

Best Practices for Harmonizing Road Construction Specifications and Standards: A Manitoba Assessment

Leonnie Kavanagh, PhD, P. Eng., Research Associate
Corresponding Author
E-mail:leonnied.kavanagh@umanitoba.ca

Alexander Afuberoh, Masters Student

Ahmed Shalaby, PhD, P. Eng., Professor

Civil Engineering Department
University of Manitoba
Winnipeg, Manitoba

Paper prepared for presentation
at the SES-INNOVATION AND TECHNOLOGY IN ROAD CONSTRUCTION: EVOLVING TRANSPORTATION
Session

of the 2018 Conference of the
Transportation Association of Canada
Saskatoon, SK

Acknowledgements:

Manitoba Infrastructure
City of Winnipeg, Public works
University of Manitoba Infrastructure Chair

Abstract

This paper presents best practice guidelines and strategies for harmonizing provincial and municipal highway construction standards and specifications in Manitoba. Developing common construction standards with stakeholders of diverging goals can be challenging, but beneficial. The adoption of a consistent set of standards and specifications in a jurisdiction could minimize redundancy, identify critical requirements that need to be retained to maintain performance, cut construction and compliance costs, simplify the process of meeting requirements, and reduce complexity for those that are tasked with testing and standard compliance. Therefore in this study, a survey questionnaire was developed and sent to the provincial and municipal highway agencies, contractors, aggregate producers, and testing labs in Manitoba. The purpose of the survey questionnaire was to obtain input on harmonizing provincial and municipal specifications and standards for asphalt, concrete, granular base and rip-rap, and grading roadway projects. The survey questions focused on identifying key issues of harmonization including barriers to change, benefits, trade-offs, common goals, potential risks, cost-effectiveness, and quality control and quality assurance delivery mechanisms. The results of the survey recommendations for harmonizing standards and specifications are presented. The recommendations can be used by highway agencies to quickly implement the best practices, thereby realizing the benefits of harmonizing standards and specifications in their jurisdictions.

INTRODUCTION

Background

Every year, provincial and municipal highway agencies in Manitoba invest a total of approximately \$800 million dollars in the construction and rehabilitation of flexible and rigid pavements (City, 2015; Manitoba, 2015). Producing high quality, long lasting pavements require good partnership between the agencies who develop standards and specifications, and the consultants/contractors who produce and place the materials. However, each provincial and municipal agency has a myriad of standards and specifications, often with differing technical requirements on roads with the same climatic and traffic conditions. Keeping track of these differing requirements can be challenging and costly for contractors and consultants.

While developing common standards with stakeholders of diverging goals can be challenging, it can be beneficial. The adoption of consistent sets of technical standards could minimize redundancy or conflicting standards, identify critical requirements that need to be retained to maintain performance, cut construction and compliance costs, simplify the process of meeting requirements, and reduce the complexity for those that are tasked with testing and standard compliance.

Since local agencies are under increasing pressure to adopt the same standards from contractors and suppliers who have to maintain different systems, with different testing requirements, material specification and equipment needs, stakeholders need to quickly identify the barriers to change in order to implement the best practice, and realize the benefits of harmonizing standards and specifications. Since the harmonization of standards and specifications can have a major impact on stakeholders, an assessment of the potential benefits and the trade-offs of harmonizing the current specifications and standards in Manitoba was performed. The results were used to provide recommendations for best practices for harmonizing standards and specifications to reduce infrastructure cost in Manitoba.

Study Objective

The objective of this study was to obtain information/input on harmonizing provincial and municipal construction specifications and standards for asphalt, concrete, granular base and rip-rap, and grading in Manitoba, and to develop best practice guidelines and strategies to harmonize provincial and municipal standards and specifications.

SURVEY METHODOLOGY

A survey questionnaire was developed to obtain the information/input on the status of harmonization of highway construction standards in Manitoba, along with current barriers, and costs/benefits of implementation. The survey included questions on key harmonization implementation issues and benefits including cost-effectiveness, trade-offs, cause for lack of harmonization, material and quality control (QC) and quality assurance (QA) delivery mechanisms, and potential barriers to implementation.

For this study, the harmonization survey was distributed in September 2017 to provincial and municipal highway agencies, and five industry representatives in Manitoba. The survey recipients included the following:

- Industry
 - Paving contractors (two)

- Aggregate producers (two)
- Consulting/testing lab (one)
- Provincial Agency
 - Manitoba Infrastructure (MI)
- Municipal Agency
 - City of Winnipeg, Public Works (COW)

Nine responses were received from the participants, for a response rate of 100%. The response from both agency and industry was desirable, because of the agency/industry partnership in developing standards and in producing and placing materials.

Table 1 presents the harmonization survey response rate from the agency and industry.

Table 1: Harmonization Survey Response Rate

Survey Participants	Number of Surveys Sent	Number of responses	Response Rate (%)
Industry	5	5	100
Agencies	2	4	100
Total	7	9	100

ANALYSIS OF RESPONSES

A summary of the responses to each of the harmonization survey questions, by industry and agency, were prepared and analysed for trends.

Table 2 presents the agency and industry responses to the current state of provincial and municipal harmonization in Manitoba. All respondents indicated that there was currently no harmonization of the materials and QC/QA specifications for asphalt, concrete, base, grading or rip-rap in Manitoba.

Table 2: Current State of Provincial and Municipal harmonization in Manitoba

Materials and QC/QA Specifications	Percent of Responses (%)	
	Harmonized	Not Harmonized
Asphalt	-	100
Concrete	-	100
Base	-	100
Rip Rap	-	100
Grading	-	100

Table 3 presents the agency and industry responses to the cause for the lack of harmonization in Manitoba. The agencies responded (44% of respondents) that 'lack of awareness of the need for harmonization' was the major cause for the lack of harmonization in Manitoba. The industry responded (44% of respondents) that 'harmonization was explored, but costs and risks were not considered and addressed', and 'lack of awareness of awareness of the need for harmonization' were the major causes

for the lack of harmonization. For 11% of the respondents, it was unclear that harmonization was attempted in the past. Additional comments from respondents indicated the local construction industry had been lobbying both provincial and municipal agencies since 2010 to amalgamate specifications, with no success. A secondary comment from one respondent was that harmonization of some items would require significant effort for little benefit in return.

Table 3: Cause for Lack of Harmonization in Manitoba

Specifications	Responses (%)	
	Industry	Agency
Lack of awareness of the need for harmonization	11	44
Harmonization was explored, but costs and risks were not considered and addressed	33	-
Harmonization was explored, but was unable to demonstrate benefits	-	-
Deciding not to harmonize outweighed the risks of harmonization	-	-
<i>Other</i> : Unsure if harmonization has been attempted in the past	11	-

Table 4 presents the industry and agency responses to the construction specification component that they perceived was the most difficult to harmonize, and why. The industry responded that ‘materials specification’ was the most difficult to harmonize. They postulated that change to material specification would automatically lead to changes in the QC/QA specification. The industry response to why materials were most difficult to harmonize included the different grading requirements between agencies, with some agencies using combined gradations while others specified each product separately; difficulty addressing too many stake holders; the volume of specifications; the desire to complete the task due to its enormity’ political issues; agency entrenched in their own specifications and methods; and some material specifications that were inconsistent between individual agency.

The agency responded that both ‘materials specification’ and ‘QC/QA’ were the most difficult to harmonize. The agency response to why both were difficult included comments that some agencies used end product specification while some used methods based specification, and the significant differences were between how inspections were administered, not how specifications were written.

Table 4: Specification Component Perceive as Most Difficult to Harmonize

Specification Component	Responses (%)	
	Industry	Agency
Material Specification	56	22
QC/QA Specification	-	22

Table 5 presents the industry and agency responses to the current delivery methods used for specifications in Manitoba. The most prevalent delivery mechanism for both provincial and municipal project delivery was the method specification. The responses also indicated that ‘warranty’ and ‘design

build' delivery mechanisms were most often used on a smaller number of high profile projects.

Table 5: Current Delivery Mechanism used for Specifications in Manitoba

Delivery Mechanism	Industry and Agency Responses (%)				
	Material Specifications				
	Asphalt	Concrete	Base	Grading	Rip-rap
Method Specification*	✓	✓	✓	✓	✓
Warranty**	✓	✓	✓	✓	✓
Design Build**	✓	✓	✓	✓	✓

Note: *-predominant specification used;
 **used on smaller number of high profile projects

Table 6 presents the agency and industry responses to the stakeholder responsible for QC/QA on larger provincial and municipal projects. The responses for provincial projects indicated that the provincial agency was primarily responsible for both QC and QA. The responses for municipal projects indicated that the contractor was responsible for QC, and the consultant or authority designated by the municipality was responsible for QA. It is important to note that both municipal and provincial agencies primarily use method specification, but administer the QC/QA component of the specification in a different manner.

Table6: Responsibility for QC/QA on Projects

QC/QA Responsibility	Industry and Agency Responses			
	Provincial Projects*		Municipal Projects*	
	QC (%)	QA (%)	QC (%)	QA (%)
Agency	90-100	90-100	-	-
Contractor	2	2	100	-
Consultant	4	4	100	100
Shared (Agency/ Contractor)	Small	-	-	-

Note: *large projects

Table 7 presents the agency and industry responses to the future plans for harmonized specification in Manitoba. There was a 66% response from the agency and industry that they were currently researching the benefits of harmonization of specifications in Manitoba and plan to implement within the next 2-3 years. The remaining 33% of the respondents indicated there was no planning to harmonize, had no response, or considered harmonization labor intensive with limited potential upside.

Table 7: Future plans for Harmonization of Specifications in Manitoba

Future Plans	Percent of Response (%)	
	Industry	Agency
Currently researching the benefits of harmonization	22	33
Planning to harmonize materials specification	11	-
Planning to harmonize QC/QA	-	-
Not planning to harmonize specifications	11	-
No response	11	-
<i>Comment:</i> Harmonization appears to be labour intensive task with limited upside potential		11

ESTIMATED COST AND BENEFIT OF HARMONIZATION

Quantifying the cost and benefits of harmonizing specifications is a challenge for agencies and industry. Costs usually include the initial capital costs of equipment, materials and associated personnel training. Assessing benefits, such as improved performance, can be done through field performance to quantify the long term benefits from harmonization. For this study, the expected cost and benefit and economic considerations of harmonization in Manitoba were based on the survey responses of the agency and industry experience. The estimated costs and expected benefits from harmonizing standards in Manitoba are presented.

Table 8 presents the agency and industry estimated reduction in cost due to harmonization of specifications in Manitoba. There was a 33% response from the agency and industry that no change in cost would occur with harmonization. However, 44% of respondents estimated a reduction of 5-10% in cost with the implementation of harmonization. The remaining 22% of industry respondents were unsure of the estimated cost or had no response. None of the respondents indicated that there would be a cost increase with the implementation of harmonization.

Where the respondents indicated that there was a cost reduction, the basis for the cost reduction was time, resources, and risk. Time was defined as early completion of projects, reduced material process time, reduced transportation haul time, reduced staff training, and increased product inventory during favorable conditions. Resources was defined as fewer number of staff to complete the job, reduced number of equipment required to complete the job, and better management of inventory. Risk was defined as reduced uncertainty in bidding, or streamlined bidding process, and reduced QC/QA requirements, or streamlined delivery mechanism.

Table 8: Estimated Costs Reduction of Harmonization of Specifications

Estimated Costs	Percent of Responses (%)	
	Industry	Agency
No change	11	22
<5% cost reduction	11	-
5-10% cost reduction	11	22
Cost Increase	-	-
Not sure/No response	22	-

Table 9 presents the agency and industry estimated increase in quality or value of construction projects due to harmonization of specifications in Manitoba. Based on the result, 44% of respondents estimated an increase of 5-25% in quality/value of construction projects with the implementation of harmonization. However, 11% of respondents indicated no change in quality/value of projects. The remaining 33% of respondents had no responses or were unsure of the quality/value. None of the respondents indicated that there would be a decrease in quality/value of the project with the implementation of harmonization.

Where the respondents indicated that there was a quality/value increase, the basis for the quality increase was 'process improvement (streamlined standards)', and 'improved infrastructure performance'. The respondents commented that quality may be improved by producing more consistent material, but that depended on what changes were made to the specification. One of the respondent commented that they were unsure of the quality/value, since there were too many variables to consider.

Table 9: Estimated Increase in Quality/Value of Project of Harmonization of Specifications

Estimated Quality/Value of projects	Percent of Responses (%)	
	Industry	Agency
No change	-	11
<5% quality/value increase	11	11
5-10% quality/value increase	11	-
10-15% quality/value increase	11	-
>25% quality/value increase	11	-
quality/value decrease	-	-
Not sure/No response	11	22

Quantifying the benefits of harmonization of specifications can also be challenging for agency and industry. For this study, the responses from the survey were used to identify the perceived benefits from harmonization in Manitoba.

Table 10 presents the agency and industry rankings of the perceived benefits that would occur with the adoption of harmonized specifications in Manitoba. The agencies ranked ‘minimize redundant or conflicting standards’ as the most likely benefit of harmonization. The industry ranked ‘reduce proliferation of specifications’ as the most likely benefit of harmonization. Additional comments from the respondents indicated that harmonization will reduce production costs and provide additional cost efficiencies in project costing, result in simplification for the contractor for producing products and storage, and in particular for hot mix asphalt (HMA) produced at permanent municipal plants for use on provincial projects.

Table 10: Perceived Benefits with adoption of harmonized specifications

Perceived Benefits to Harmonization	Ranking* Responses	
	Industry	Agency
Minimize redundant or conflicting standard	2	1
Cut construction and compliance costs	2	2
Cut construction and compliance time	4	3
Simplify the process of meeting requirements	3	3
Reduce complexity with testing and compliance	2	2
Retain critical requirements for performance	2	4
Reduce proliferation of specifications	1	3
No benefits	5	5

Note: * Ranking: 1=highest, 5=lowest

OVERCOMING BARRIERS TO HARMONIZATION

The ranking of potential barriers and challenges to implementing harmonization were evaluated from the agency and industry responses to the survey.

Table 11 presents the agency and industry rankings of the perceived barriers to harmonization in Manitoba. On average, the agencies ranked ‘lowest (inferior) specification may be adopted’ and ‘harmonization may eliminate sources of aggregates/materials’, as the first and second most important barriers to harmonization, respectively. The industry ranked ‘unable to build consensus on harmonization priorities’ and ‘harmonization specification may be too restrictive’ as the first and second most important barriers to harmonization, respectively.

Table 11: Perceived Barriers to Harmonization of Specifications in Manitoba

Perceived Barriers to Harmonization	Average Ranking* Responses	
	Industry	Agency
Trade-offs between agency specs too complex to measure	3	4
Lowest (inferior) specification may be adopted	6	1
My agency materials and QC/QA specifications are superior	4	5
Harmonized specification may be too restrictive	2	5
Harmonization may not focus on tests that matter	8	7
Harmonization may eliminate sources of aggregates/materials	5	2
Unable to build consensus on harmonization priorities	1	6
Harmonization goal not attainable or implementable	7	6
Unable to measure improvements due to harmonization	9	9
Harmonization may stifle innovation	9	8
<i>Other: Harmonization requires too much effort</i>	-	3

Note: * Ranking: 1=highest, 5=lowest

Strategies for overcoming the barriers/challenges to harmonization and future actions to implementing harmonization of specifications were evaluated from the agency and industry responses.

Table 12 presents the agency and industry ranking of the best approach to facilitate collaboration on harmonization in Manitoba. On average, the agencies ranked 'joint inter-agency specification committee' as the best approach to facilitate harmonization. The industry ranked 'joint industry-agency specification committee' as the best approach to facilitating harmonization of specifications.

Table 12: Best Approach to Facilitate Collaboration on Harmonization in Manitoba

Facilitate Collaboration	Ranking* Responses	
	Industry	Agency
Joint industry-agency specification committee	1	4
Joint inter-agency specification committee	2	1
Review specifications on case-by-case basis	6	2
Select one specification from competing specifications	5	3
Combine competing specifications into one specification	3	5
Make specification review publically available, including justification for lack of harmonization	4	7
Track and provide rationale for any unintended impacts of harmonization	5	5
Make harmonization a condition for specification considerations	7	6

Note: * Ranking: 1=highest, 5=lowest

CONCLUSIONS AND FINDINGS

A study was conducted to develop best practices for harmonizing highway construction specifications and standards, along with current barriers, and costs/benefits of harmonization implementation in Manitoba. A survey questionnaire was developed and distributed to agency and industry participants to obtain the key harmonization implementation issues and benefits including cost-effectiveness, trade-offs, cause for lack of harmonization, material and quality control (QC) and quality assurance (QA) delivery mechanisms, and potential barriers to harmonization. The results of the survey were used to provide recommendations for best practices for harmonizing standards and specifications.

The summary responses from the survey were the following:

- There is currently no harmonization of specification in Manitoba. The cause cited by the majority of responses was the 'lack of awareness of the need for harmonization'.
- The majority of the respondents indicated that the 'material specification' component was the most difficult to harmonize.
- The most likely benefits of harmonization of specifications were 'reduce proliferation of specifications' and 'minimize redundant or conflicting standards'.
- The most perceived barriers to harmonization of specifications were 'unable to build consensus on harmonizing priorities', and 'lowest (inferior) specification may be adopted'.
- The majority of respondents indicated that harmonization of specifications would reduce the cost by <5-10%.
- The majority of respondents indicated that harmonization of specifications would increase the quality/value of projects by from 5-25%.
- Manitoba plans to research the benefits of harmonization, with implementation within the next 2-3 years.

RECOMMENDED BEST PRACTICES FOR HARMONIZATION IMPLEMENTATIONS

The smooth implementation to the harmonization of specifications requires buy-in from all affected parties; agencies, contractors and material suppliers. Since implementing new technologies, new specifications, and procedure is challenging and risky, the barriers to change and the value of the improvements should be well defined. Strategies for overcoming the barriers/challenges and who should be responsible are required as future actions to implementing harmonization in Manitoba.

The following are recommended best practices for harmonization:

- Facilitate collaboration for harmonization by establishing 'joint industry-agency specification committee' and 'joint inter-agency specification committee' to build consensus on harmonization priorities and develop harmonized standards and specifications.
 - Adopt an implementation strategy with industry to disseminate information and technology transfer of specification changes, along with training needs. Provide technical assistance between agency and contractors to overcome barriers by sharing data and solutions to failures/problems encountered during implementation.
 - Ensure materials/technical research justify rationale for changing specification, so that lowest specification is not adopted and/or sources of materials are not eliminated.

The recommended best practices can be used by highway agencies to implement the best practices, and thereby realizing the benefits of harmonizing standards and specifications in their jurisdictions.

REFERENCES

City of Winnipeg Annual Report, City of Winnipeg Corporate Finance, Public Works. 2015,
<http://www.winnipeg.ca>

Manitoba, Annual Report Infrastructure and Transportation, 2014/2015,
<http://www.gov.mb.ca/MIT/reports>