



Vancouver, Canada

May 31 – June 3, 2017/ *Mai 31 – Juin 3, 2017*

A MAJOR TRANSPORTATION PROJECT: A CASE STUDY ON THE IMPLEMENTATION OF A SUSTAINABLE RATING SYSTEM FOR A MVRD MUNICIPALITY

Kirk, Tiffany^{1,5}, Froese, Thomas M.², Nelms, Cheryl³, and Zammar, Jimmy⁴

^{1,2,3} Department of Civil Engineering - Construction and Project Management, University of British Columbia, Canada

⁴ Senior Advisor, Capital Infrastructure Planning and Delivery, Canada

⁵ tiffk89@gmail.com

Abstract: In the past decade, numerous sustainable rating systems have been developed for large infrastructure projects. These systems facilitate and assess sustainable practices throughout the entirety of a project. Despite these systems' prevalence in international projects, there is only one large infrastructure project in the Metro Vancouver Regional District that has achieved a full rating system certification. This paper explores how to include sustainable rating systems as a tool to manage sustainability for more infrastructure projects in the Metro Vancouver Regional District to become certified. The main objective of this paper is to conduct a case study of a Metro Vancouver Regional District transportation project's inclusion of a sustainable rating system, Envision, during the planning phase of the project. The paper highlights the challenges, successes, impacts and recommendations for the inclusion of Envision. The methods adopted in this case study involve, first, a literature review of decision-method and lesson-learned case studies for the inclusion of Envision, and second, a series of interviews with the transportation project's project team to determine the lessons learned in selecting Envision. The deliverables are presented in a decision matrix and a lessons learned table organized by the Project Management Book of Knowledge – knowledge management areas. The results demonstrate that the main lessons learned were the outcome of the development a decision matrix, senior leadership endorsement, employee training in Envision techniques, and working within a limited time frame. Future project teams can use the concluded lessons learned to develop risk registers for using Envision for other projects.

1 INTRODUCTION

Municipalities in the Metro Vancouver Regional District (MVRD) aim to be on the leading edge of sustainability globally. Municipal strategies focus on enhancing local economies, neighborhoods and environments to meet the needs of future generations. Various strategies imply a need for the sustainable triple bottom line principle—economics, society and environment—to be included in all phases of construction projects (Janowitz 2014). The building industry has been successfully implementing sustainable principles into design and construction for over a decade through the use of rating systems like Leadership in Energy and Environmental Design (LEED), Comprehensive Assessment System for Building Environmental Efficiency (CASBEE), and Establishment Environmental Assessment Method (BREEAM) (Say and Anthony 2008). Although there are many systems being successfully applied internationally for building construction, there is no dominant rating system being used for large infrastructure projects. Rating systems and guidelines such as Envision, Greenroads, and Infrastructure Voluntary Evaluation Sustainability Tool (INVEST) are growing in use for infrastructure projects. Nevertheless, the authors are aware of only project to date in the MVRD—the North Vancouver Low

Level Road Project—that has received a sustainability rating system certification. The result is a challenge for other municipalities in the MVRD to determine the appropriate means and methods to include sustainable principles into the planning, design, construction and decommissioning for infrastructure projects. Understanding the challenges, successes, impacts and recommendations associated with rating systems can guide municipal strategies for proper sustainability management. For this reason, this paper focuses on examining another municipality's (other than North Vancouver's Low Level Road project) decision to include Envision in the planning process of a transportation project. At the request of the project team, the transportation project and municipality will remain anonymous.

The transportation project is one of the biggest expenditures in the MVRD. It is currently in the planning phase, and an RFQ has been issued for design services. The Project Management Office (PMO) recommended that a rating system be used to meet the overarching municipal priority to pioneer sustainability for the community, industry and the PMO. The result was the evaluation of multiple rating systems, and the selection of the rating system, Envision, to be included in the RFQ.

The Envision rating system is a holistic framework of 60 sustainability credits that includes the sustainable triple bottom principle of economy, environment and society in project design, construction and operation. The available credits are categorized into five sections: Quality of Life, Leadership, Resource Allocation, Natural World, and Climate and Risk (Envision 2017). It can be applied to widest range of projects including transportation, pipelines, transmission lines etc. (Gardel et al. 2012).

Although a final decision was made to proceed with Envision, the PMO emphasized one major finding during the evaluation process: there was a lack of knowledge in understanding the successes, challenges, impacts and recommendations encountered when using Envision during the projects' life cycle. It became apparent that the PMO needed to highlight the successes and challenges for the inclusion of Envision for the transportation project and for future projects.

For the purpose of this paper, successes and challenges will be defined by the Project Management Book of Knowledge (PMBOK) definition for lessons learned. Lessons learned include what went well (successes) and what did not (challenges). Each success and challenge will be further defined by the impact it had on the planning process and a recommendation for future decisions to include Envision for infrastructure projects in the municipality.

1.1 Objectives

The main objectives of this paper are to conduct a case study detailing the inclusion of Envision in the planning phase of the project and to identify the lessons learned. The sub-objectives are to outline the decision making process and highlight the problems, successes, impacts and recommendations encountered by a project team when selecting a rating system.

1.2 Methodology

The methods adopted to outline the challenges, successes, impacts and recommendations for the inclusion of Envision are as follows: (1) identify current literature discussing the inclusion of rating systems and the lessons learned for large infrastructure projects and (2) conduct a series of interviews with the project team from the transportation project to determine the decision method and lessons learned in selecting Envision.

The interviewees included the following the project team members: Project Manager, Utility Manager, Project and Quality Management Engineer, and the PMO Department Head. Each member was selected based on project involvement and availability. The interviews were a total of 60-minutes and were semi-structured. Each interview included 17 questions organized by the objectives and sub-objectives of this paper.

Considering that the case study is a qualitative analysis based on the experience of the project team, the epistemological framework known as constructivism will be used. Constructivism acknowledges that knowledge is constructed rather than discovered (Yazan 2015). Adopting such a philosophy will establish

how lessons learned are constructed. **Error! Reference source not found.** outlines how the research will move from a constructivism epistemology to the paper's main deliverables.

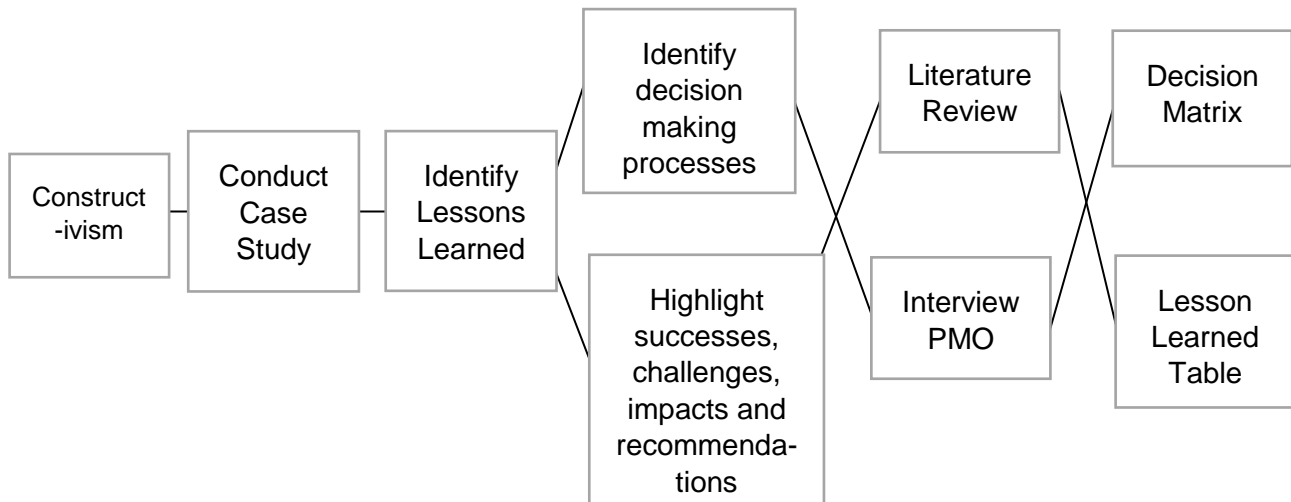


Figure 1 Research Road Map

2 LITERATURE REVIEW

2.1 Rating System Inclusion Methods

Current literature suggests multiple methods to understand and evaluate the differences between various rating systems for a specific project. Papajohn et al. (2016) establish a metaframework for assessing sustainability rating systems (MARS) for both building and infrastructure projects. Papajohn et al. (2016) argue for the creation of an assessment framework as a standardized framework is lacking in the evaluation of available rating systems. The methods include a literature review, analysis of current sustainable indicators and the development of a metaframework to evaluate what rating system to use on differing projects. The metaframework is broken down into 5 main assessment criteria: approach, setting, information, results and application. Each category is then ranked by performance indicators included in a given rating system for either building or infrastructure projects. The criteria indicators are scored, averaged and ranked in order to determine the best rating to use per project.

To evaluate how rating systems meet sustainable goals of an organization, Clevenger et al. (2016) suggest using the Analytical Hierarch Process (AHP). Clevenger et al.'s (2016) paper addresses how the Colorado Department of Transportation (CDOT) could use the AHP to determine what rating system to use for upcoming transportation projects. The paper compares the different rating systems to the CDOT objectives using AHP. The analysis aims to evaluate if it is a better choice to use the CDOT's own custom rating system or INVEST. The results demonstrate that INVEST ranked first and the custom rating system ranked fourth using the AHP as a decision-method.

For both the MARS and AHP decision making methods, the common result is to compare and rank sustainable targets of a project or municipality to rating system objectives. In this case study, the PMO came to a similar conclusion for the major transportation project. The main decision-making method used by the PMO was a comparative analysis of transportation and comprehensive rating systems in relation to municipal sustainability goals. The comparison identifies what systems work well and which do not, but does not outline clearly the key lessons learned when making a decision.

2.2 Lesson Learned Case Studies

Lessons learned can assist future project teams in the decision-making process. Gardel et al. (2012) discuss the importance of identifying lessons learned to understand how to select a rating system for four sewer projects in Omaha, Nebraska. The paper highlights the results of the decision-making process and the lessons learned. To achieve a triple bottom line principle on each project, the city made the decision to implement the Envision framework. The city held a series of workshops to incorporate Envision's framework into Omaha's target sustainable objectives. The key lessons learned are as follows: project teams should choose rating systems that are the most applicable to the widest range of projects; project teams should hold sustainability workshops early on in the design process; and project teams should choose rating systems that meet the most relevant objectives of a project.

Sheesley et al. (2014) conducted a case study of how to apply Envision to an oil field facility. The facility was designed and constructed before Envision was available. The paper focuses on the number of achievable points that the project could have received if Envision had been used. Similar to Gardel et al. (2012), the paper discusses the lessons learned when applying Envision but from a hypothetical assessment point of view. The lessons learned are as follows: the Envision rating system, if applied after project completion, can confirm the improved nature and built environment of a project that incorporates sustainable principles into its design and execution; the breakdown of sustainability into sub-categories demonstrates how different aspects of sustainability can be achieved on infrastructure projects; the operation and maintenance of a project has the largest impact on sustainability and should be included in the evaluation process; and re-using materials will reduce cost, transportation but also help the environment in the long-run.

The common outcome of each case study is to apply the objectives of Envision to manage sustainability for infrastructure projects. The preeminent attributes of Envision are that it is the most applicable rating system to the widest range of projects and it meets the most relevant sustainable objectives of different infrastructure projects. Moreover, each cases' lessons learned are stated as general points of discussion for future dialogues. Consequently, the lessons learned are limited by an inability to create a standardized lessons learned framework that clearly outlines problems, successes, impacts and recommendations for future use of Envision for large infrastructure projects.

3 DECISION METHOD AND PROCESS FOR SELECTING ENVISION

There were seven main steps taken by the project team in the decision-making process. The decision-making process was as follows:

1. Determine the most developed rating systems or sustainability guidelines;
2. Create a decision-matrix based on parameters that best meet municipal strategies and relevant project sectors;
3. Assess each rating system in relation to selected parameters by assigning qualitative and/or quantitative values to each rating system.
4. Select a rating system with the most suitable qualitative and quantitative values for the selected parameters.
5. Evaluate the pros and cons of the selected rating system and if the pros outweigh the cons then select the rating system.
6. Obtain approval from Senior Officials; and,
7. Include the selected rating system in the Project Definition.

The decision to include a rating system was made two weeks before the RFQ was issued for tender. Prior to the final decision being made, research student interns conducted extensive research to assess the

sustainable goals of the municipality in relation to the most developed rating systems. A custom sustainable rating system similar to Envision was also developed by the municipality to be included as a feasible option in the selection process. However, the PMO took into consideration two recommendations made by the Association of Consulting Engineering Companies (ACEC) (2014) to select a rating system. The first recommendation is that it does not make sense for Canadian associations to try to develop their own tool, simply because they will run into the same problems, frustrations, and limitations that others have experienced. For this reason, the option of a custom rating system was eliminated from the decision. The second recommendation is that no system is recommended as a universal panacea and a thorough study of any or all of them would help in developing an understanding of the subject. For this reason, the PMO expanded upon this recommendation by conducting a further analysis of rating systems from the previous work of the research students by developing a decision matrix.

The PMO considered the following parameters to analyze the most developed rating systems applicability to municipal sustainable objectives: years in place; depth of existing research and quality of triple bottom-line outcomes; number and location of current projects; comprehensiveness across infrastructure disciplines; adaptability to local codes, practices, geography, climate, project types; North American and global recognition; direct and indirect cost of application and certification; local training and support; scalability and opportunity to adapt across the PMO portfolio; learning opportunity for the PMO; and, potential for the municipality to drive improved practices in the wider economy.

Each rating system was compared to the listed parameters and then compared to the following municipal sustainability objectives: water, sewers, transportation, solid waste, energy, and neighborhoods. The main sustainable objectives of the municipality were compared to the most developed transportation and comprehensive systems. Each System was ranked qualitatively and quantitatively as seen in Table 1 Transportation Rating System Comparison (Anonymous Municipality, 2016)

Table 1 Transportation Rating System Comparison

	GreenRoads	INVEST	CGGR	GGR/Stantec	GreenLITES
Certification Fee	By Negotiation	N/A	N/A	Unclear	N/A
3 rd Party Evaluation	Yes	No	No	Unclear	No
Total Projects	100+	21 self-reported	Likely Several	Unclear	Unclear
Origin	USA, 2010	USA, 2012	Canada, 2015	USA, 2009	USA, 2008
Projects in Canada	8	0	Likely Several	Unclear	0
International Recognition	Medium	Low	Low	Low	Low
Recognition in Canada	Medium	Low	Medium	Low	Low
Estimate Learning Curve	Medium	Medium	Low	High	High

Relevant Sector Coverage for Transportation Project

Water	No	No	No	No	No
Sewers	No	No	No	No	No
Transportation	Yes	Yes	Yes	Yes	Yes
Solid Waste	No	No	No	No	No
Energy	No	No	No	No	No
Neighborhoods	No	No	No	No	No

Considered for
Transportation Project? X X ✓ X X

Table 1 shows the alternatives considered for the most developed transportation systems that included: GreenRoads, Invest, CGGR, GGR/Stantec, and GreenLITES. Based on this assessment, the best choice was the CGGR. The CGGR was developed in Canada and links practices to goals; however, it does not provide any direction on what warrants a rating in a specific context, which makes it more of a guideline than a rating system.

Accordingly, the project team took a more general approach and compared the most developed rating systems that can be applied to a wider range infrastructure projects rather than only transportation projects. The following systems were selected and compared as seen in Table 2: Envision, LEED-Neighborhood, CEEQUAL, BREEAM Infrastructure, BREEAM Communities and Infrastructure Sustainability. Of these, Envision was rated most highly. Envision has been successfully tested internationally, has a robust scoring methodology and provides training for project personnel. After weighing the pros and cons of each system, the PMO concluded that among the rating systems considered, Envision is the most suitable for adoption. It was approved by Senior Officials and included in the transportation projects RFQ.

Table 2 Comprehensive Rating System Comparison

	Envision	LEED-ND	CEEQUAL	BREEAM Infrastructure	BREEAM Communities	Infrastructure Sustainability
Certification Fee	\$38,400	\$38,000	\$26,300	Unclear	Unclear	\$41,000
3 rd Party Evaluation	Yes	Yes	Yes	Yes	Yes	Yes
Total Projects	19	160	260+	Piloting	Unclear	15
Origin	USA, 2012	USA, 2010	UK, 2003	UK, 2015	UK, 2008	Australia
Projects in Canada	2	17	0	0	0	0
International	Medium	High	Medium	Low	Medium	Low

Recognition						
Recognition in Canada	Medium	High	Low	Low	Low	Low
Estimate Learning Curve	Medium	Low	High	High	High	High
Relevant Sector Coverage for Transportation Project						
Water	Yes	Partial	Yes	Yes	No	Yes
Sewers	Yes	Partial	Yes	Yes	No	Yes
Transportation	Yes	Partial	Yes	Yes	No	Yes
Solid Waste	Yes	Partial	Yes	No	No	No
Energy	Yes	Partial	Yes	Yes	No	Yes
Neighborhoods	Partially	Yes	No	No	Yes	No
Considered for Transportation Project?	✓	X	X	X	X	X

4 LESSONS LEARNED

The decision method selected by the municipality outlines several key lessons learned for the project team. Table 3 summarizes the lessons learned to highlight the challenges, successes, impacts and recommendations for the inclusion of Envision. The table is categorized by the municipality's key issues based on the PMBOK – project management knowledge areas for scope, time, human resource and procurement. The issues, successes, challenges, impacts and recommendations are summary points from interviews with the project team. To validate the lessons learned, the table was approved and critiqued by the PMO Department Head for future discussion and development of a potential risk register for inclusion of rating systems.

Table 3 Lessons Learned

Category	Issue Name	Success/Challenge	Impact	Recommendation
Scope Management	Third Party Recognition	The PMO was challenged in that it had to make a rapid recommendation about whether to pursue Envision certification or to pilot Envision with an optional certification for the project.	The evaluation process took longer to complete because a more thorough comparison had to be conducted.	A good management practice for large infrastructure projects it is to pursue a proven third party certification because it drives decision-making, provides assurance of outcomes and signals the role of a municipality as a leader in the market.
Scope Management	Understand Rating Systems	The PMO successfully completed a study of the most developed	Evaluating the differences between the most developed	A good management practice is for a municipality to conduct a comprehensive study of various systems.

		systems.	systems helped the PMO develop an understanding of the subject.	Each study should compare the results concluded by department officials, research students and project personnel. All research should focus on the feasibility of each system in relation to municipal sustainability and infrastructure objectives and plans.
Scope Management	Scope of Work	The PMO successfully created a comparative framework in the form of a decision matrix to select a rating system that were the most applicable to the transportation project.	Comparing municipal and rating systems objectives identifies which rating systems are the most feasible for a specific projects scope of work.	A good management practice is for a municipality to create an decision matrix that compares municipal objectives to each system and to assign a qualitative and quantitative value as seen in Table 1 and 2.
Time Management	Third Party Validation	The PMO did not consult organizations or subject matter experts that were involved in projects that have an Envision certification because the decision was on the critical path.	The decision was not validated by third party experts or lessons learned from other certified projects.	A good management practice is for a municipality to hold interviews with organizations or subject matter experts involved in rating system projects.
Human Resource Management	Career Development	The PMO found that many rating systems do not apply training component for employees to gain from the certification process.	The lack of rating systems that apply a training component caused lower rating scores for other rating systems.	A good management practice is for a municipality to select a rating system that supports career development to enhance sustainable adoption and learning for future projects.
Procurement Management	Approval	The decision process gained buy-in from senior leadership to include a rating system for the transportation project.	There were no conflicts in the decision-making process and the rating system was approved to be included in the RFQ.	A good management practice is for senior leadership to mandate sustainability goals at the project level.

4.1 Scope Management

The main success in the decision-making process was the PMO's ability to create a comparative decision matrix as seen in Table 1 and 2 that highlighted not only municipal sustainability initiatives but also develops an understanding of rating systems.

There are still many sources of uncertainty for scope management. For example, all rating systems are undeveloped in terms of the number of local projects certified and overall international recognition. Contractors bidding on the project and Municipal Representatives may experience further difficulty in understanding how to design and construct the transportation project using Envision guidelines. Therefore, it is understandable why the PMO is challenged by the question of whether it is preferable to pursue Envision certification or to pilot Envision with an optional certification.

4.2 Time Management

The main challenge in selecting a rating system is time management. As mentioned in Section 3 – Decision Method and Process for Selecting Envision, the decision was on the critical path for issuing the RFQ to tender and the PMO finalized the decision with two weeks left. The municipality did have previous studies by department officials, research students and project personnel, but there was not enough time to conduct broader data collection and hold interviews with organizations or subject matter experts involved in rating system applications across Canada. The benefit of consulting third parties is that it would provide validation for the selected rating system.

4.3 Human Resource Management

It is important that a rating system apply a training component that supports career develop to enhance sustainable principles for future projects. Envision provides expert training for project personnel to become Envision Professional (ENV SP). The result is an estimated smaller learning curve and an increase in the municipality's ability to analyze the applicability of rating systems to the City's Engineering portfolio.

4.4 Procurement Management

Senior Leadership was responsible for mapping out future plans focused on sustainability. The sustainability goals are included in the strategic plan of the municipality. Although the final recommendation to include Envision was determined by the PMO, it is still senior leadership that mandated the inclusion of a rating system. Therefore, selecting a rating system needs to be accompanied with executive sponsorship in which senior leadership endorses not only the selected rating system at the project level, but also sustainability principles at the core of municipal strategies.

5 CONCLUSION

Numerous projects in North America and globally are increasingly adopting sustainable rating systems into project design and execution. The inclusion of Envision is becoming the dominate system in North America because it is the most applicable to the widest range of projects. However, there is still a limited number of certified projects in Canada and, in particular, the MVRD. The result is a lack of understanding as to the benefit of rating systems for large infrastructure projects.

This paper contributes to the body of knowledge by outlining the key lessons learned when including a rating system to achieve an optimal level of sustainability for a transportation project. The methods used develop a management structure for owners and contractors to translate the experience of project personnel into successes, challenges, impacts and recommendations for future projects. Moreover, the use of a case study provides a tested decision method, while the lessons learned facilitate further discussion about potential risks that project teams may encounter in the decision-making process.

The main successes for the municipality's evaluation of various rating systems can be attributed to the creation of a comparative decision matrix that qualitatively and quantitatively ranks each rating system to municipal sustainable objectives. The comparison was based on thorough research conducted by department officials, research students and project personnel to best understand the feasibility of rating systems. Furthermore, buy-in from all decision-making levels was achieved. Buy-in can be achieved through senior leadership mandating sustainability goals at the project level, and project employees receiving an ENV SP certification to enhance sustainable principles for future projects.

The main challenges for the inclusion of Envision can be attributed to the limited number of certified projects in the MVRD and limited time to consult with experts involved in rating system applications. Knowing the lessons learned from previous projects may have assisted in determining whether it was better to pursue Envision certification or to pilot Envision with an optional certification. Nonetheless, the challenges can be used as next steps in analyzing the applicability of rating systems for the PMO portfolio.

Future research is recommended into the next steps for the PMO inclusion of rating systems. The transportation project should be observed at various points of a projects life cycle, such as during the design or construction phases for a complete lessons learned evaluation. The research should also incorporate further interviews with experts in Canada who have been involved in rating system implementation and look at lessons learned from other certified projects. The information gained from further research will provide a better understanding of the feasibility of rating systems in large infrastructure projects for municipalities and contractors alike in the MVRD.

ACKNOWLEDGEMENTS

This research was supported by the Department of Civil Engineer for Construction and Project Management at the University of British Columbia and a municipality in the MVRD.

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