Summary of MIIP and related research in asset management at NRC

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Conseil national de recherches Canada

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NRC·CNRC
Institute for Research in Construction

National Asset Management Working Group

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Summary

- Overview of MIIP Project
  - Scope
  - Definition of Asset Management
  - Partners
- Deliverables
  - Client Reports on the Web (GIS, Case Studies, etc.)
  - Open Forum on Research in Asset Management in Canada
  - Municipal Infrastructure Management Framework
  - Software Prototype (DSS)
  - Phase II of MIIP
- New NRC Initiatives
  - Built Environment – Science Insight (BeSI 2006)
  - NSERC Proposal
  - Centre for Sustainable Infrastructure Research (CSIR Regina)

Overview of MIIP Project

- Scope
  - Municipal Infrastructure Investment Planning
  - 3 Year project started in June 2002
  - To finish in Mar 2006
  - Approximately $ 1.5 million (in-cash, in-kind)
  - Consortium: NRC and 10 Collaborators
- Objective
  - MIIP will develop and formalize a Generalized Framework for information and knowledge related to strategic asset management of municipal infrastructure
- Concentrating on:
  - Buried Utilities (Sewers)
  - Geographic Information Systems (GIS)
  - Decision Support Systems
  - Maintenance and Renewal Optimization

Overview of MIIP Project

- Definition of Asset Management (MIIP)
  - Asset management is a business process and decision-support framework that:
    (1) covers the extended service life of an asset,
    (2) draws from engineering as well as economics, and
    (3) considers a diverse range of assets

MIIP Partners

Municipal Infrastructure Investment Planning Project (MIIP)

http://irc.nrc-cnrc.gc.ca/ui/bu/miip_e.html

Deliverables

- Client Reports on the Web (www.nrc.ca/irc/uir/miip)
  - Survey on Municipal Infrastructure Assets (B5123.2)
  - Primer on Municipal Infrastructure Asset Management (B5123.3)
  - Geographic Information Systems (GIS) and Interoperability of Software for Municipal Infrastructure Applications (B5123.4)
  - Case Studies on Municipal Infrastructure Investment Planning (B5123.5)
  - Evaluation of Condition Assessment Protocols for Sewer Management (B5123.6)
  - Social Cost Considerations for Municipal Infrastructure Management (B5123.8)
  - Open Forum on Opportunities for Research in Asset Management in Canada, (B-5123.12)

Deliverables

- Software Review
  - Municipal infrastructure asset management systems: state-of-the-art review (irc.nrc-cnrc.gc.ca/fulltext/nrcc48339)
    - Mahmoud Halfawy, Linda Newton, Dana Vanier
  - Reviews the following:
    - Synergen
    - Hansen
    - Infrastructure2000
    - Municipal Infrastructure Management Systems (MIMS)
    - CityWorks
    - RIVA
    - Harfan
  - Conclusions
    - Well-known applications
    - COTS (off-the-shelf)
    - GIS focus
    - Focus on collaborators' interests
    - Need for industry standards for interoperability
  - To be expanded to a MIIP Client Report

Deliverables

- The State of Canadian Sewers – An Analysis of Asset Inventory and Condition (Nov 05)
  - B-5123.11
  - Sewer asset data from partners
    - Edmonton, Hamilton, Prince George, Ottawa, Regina, Durham, Halton and Niagara
  - Three non-MIIP municipalities
    - Saskatoon, Niagara Falls and the Greater Vancouver Regional District (GVRD)
  - Data for over 11,200 km of sewer pipes
    - 9,000 km of sanitary sewer pipes (inventory data)
    - Condition data for 3,400 km of sanitary pipes were available and used to model pipe performance

Deliverables

- The State of Canadian Sewers – An Analysis of Asset Inventory and Condition (Nov 05)
  - Pipe number or unique identifier
  - Pipe class (combined, sanitary, storm)
  - Construction year
  - Diameter
  - Material
  - Inspection date
  - Survey length
  - Peak defect score
  - Pipe grade

Pipe Diameter Group	Code
< 250 mm	250
251 – 450 mm	450
451 – 600 mm	600
601 – 900 mm	900
> 900 mm	> 900

Deliverables

- The State of Canadian Sewers – An Analysis of Asset Inventory and Condition (Nov 05)

Source	Material	Pipe Diameter (mm)	Service Life (years)
International Infrastructure Maintenance Manual (2000)	All		80 – 100
WRc (1994)	Non-plastic	<225	80
		300-1000	100
		>1000	125
	PVC/new materials	all	40
City of Victoria (2005), USACE (1984)	Asbestos cement	all	50-100
NAASCO (2004)	Vitrified clay (VC) or reinforced concrete with PVC liner	100 - 6705	75
	Plastic	100-380	50
Missouri Highway & Transportation Department MR91-1 (ACPA, 1991)	Corrugated steel pipe (CSP)	all	15 - 60
National Clay Pipe Institute (2004)	VC	all	100

Deliverables

- The State of Canadian Sewers – An Analysis of Asset Inventory and Condition (Nov 05)

Table 14. Predicted average service life of Canadian sanitary sewers.

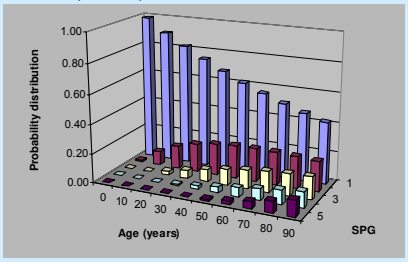
Material	Predicted Service Life (years)	Predicted Service Life (years) Approx. Confidence Interval 10%
All materials	115	105 – 130
Asbestos cement (AC)	138	125 – 155
Concrete (CO)	114	105 – 130
PVC	75	70 – 85
Vitrified clay (VC)	136	120 – 150

Deliverables

- The State of Canadian Sewers – An Analysis of Asset Inventory and Condition (Nov 05)
  - One of most comprehensive sewer inventory and assessment surveys
  - Peak decade of growth for Canadian sewers was 1970
  - Small diameter pipes (≤ 600 mm) comprised 91% of all pipes
  - Most pipes were Vitrified Clay
  - PVC has become the material of choice for newer pipes
  - Concrete was the most used material for larger diameter pipes
  - Joint defects were most prevalent in PVC and VC pipes
  - Regression analysis used to predict sanitary sewer pipe service life (105 to 130 years)
  - Markov transition matrices were developed for small diameter pipes (any material) as well as matrices for AC, CO and VC pipes
  - Not enough data to develop matrices for PVC pipes

Deliverables

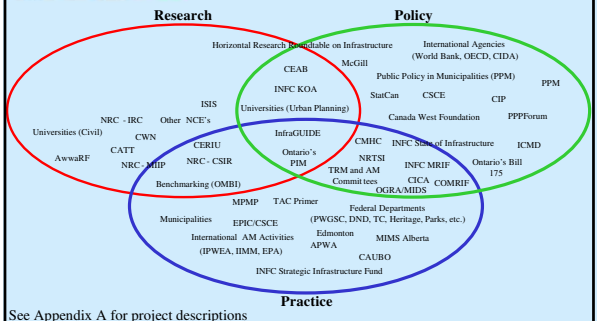
- The State of Canadian Sewers – An Analysis of Asset Inventory and Condition (Nov 05)



Deliverables

- Open Forum on Opportunities for Research in Asset Management in Canada
  - In conjunction with MIIP semi-annual meeting
- Attended by 34 individuals
- 19 different organizations representing primarily consultants, municipalities, universities and federal departments
- Objectives
  - Present an overview of the deliverables of the MIIP project;
  - Outline current activities in other AM areas in Canada, and
  - Elicit suggestions from the group regarding future research directions for:
    - subsequent phases of MIIP project, and
    - collaborative AM research

Open forum on AM Research - Opportunities



See Appendix A for project descriptions
irc.nrc-cnrc.gc.ca/fulltext/b5123.12

Open Forum

- Breakout groups identified similar priorities (loose ranking)
  (1) Communication of technical information to stakeholders;
  (2) Research and knowledge acquisition;
  (3) Education;
  (4) Sustainability, and
  (5) National infrastructure strategy

Open Forum

Communication of Technical Information to Stakeholders

- infrastructure literacy,
- public awareness, and
- professional awareness

- "Infrastructure literacy" used to describe importance of civil infrastructure systems to economy:
  - general state, condition and performance, cost to repair and replace
- Awareness of asset management (i.e. tools, techniques, advantages, success stories, best practices, costs, software, etc.) was shortcoming
- Opportunities include: federally sponsored workshops on asset management; continued activities by Technology Road Map (TRM) and associated roundtables, and a central clearinghouse for AM
- Stakeholders are InfraGuide, Federation of Canadian Municipalities (FCM), Infrastructure Canada, CSCE, RAIC, CPWA/APWA Canadian Chapters, etc.

Open Forum

Research and Knowledge Acquisition

- A distinction made between research and knowledge acquisition:
  - Research being the process of creating new knowledge
  - Knowledge acquisition is discovery of existing knowledge
- Two general gaps:
  - Economic analysis gaps included:
    - Determination of the life cycle costs of assets;
    - Evaluation and validation of the 2-4% general "rule of thumb";
    - Studies on the social benefits and costs of infrastructure, and
    - Equitable prioritization and funding between engineering disciplines
  - Technical analysis gaps included:
    - Lack of defined levels of asset service;
    - little data on remaining service life;
    - few standardized asset assessment and rating methods, and
    - dearth of tools to perform integrated asset management

Open Forum

Research and Knowledge Acquisition

- Opportunities include:
  - Economic benefit/cost analysis research identifying life cycle and social costs of infrastructure intervention;
  - Development and acceptance of standardized and defined levels of service (municipal benchmarking initiative, rider comfort index);
  - Research and development of standardized condition assessment protocols for municipal infrastructure; objective reviews of AM software, and
  - Creation of a "toolbox" or repository of standard software methods
- Stakeholders identified include:
  - Universities (both civil engineering and urban planning departments),
  - NRC and consultants, and
  - Municipalities, InfraGuide, Canadian Water Network (CWN), Centre for the Advancement of Trenchless Technology (CATT), MIIP, AwwaRF, and CSA

Open Forum

Education

- The gap is current focus on "design" in conventional education
- Little emphasis placed on "renewal" or life cycle analysis
- Few courses exist in Canada relating to infrastructure, let alone infrastructure management
- Current curricula still focused on "silos"
- Opportunities exist:
  - university degrees, post graduate degrees
  - community college diplomas in public infrastructure management
  - joint programs between civil engineering and urban planning
  - dedicated conferences and workshops in Canada and abroad focused on infrastructure management
  - courses and workshops related to the InfraGuide Best Practices, and
  - courses geared towards developing countries

Open Forum

Education

- Stakeholders :
  - universities,
  - community colleges, and
  - technical schools
- Organizations such:
  - CSCE, RAIC,
  - Canadian International Development Agency (CIDA),
  - International Centre for Municipal Development (ICMD),
  - Canadian Institute of Planners (CIP),
  - Canadian Engineering Accreditation Board (CEAB) and
  - Educational Program Innovations Center (EPIC)

Open Forum

Sustainability

- Not discussed at same level of detail as previous 3 priorities
- Gaps included:
  - lack of sustainable infrastructure strategies for Canadian municipalities, and
  - lack of solid knowledge relating to environmental impact of rehabilitation
- Opportunities include:
  - "Green" agendas, climate change and toxins
- Stakeholders include:
  - municipalities, provincial and federal authorities and research organizations

Open Forum

National Infrastructure Strategy

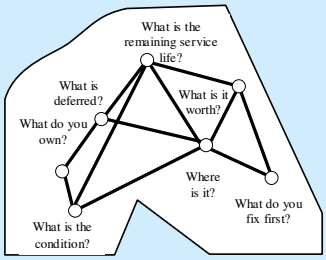
- Need for a national strategy on infrastructure issues
  - expression used was "National Infrastructure Strategy"
- A proposal was made by a number of participants for:
  - objective, non-political body such as a "Canadian Council for Infrastructure" reporting at high level of government
- Mandate should be to ensure:
  - "infrastructure agenda" is high on the priorities of politicians (much like education and health care)
- Stakeholders include:
  - Infrastructure Canada and its provincial counterparts, FCM, the "Big City Mayors' Caucus, CCPE, CSCE, and the Horizontal Research Roundtable on Infrastructure (HRRI)

Deliverables

- A Framework for Municipal Infrastructure Management for Canadian Municipalities (Dec 05)
  - Part 1 details "top level" processes for municipal infrastructure management (MIM);
    - Primarily deals with decision-making
    - 10 Pages
  - Part 2 delves into the details of the "WHAT" and "HOW";
    - Outlines implementation issues faced by practitioners
    - Describes available technologies to address the opportunities and suggests potential solutions
    - 100 pages
  - Ready in December 2005

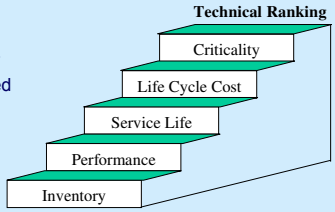
MIM Framework- Part 1

- General rules exist only in practice today



MIM Framework- Part 1

- Value Engineering exercise
- To properly determine the Technical Ranking need to:
  - Identify inventory
  - Predict performance
  - Estimate service life
  - Calculate LCC
  - Determine Criticality
- All 5 facets are described
  - Parts 1 and 2

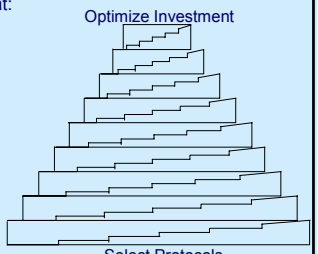


MIM Framework- Part 1

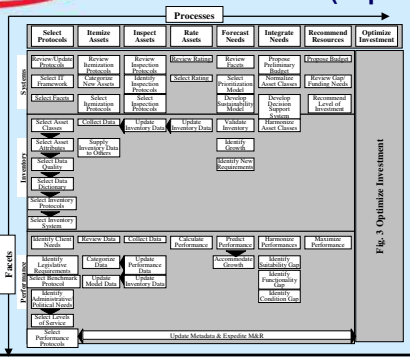
- In addition - identify processes
  1. Select Protocols
  2. Itemize Assets
  3. Inspect Assets
  4. Rate Assets
  5. Forecast Needs
  6. Integrate Needs
  7. Recommend Resources
  8. Optimize Investment
- All 8 processes described

MIM Framework- Part 1

- Describes overall goal as an ever-tightening spiral
- Each Process level looking at:
  - Inventory
  - Performance
  - Service Life
  - LCC
  - Criticality



MIM Framework- Part 2 Technical (Top Half)



MIM Framework- Part 2 Technical (Bottom Half)

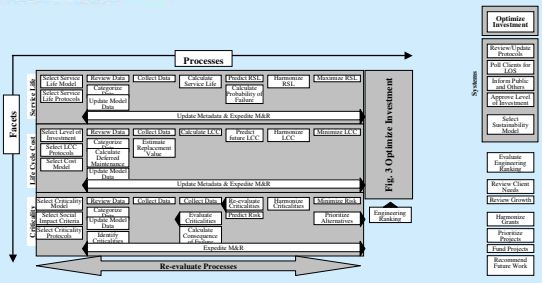
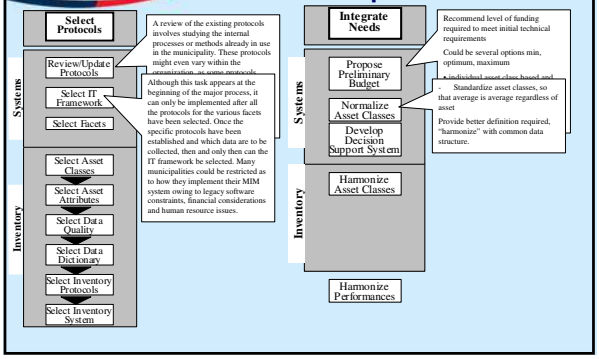


Fig. 3

MIM Framework- Part 2 Examples of Detail



MIIP Deliverables

Software Prototype

- Decision support system
- Risk and condition-based
- Life cycle costs

MIIP Phase II

Phase II of MIIP

- Still in discussion phase
- Smaller cities/towns
- National database of inventory for condition assessment
- 2-3 year term

Recent events

Graduate Course on Public Infrastructure Management

- UBC Graduate students (20)
- One-week intensive
- Dedicated to asset management procedures (6 whats)
- Used the InfraGuide Best Practices as case studies
- Will have follow-up courses at UBC next year
- Use as template for proposed Master's programme in PIM at UBC:
  - KOA submission (both last call and Sep call)
  - Distance learning programme
  - Professionals (partnered with CSCE-Education)
- Market to other universities (Ottawa/Carleton) – Guy Felio, Linda Newton

New NRC Initiatives

Built Environment – Science Insight (BeSI 2006)

- Topic: Management of Sustainable Infrastructure
- Similar to BSI – Building Science Insight from past years
- 10 Major Canadian Cities
- Oct / Nov 2006 (Quebec presentations in Jan 2006
- Six experts from various engineering disciplines
- Collaboration with InfraGuide

New NRC Initiatives

NSERC Proposal

- Centre of Excellence in Sustainable Infrastructure Management
  - McGill
  - U of Toronto
  - Ryerson
  - UNB
  - U of Alberta
  - UBC
  - U of Waterloo
  - NRC
- Still in preliminary discussion phase

New NRC Initiatives

Centre for Sustainable Infrastructure Research (CSIR Regina)

- Federal Budget (Feb 03) allocated $10M over 5 years for NRC
  - Sustainable infrastructure management research and innovation
- Federally funded initiative in conjunction with:
  - Communities of Tomorrow
    - "will be an international centre of excellence in research, innovation and commercialization for sustainable communities"
  - City of Regina,
  - University of Regina,
  - Western Economic Diversification, and
  - Saskatchewan Industry and Resources
- Located at University of Regina
- Up to 12 NRC employees (Dr. David Hubble, Manager CSIR)

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