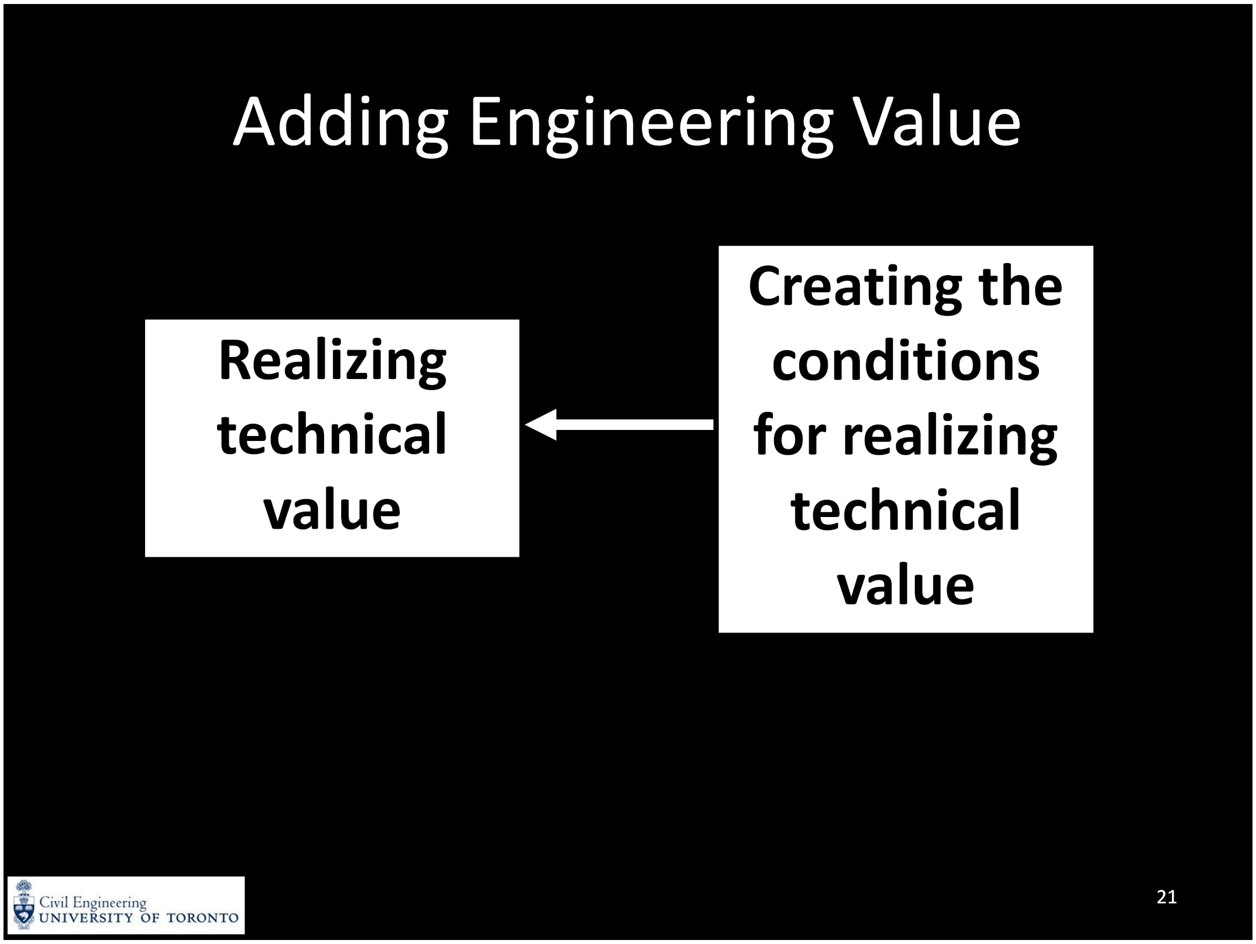


PBS is a short-term-thinking way of approaching infrastructure projects because this selection process does not explicitly consider the life-cycle costs of a project (e.g., pumping energy costs, treatment chemical costs). As shown in the pie chart above (Infraguide 2006), when life-cycle costs of Canadian and US infrastructure projects are considered, the engineering and design costs are quite low (1-2%), but engineering design affects construction costs and operations and maintenance costs, which account for a majority of the total life-cycle costs of a project. By investing more up-front in engineering expertise, more value can be realized from the project over its lifetime. Such value allows municipalities to do much more with less over a longer period of time with relatively little up-front engineering consulting investment.

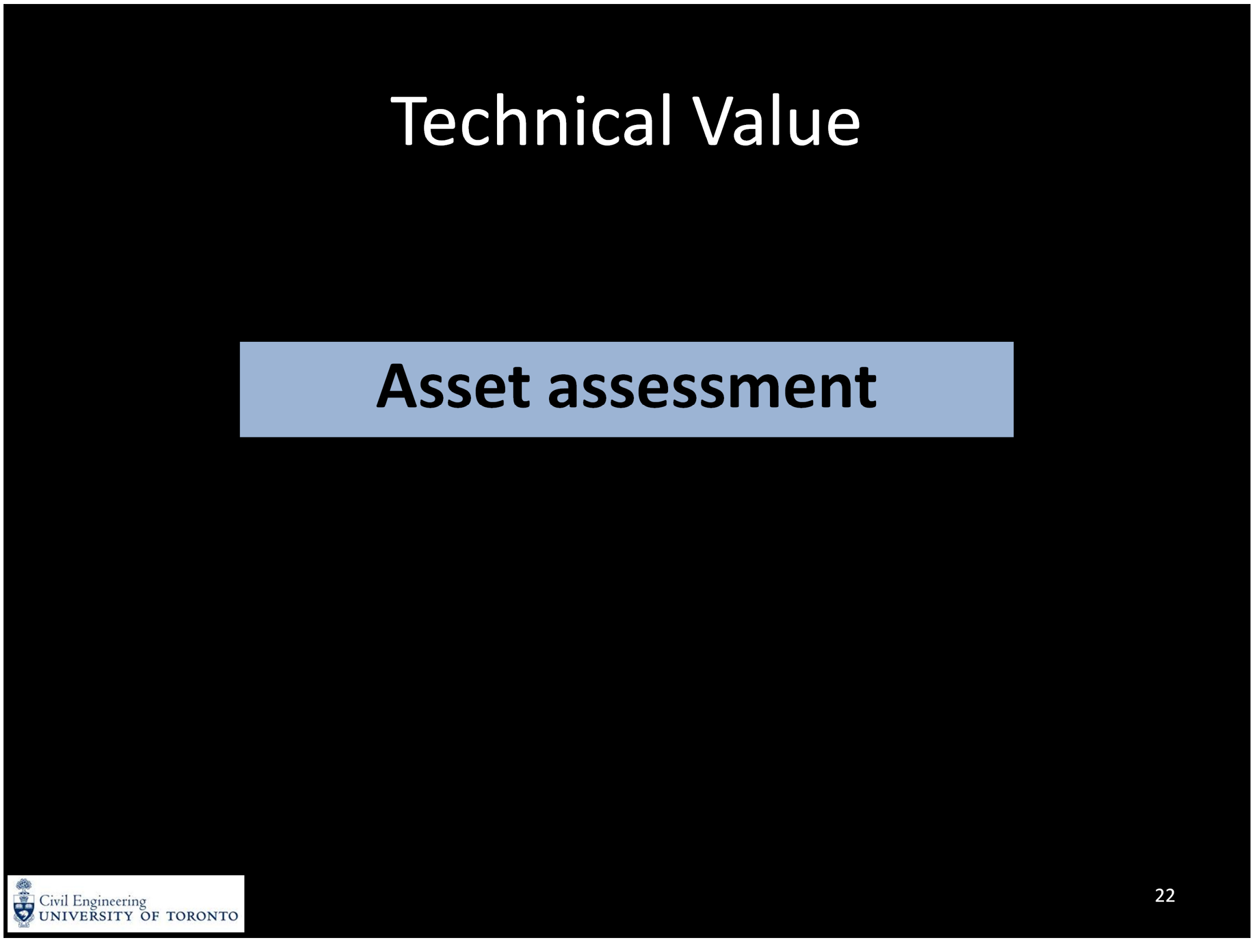


If PBS dominates the selection of engineering consulting firms for municipal water projects in the province, the engineering consulting market may become increasingly commoditized. With commoditization (Capelin 2005):

- Projects may exhibit poorer long-term planning due to the lack of long-term life-cycle costing.
- There may be less innovation in design because the need to provide the lowest cost can limit time spent on a project, thus limiting creative output.
- Fees tend to be lower because the need to provide the lowest cost to win a project may lead to unrealistically low bids, requiring cost-cutting on the part of firms.
- It may eventually be difficult to attract talent to the profession due to lower salaries and a diminishing ability to contribute to innovation in design.

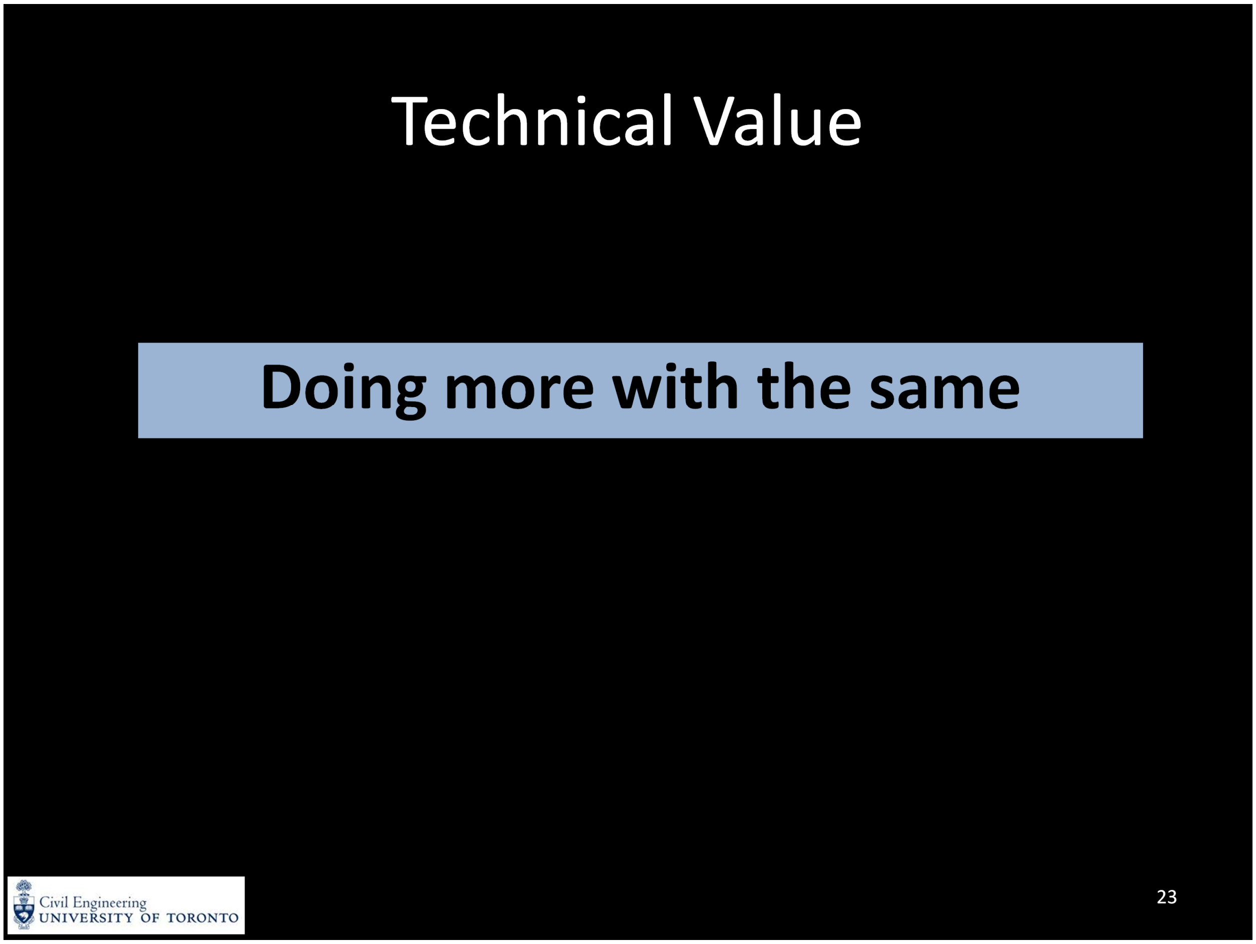


In order to add engineering value to water infrastructure projects, the conditions for realizing technical value must be created. The next few slides provide a discussion of how technical value can be realized, followed by a discussion about how to create the conditions for realizing this value.

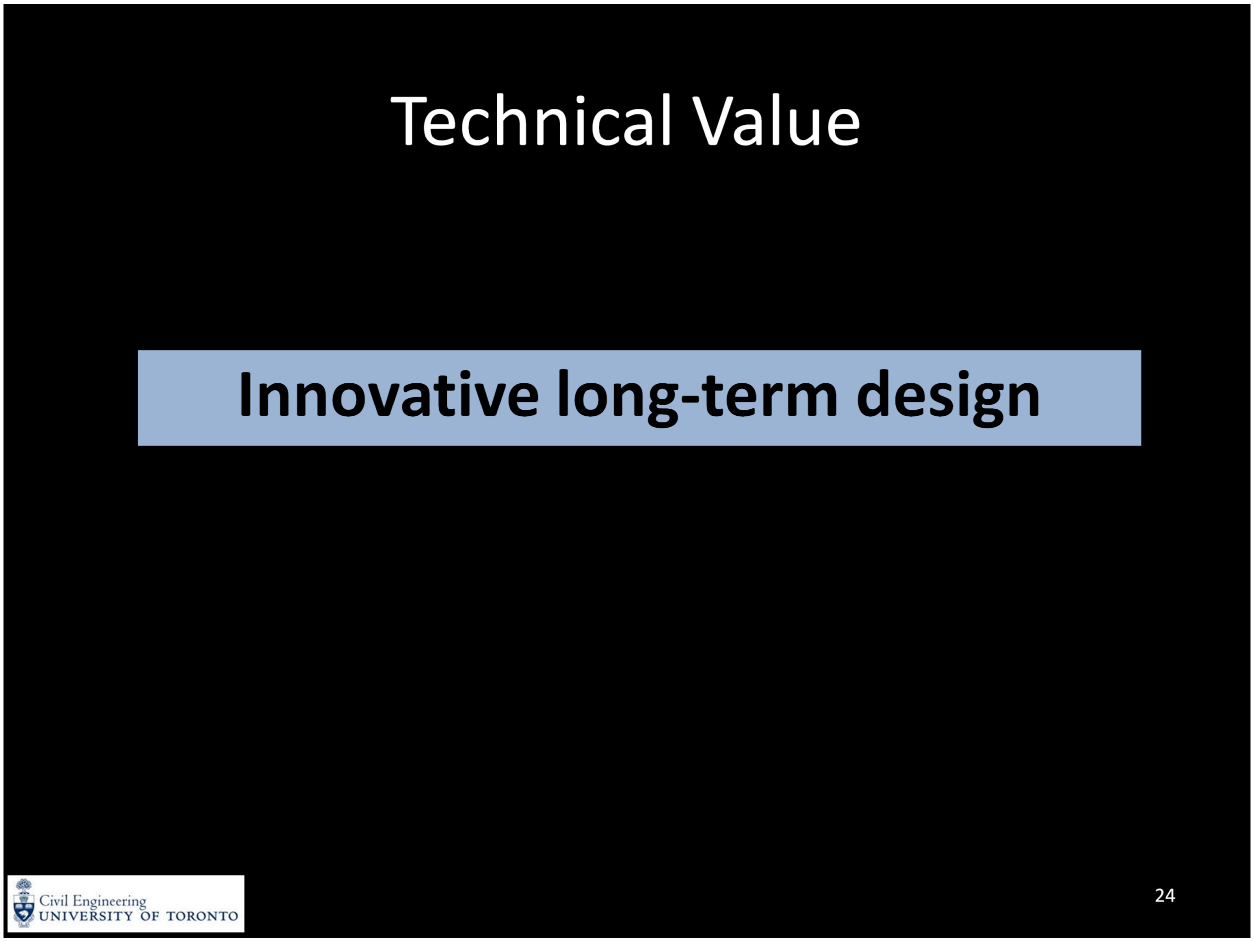


Many utilities do not know what is in the ground and if they do know what is in the ground, they may not know its condition. In 2009, the Public Sector Accounting Board required local governments to present information about the complete stock of their tangible assets and amortization in their summary financial statements.

Engineers are developing asset assessment tools, such as new technologies for and approaches to assessing underground assets, developing mapping software that can help plan asset renewal over time, and developing new asset assessment tools that are better matched to the needs of a particular municipality.



Some engineering firms are offering services that create solutions that allow systems to last longer than expected. In North America, the average system loses approximately 20% of its distributed water to leakage. This water is treated and pumped, but is not paid for directly by any specific user. New approaches to system operation, such as pressure management, and new leak detection technologies are helping utilities lose less water, thus leaving more room in the system for new users and diminishing the amount of non-revenue water in the system. In addition, conservation approaches are helping providers create even more room in their systems for new users, thereby delaying, diminishing or eliminating the need for capital investment.



When the need for capital expenditure arises, engineering consultants can provide new innovations that add long-term value to a given system.

System Conditions

Going beyond the technical system

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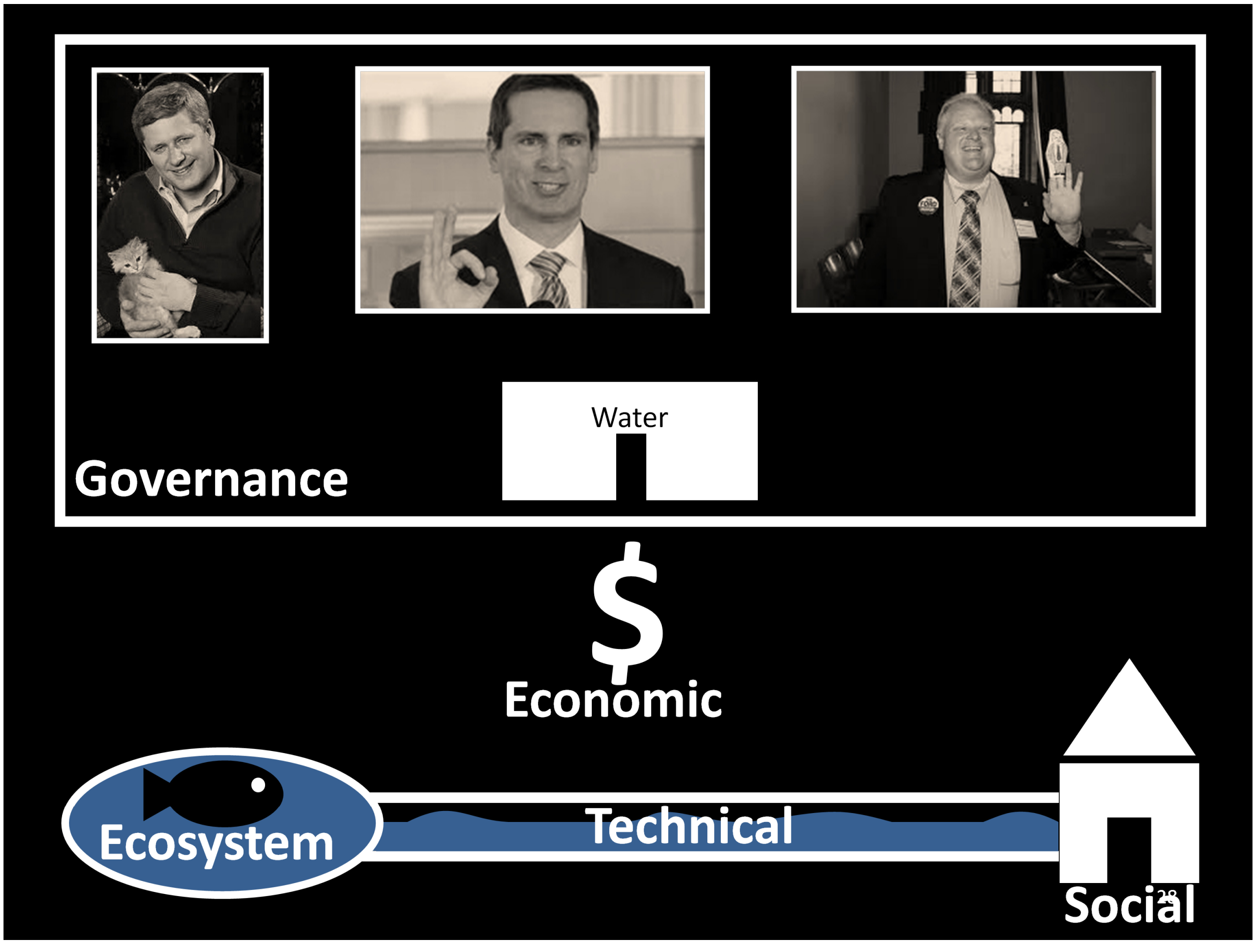
Engineers, and their municipal partners, have the potential to realize the technical value of given system, but they are somewhat constrained by the system in which they exist.



The Southern Ontario water sector can be thought of as a system, consisting of the following dimensions:

- Ecosystem
- Technical
- Social
- Governance
- Economic

Although mentioned separately and shown simply above, these dimensions interact in a complex manner at multiple space, hierarchical, and time scales. In short, the whole is greater than the sum of its parts.

Engineers must navigate through the uncertainty and complexity of this system to create design solutions and a professional engineering approach that considers the context of this particular sector and adds value to individual systems and to the sector as a whole.

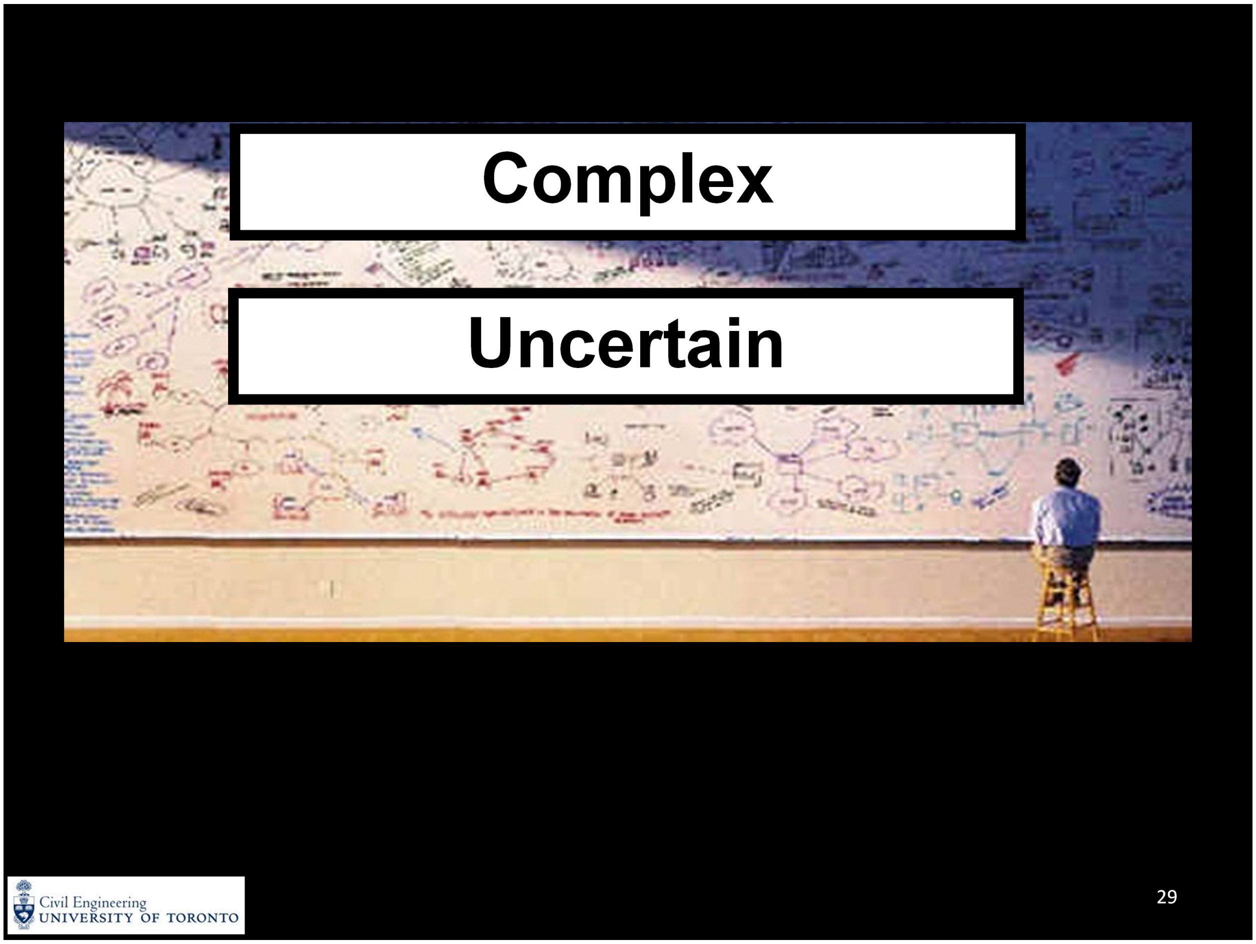


Photo credit: http://designandtransformation.org/?p=5

System Conditions

Which system conditions would allow engineers to bring more value to the system as a whole?

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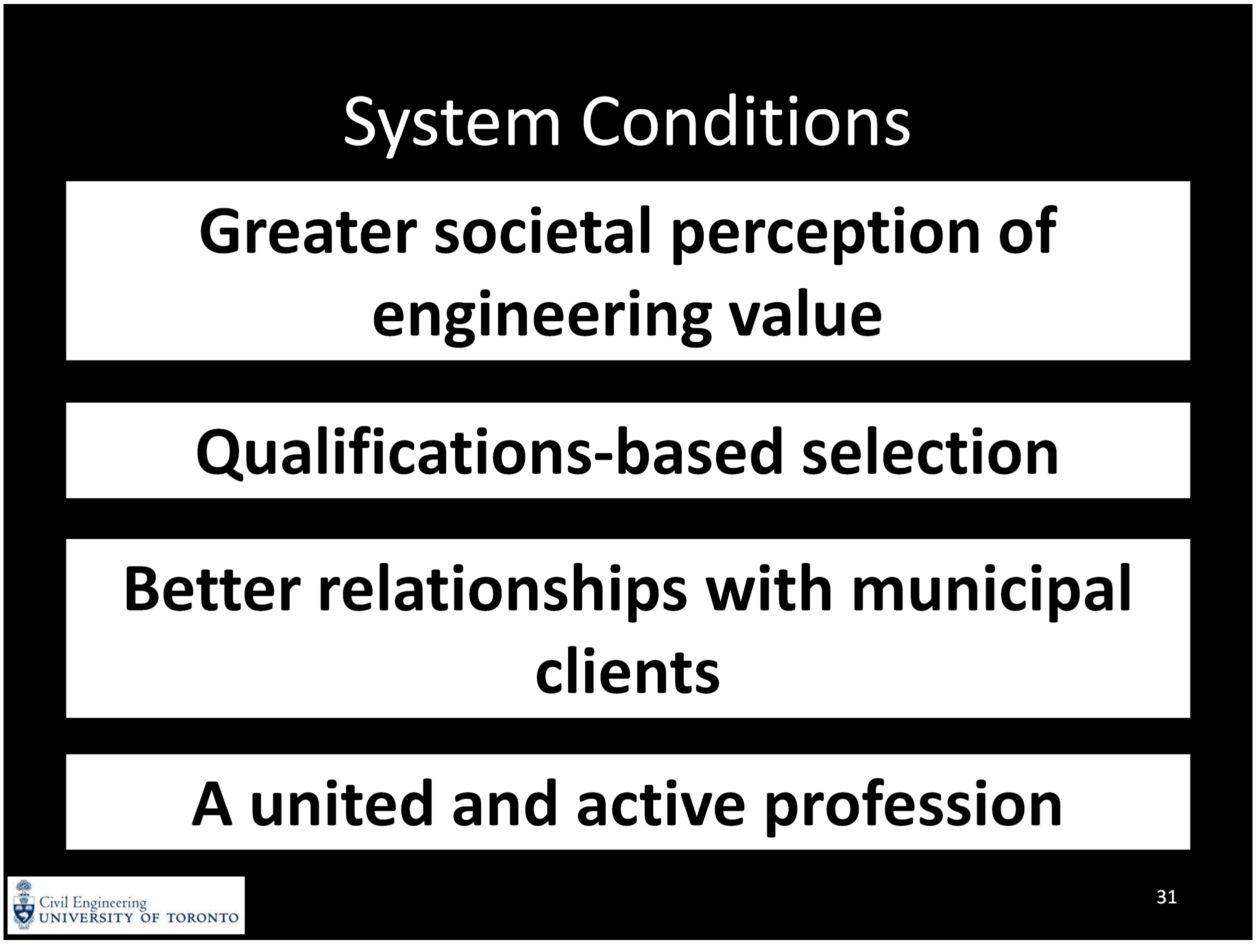
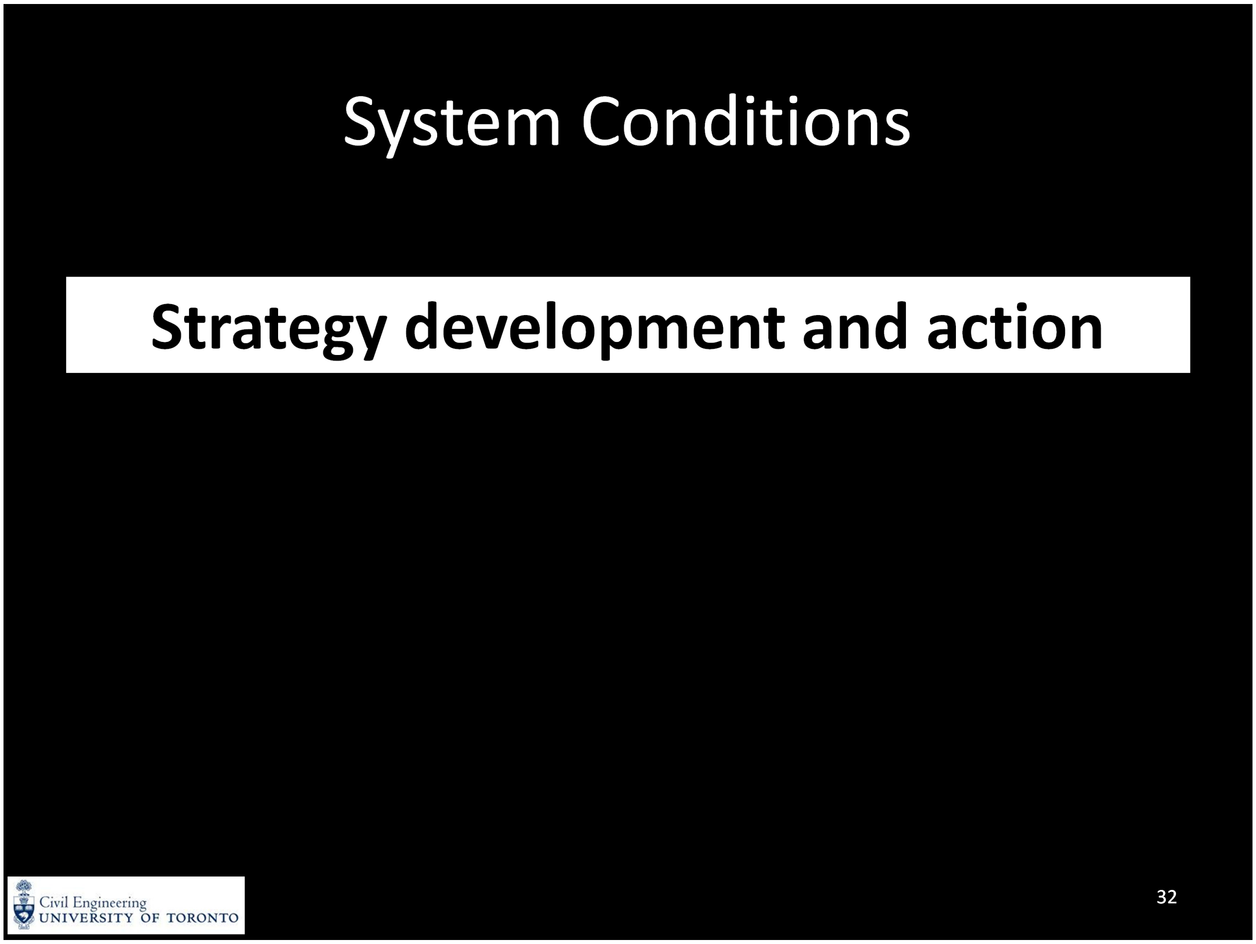


Greater societal perception of engineering value: People constantly interact with lawyers, accountants and doctors, but not everyone will have direct contact with an engineer in his/her lifetime. We do, however, depend on engineering design on a daily basis when we turn on the tap, drive on a road, and turn on a lamp. This value is under-recognized and should be conveyed to the public constantly to allow for an appreciation of much of the engineering value that we tend to take for granted.

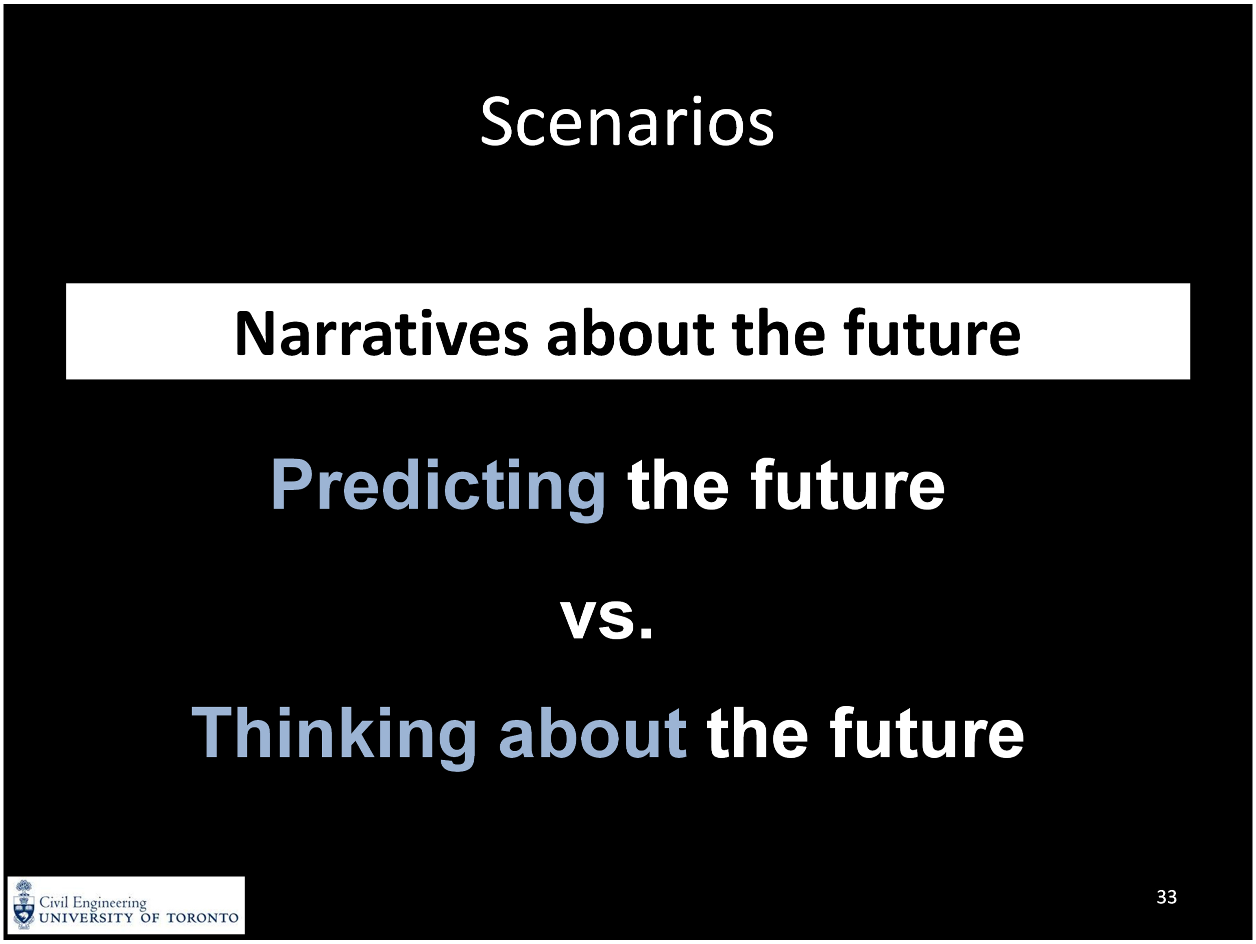
Qualifications-based selection: If engineering value is to be recognized and realized, QBS should be a priority in public sector procurement of engineering services.

Better relationships with municipal clients: When undertaking a project, engineers form partnerships with their municipal clients. At times, this relationship can be less amicable than required, which does not allow for the full realization of the potential of an engineering consulting firm to add maximum value to a given project. Both parties need to collectively find better ways to work together to create a lasting trust that will allow for communication conducive for providing the correct service for the project.

A united and active profession: The above recommendations cannot be realized without a united engineering front. Engineers must come together to advocate for QBS, create a unified vision for the profession in the Province and act to realize this vision collectively. In addition, engineers should participate in their communities more often to expose as many people as possible to engineers and the value that engineers can bring to the table.



Part of creating these conditions for the water sector requires some sort of common strategy, which must be developed and acted upon.



One approach to strategy development is to try to envision a collective future that the water sector would like to work toward and to recognize the challenges in achieving that future. This can be accomplished through the development of scenarios, which are story-like narratives created by sector stakeholders that explain the future in terms that are accessible to all stakeholders. Scenarios do not predict the future; instead, they provide a means of thinking about the future, which can lead to more meaningful and valuable collective action in the present. Scenarios allow stakeholders to work through complexity by better understanding how collectively directed individual action might translate through to more predictable or manageable whole system outcomes.

For more information on how scenarios in the Southern Ontario water sector are being explored, please visit: www.thewaterworkshop.ca

Summary

Complex history of the sector

Outcomes

Realizing engineering value

Creating conditions to realize engineering value

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