BMS with an Integrated Comprehensive LCC Tool

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Introduction

- Generally, bridge investment and management decisions are multi-alternative-oriented.

- Although many bridge management systems (BMSs) contain some form of life-cycle costing (LCC), the use of LCC in bridge engineering is scarce.

- LCC in many BMSs has mainly been applied within the bridge operation phase to support decisions related to existing bridges.

- Even though BMSs and LCC are interrelated, many bridge management researches have treated them as separate aspects; therefore, neither may lead to the best usable decision-support tools.

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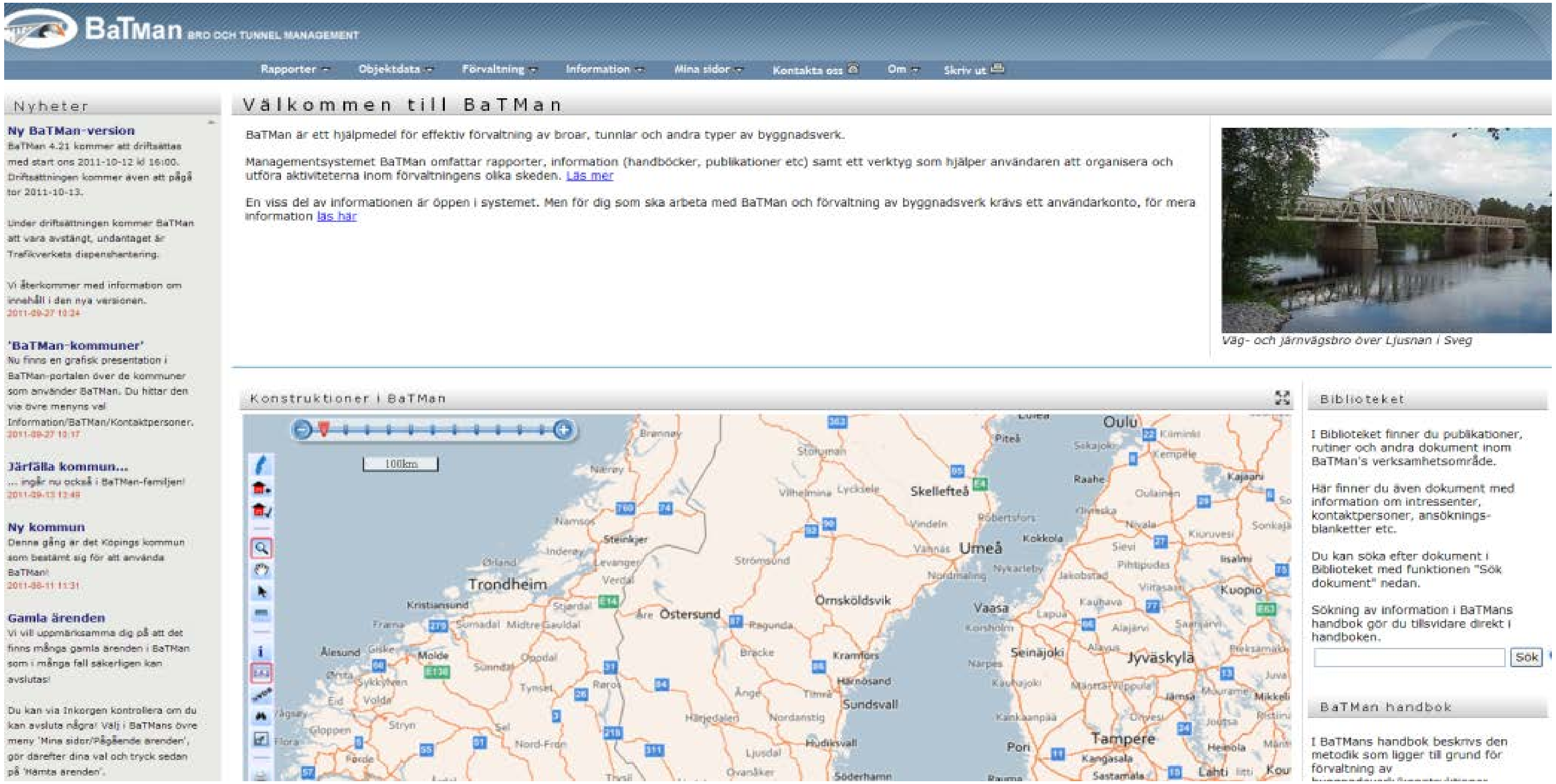
Aim and Scope

- The project aims at enhancing the bridge investment and management decisions by upgrading and expanding the use of LCC in the Swedish Bridge and Tunnel Management System (BaTMan).

  - ➢ Address the possible LCC applications for bridges
  - ➢ Supported with detailed case studies, demonstrate the LCC implementation on whether to ***repair or to replace a bridge,*** (Paper I and II).
  - ➢ Supported with a detailed case studies, demonstrate the LCC implementation on whether to ***repair or to replace a specific bridge structural member,*** (Paper III).

The Swedish Bridge and Tunnel Management System (BaTMan)



https://batman.vv.se/batman/

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BaTMan

- Sweden has a long tradition in bridge management. Since 1944, information about the condition of the national road network has been documented and stored in different archives.

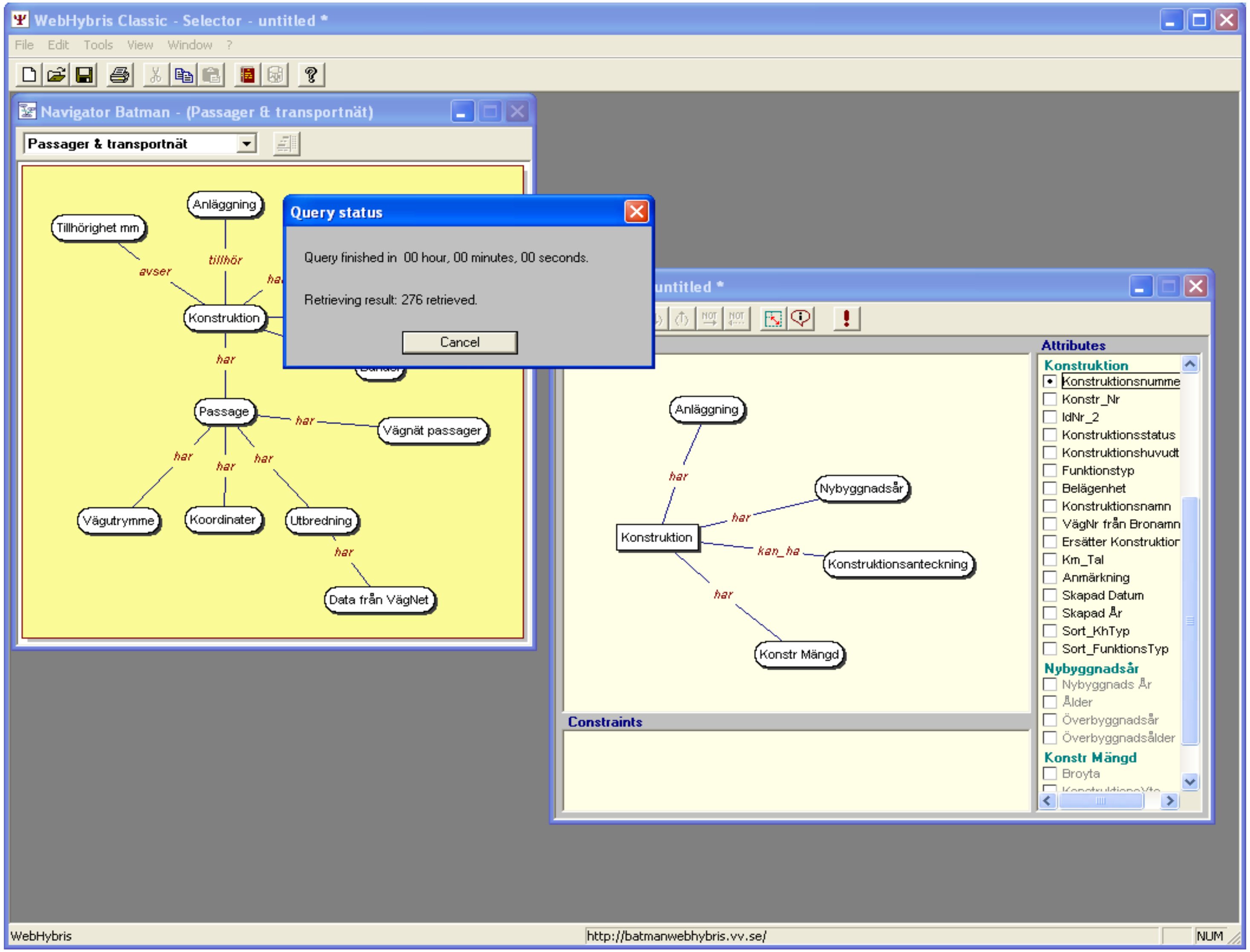
- The Swedish Transport Administration (Trafikverket) is the largest bridge manager in Sweden. The latest update of Trafikverket's BMS is called a Bridge and Tunnel Management system (BaTMan), which was introduced in 2004.

- BaTMan is recognized as the best-known software-based digital BMS in Europe.

- All information is given on repair, strengthening, and maintenance, including their costs.

- Furthermore, the system consists of a separate navigation tool (WebHybris) that can access the BaTMan's database and answer any related question for any research or management purposes.

BaTMan Navigation Tool (WebHybris)



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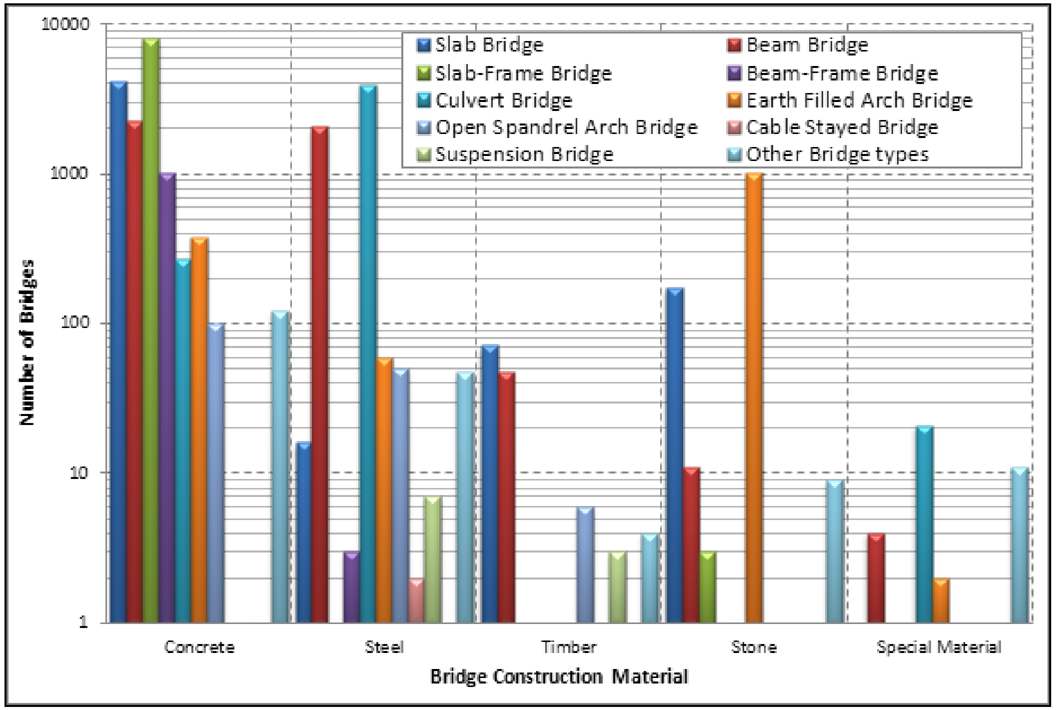
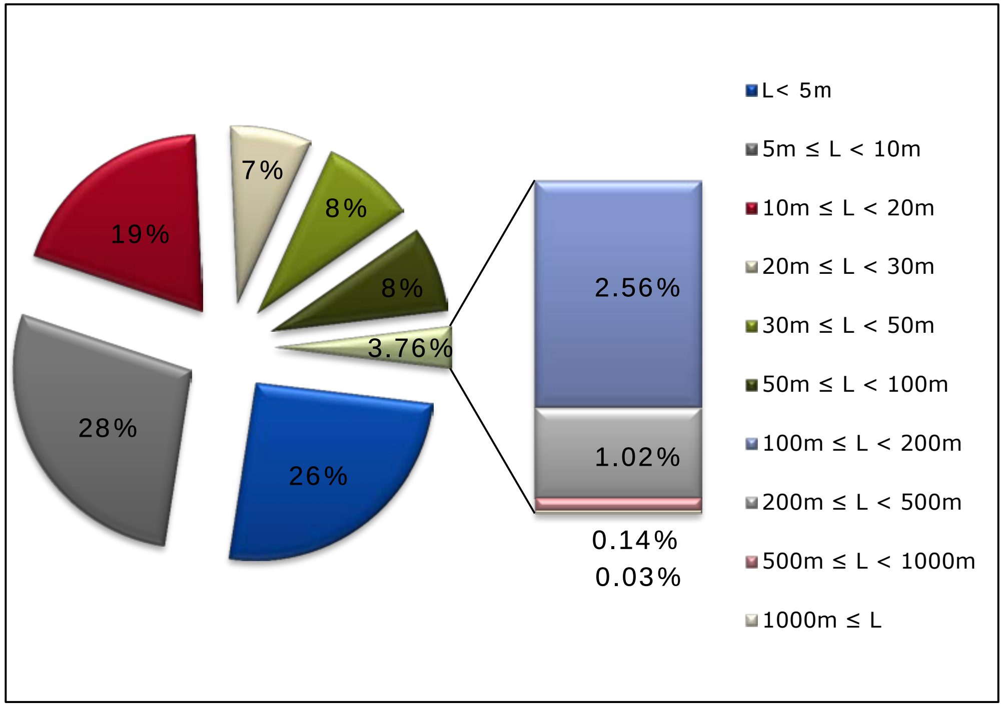
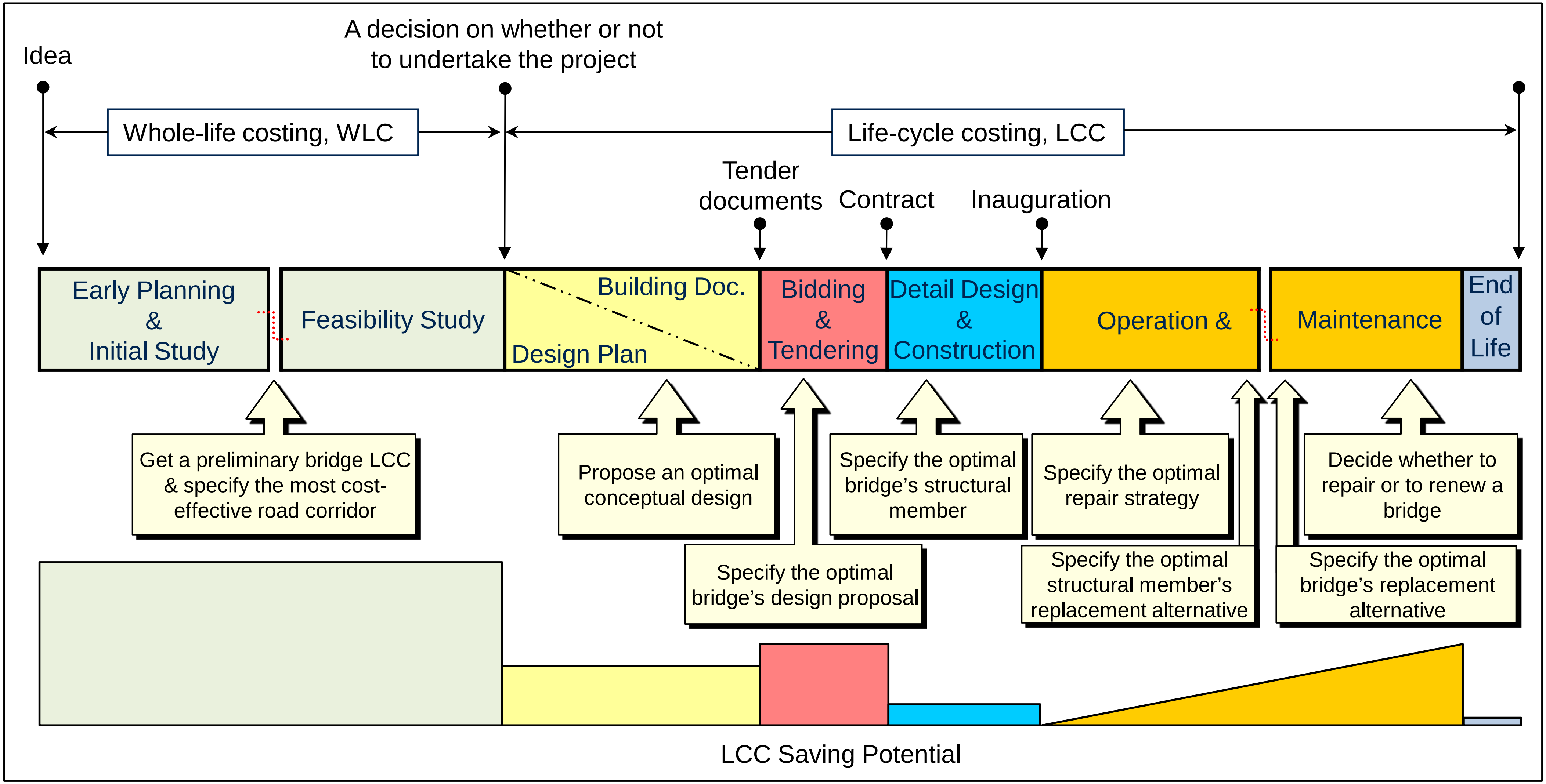
The Swedish Bridge Stock

	Bridge Function Type				Total No. Of Bridges	Bridge Total Area (m^2)	Bridge Total Length (m)
	Roadway	Railway	Pedestrian & Bicycle	Other			
BaTMan's Bridges	23,848	4,411	1,619	251	**30,129**	7,644,208	668,381
Trafikverket's Bridges in BaTMan	20,050	3,179	207	14	**23,450**	5,858,570	528,905

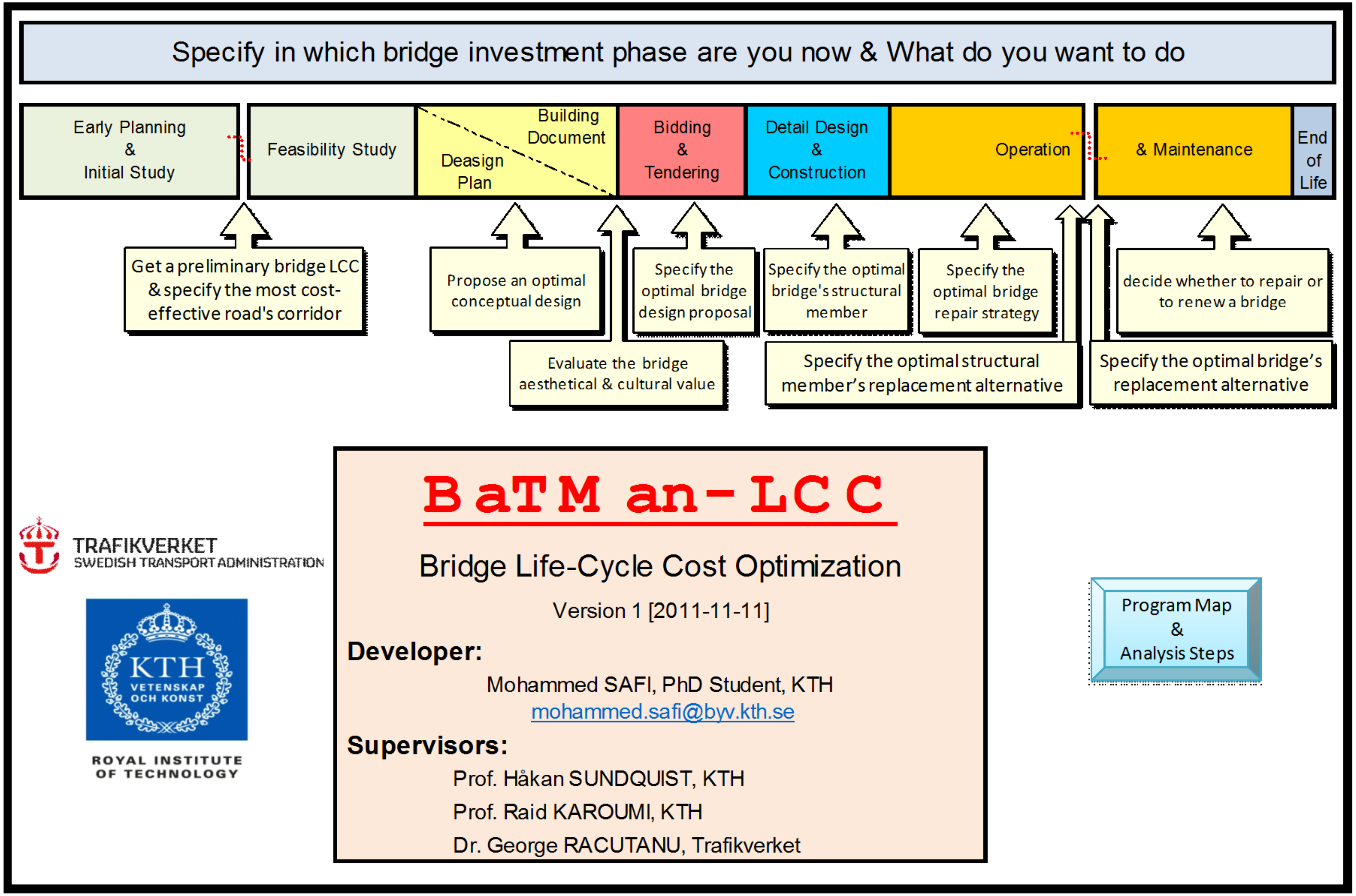




Comprehensive Integrated LCC Implementation Scheme



BaTMan-LCC



Specify in which bridge investment phase are you now & What do you want to do
Early Planning & Initial Study
Feasibility Study
Deasign Plan
Building Document
Bidding & Tendering
Detail Design & Construction
Operation
& Maintenance
End of Life
Get a preliminary bridge LCC & specify the most cost-effective road's corridor
Propose an optimal conceptual design
Evaluate the bridge aesthetical & cultural value
Specify the optimal bridge design proposal
Specify the optimal bridge's structural member
Specify the optimal bridge repair strategy
Specify the optimal structural member's replacement alternative
decide whether to repair or to renew a bridge
Specify the optimal bridge's replacement alternative
TRAFIKVERKET
SWEDISH TRANSPORT ADMINISTRATION
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BaTMan-LCC
Bridge Life-Cycle Cost Optimization
Version 1 [2011-11-11]
Developer:
Mohammed SAFI, PhD Student, KTH
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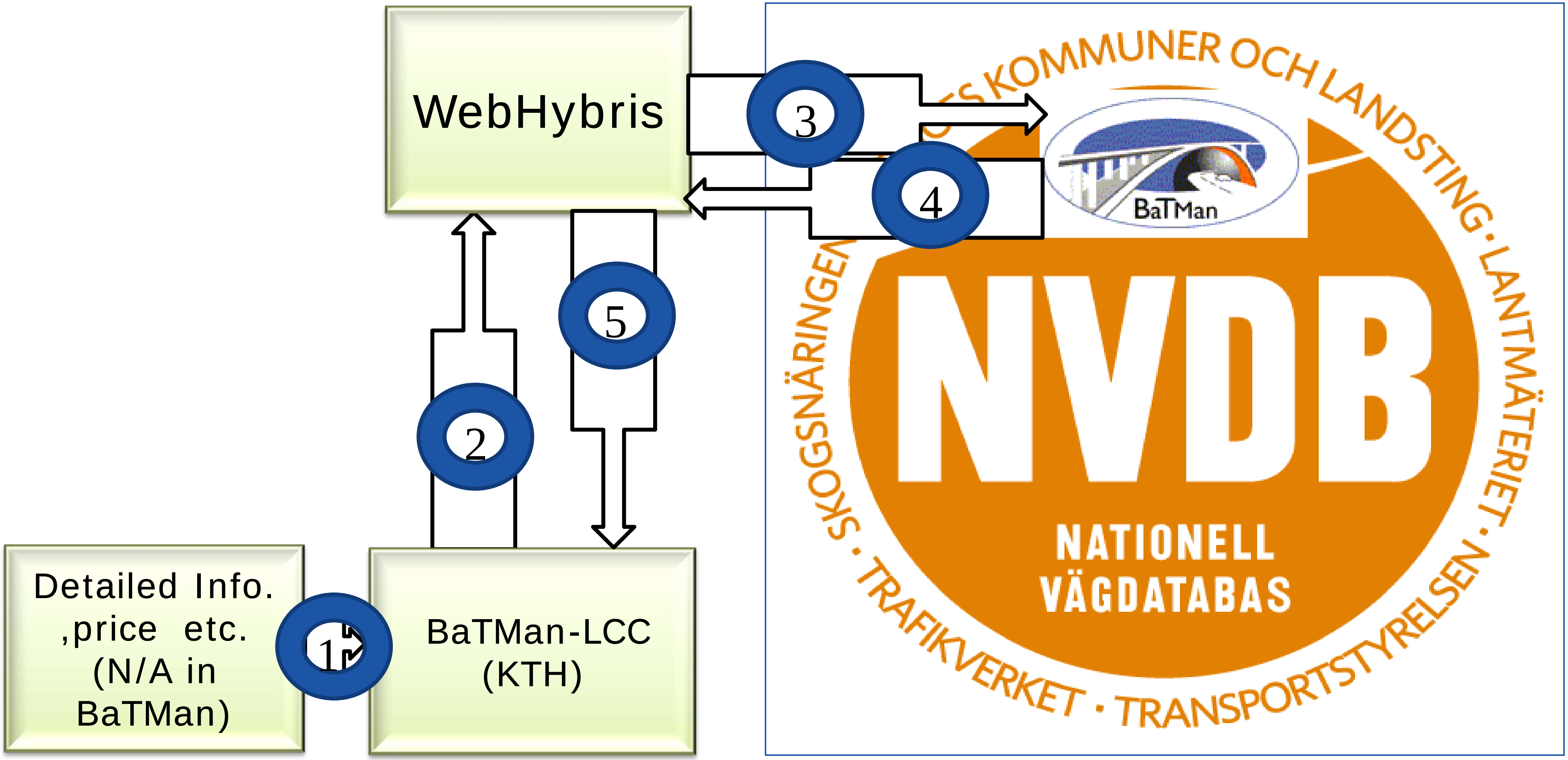
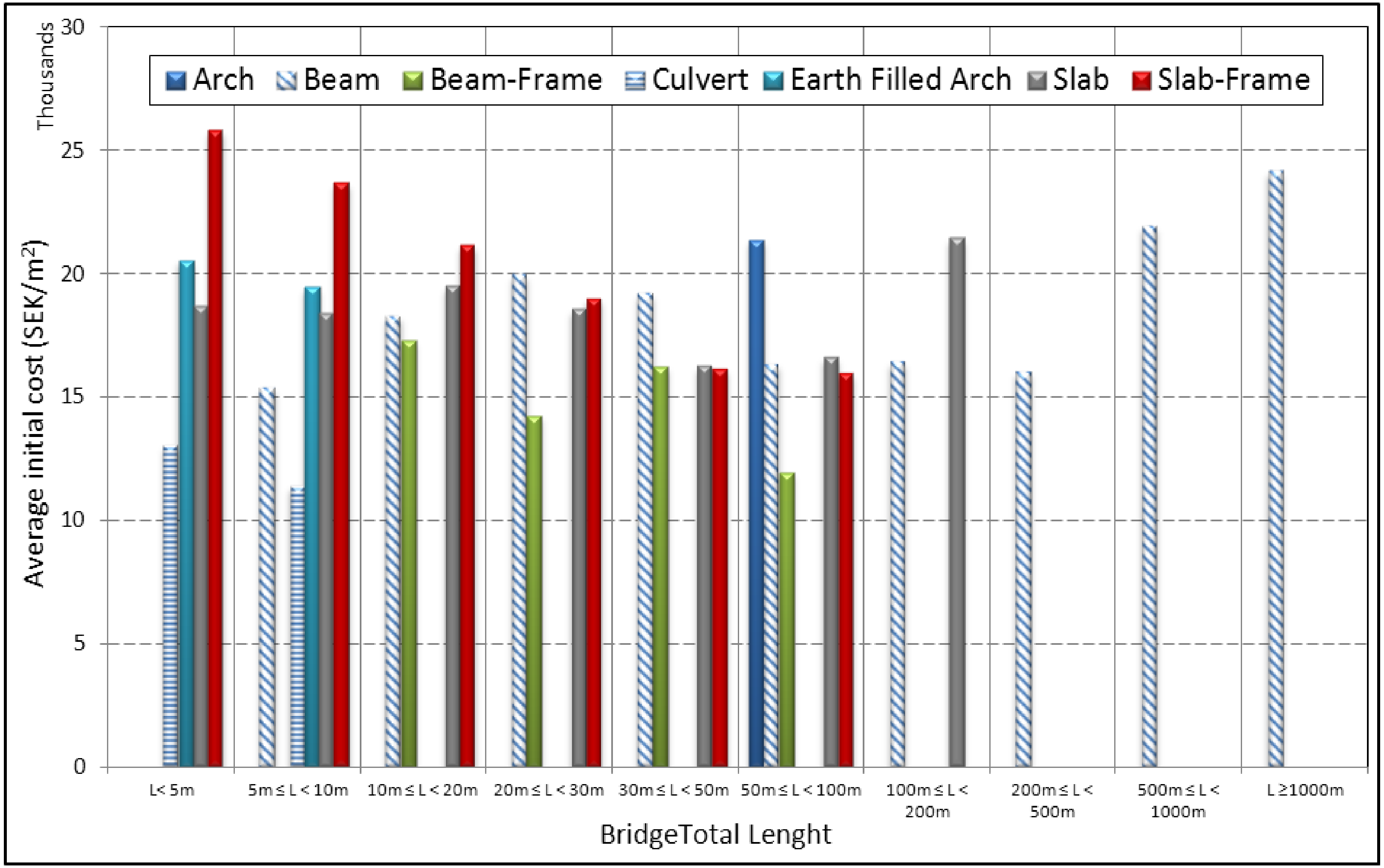
Supervisors:
Prof. Håkan SUNDQUIST, KTH
Prof. Raid KAROUMI, KTH
Dr. George RACUTANU, Trafikverket
Program Map & Analysis Steps

BaTMan-LCC relation with BaTMan



Benefit of Using BaTMan's Records



The average real initial costs of the Swedish bridges different types, based on cost data for 2,508 bridges constructed between 1980 and 2011.

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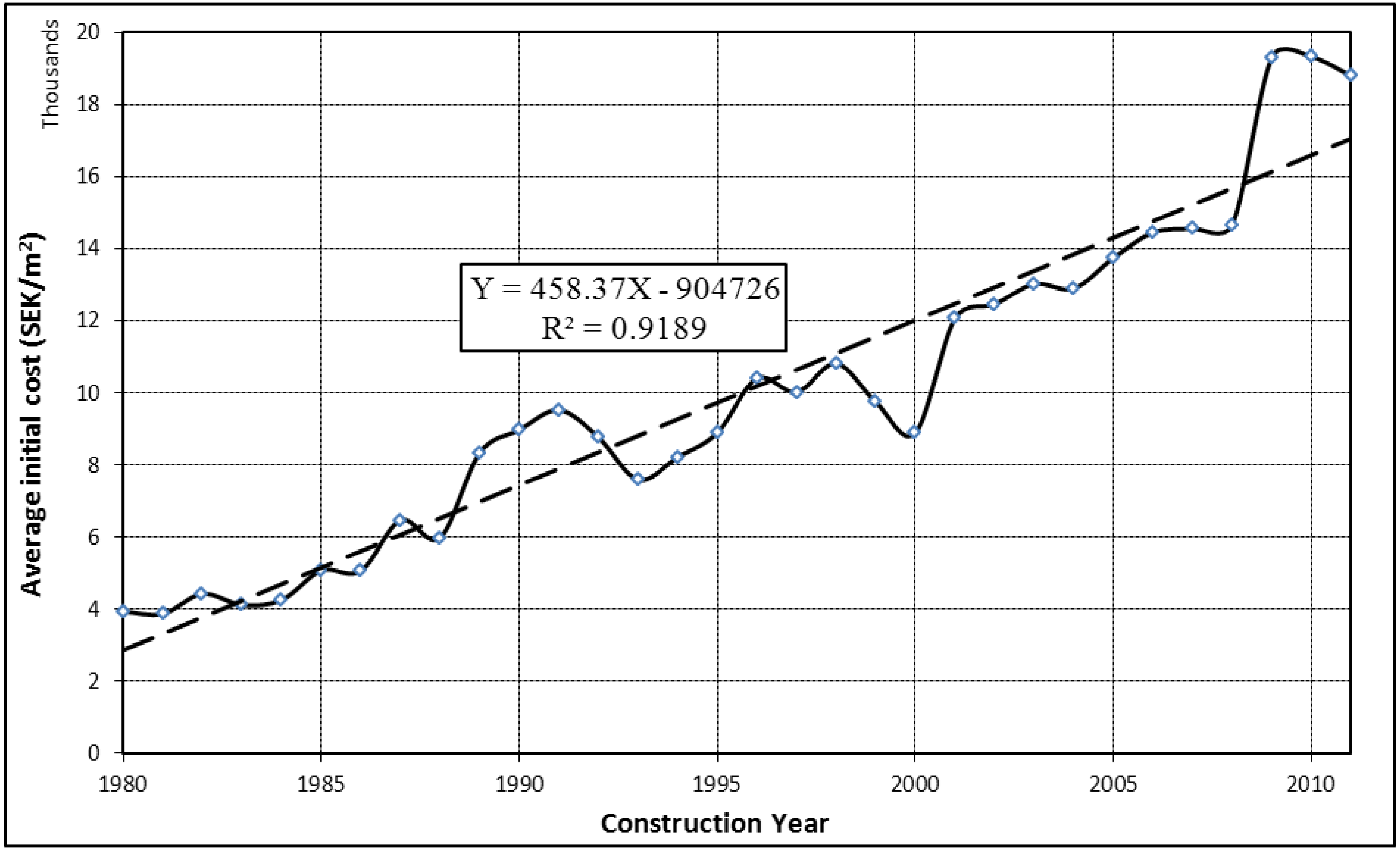
Benefit of Using BaTMan's Records



The inflation rate for the Swedish bridges initial costs

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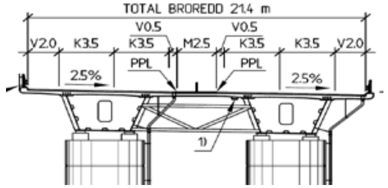
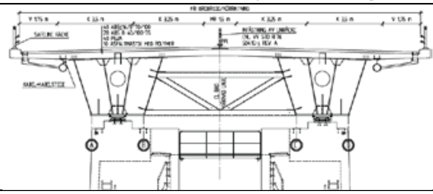
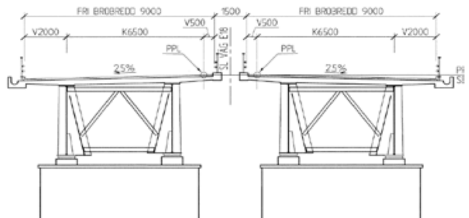
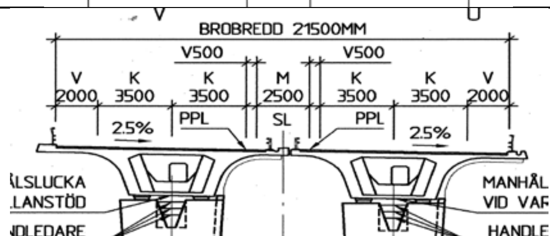
Case-Studies & Pilot Projects

Paper I: Struc. & Infrastructure Eng. J. [6-367-1] Bro över Lillån Construction Year: 1934	Paper II: TRR Journal [18-352-1] Bro över Täbyån, Höjen Construction Year: 1929

(Residual service life is not more than three years, if no action is taken CC2)

Case-Studies & Pilot Projects

Proposal No.	Description	Similar & Reference Bridges	Cross-Section Details	Average Constr. Height
1	Trafikverkets proposal: One bridge, Continuous two steel boxes, two bearing per box	11-788-2, 22-1455-1, 22-1106-1, 22-999-1, 22-1125-1, 14-1817-1	 (Trafikverket conceptual design)	2.3m
2	One bridge, Continuous two steel boxes, one bearing per box			2.3 m
3	Two bridges, Continuous, two I-steel Beams, One bearing per beam	18-1017-1, 14-1506-1, 3-339-2, 22-1533-1, 20-1220-1		Haunch beam Max. 3.2m Min. 1.8m
4	Two bridges, Continuous, one Pre-Stressed Concrete box per bridge, two bearings per box	7-674-1, 19-841-1		2.8 m
5	Two Bridges, Integral Pre-Stressed Cantilever Continuous, one concrete box per bridge	18-767-1		Haunch beam Max. 3.4m Min. 1.3m

Large-Scale Feasibility

- Repair or Replace a Bridge:
  - The opportunity loss is equal to 241 SEK/year/m^2
  - Trafikverket is responsible for 6,268 bridges older than 70 years, total bridge area of 619,944 m^2.
  - Trafikverket can save/might loos 74.7 million SEK/year, 1.49 billion SEK during the coming 20 years.

- New Investment:
  - The opportunity loss is equal to 275 SEK/year/m^2
  - Trafikverket is approximately building 55,000 m^2/year.
  - Trafikverket can save/might loos 15 million SEK/year, 1.5 billion SEK/100 years.

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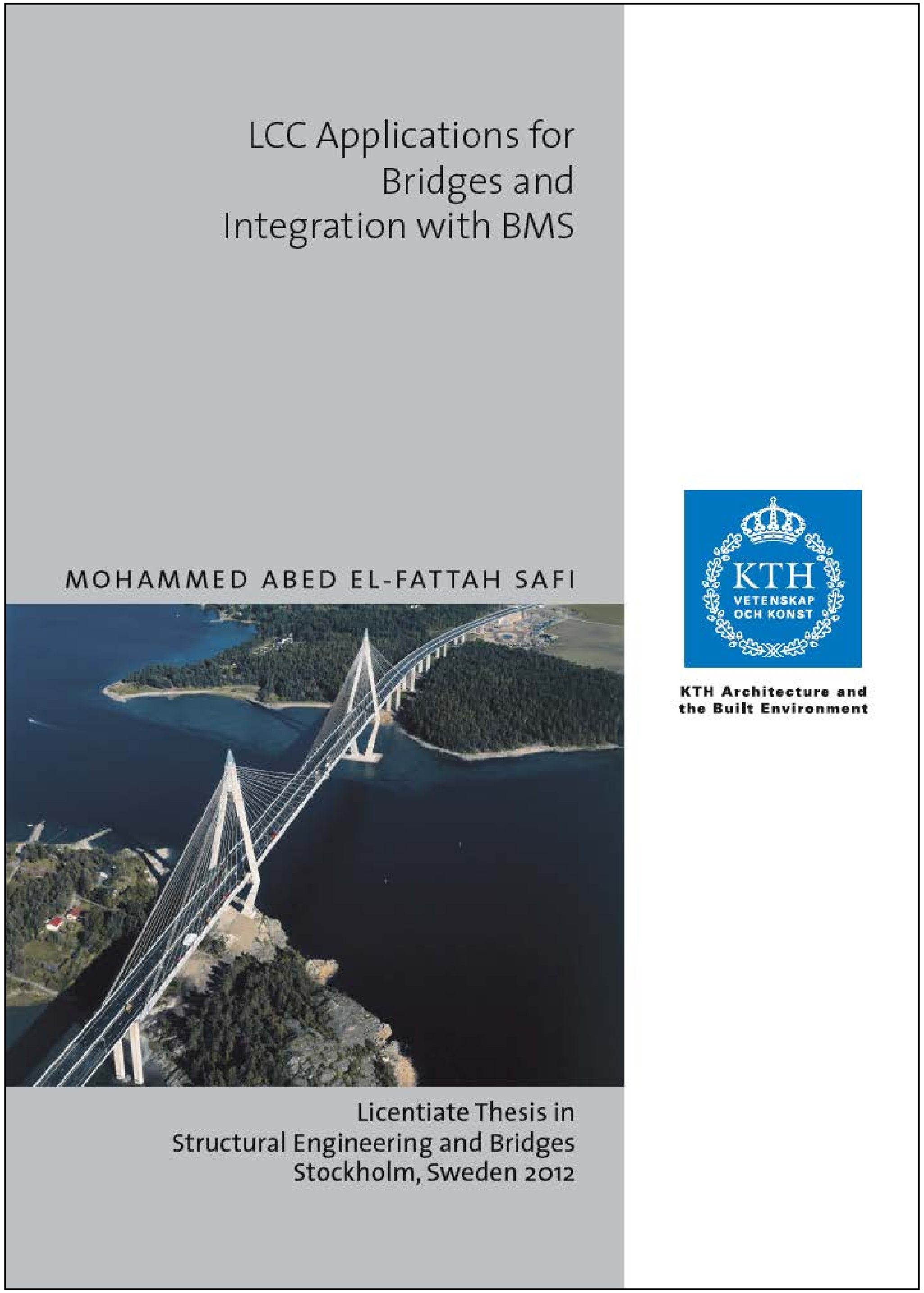
Thesis Structure

- Part I: Extended Summary

  1) Introduction
  2) The Swedish BMS
  3) Bridge Life-Cycle and the Possible LCC Applications
  4) LCC Analysis Tools and Techniques
  5) Case Studies
  6) BaTMan-LCC
  7) Conclusion

- Part II: Appended Papers



Thank You

Questions?