# Table of Contents

1. Introduction and Background................. 8  
   1.1 Country Context................................. 8  
   1.2 Objective of this Evaluation Design Report..... 8  
2. Overview of The Compact and The Interventions Evaluated........ 10  
   2.1 Overview of the project and implementation plan........ 10  
   2.1.1 Original project description............... 10  
   2.1.2 Project participants......................... 11  
   2.1.3 Geographical coverage....................... 11  
   2.1.4 Description of implementation to date......... 13  
   2.2 Theory of Change................................. 16  
   2.2.1 MCC Theory of Change....................... 16  
   2.3 Cost Benefit Analysis and Beneficiary Analysis........ 19  
   2.3.1 Cost Benefit Analysis......................... 19  
   2.3.2 Beneficiary Analysis......................... 19  
   2.4 Literature Review................................. 20  
   2.4.1 Access to resources.......................... 20  
   2.4.2 Poverty reduction.............................. 21  
   2.4.3 Trade offs........................................... 22  
   2.4.4 Policy Relevance of the Evaluation........... 23  
3. Evaluation Design................................. 23  
   3.1 Evaluation Questions............................... 23  
   3.2 Evaluation Design Overview...................... 25  
   3.3 Level of Precision Table......................... 26  
4. Research Question 0.................................. 40  
   4.1.1 Overview........................................ 40  
   4.1.2 Data Collection and Review................... 40  
5. Research Area 1 (RA1): Engineering Analysis & Economic Model........ 40  
   5.1 Research Area 1................................. 40  
   5.2 Methodology........................................ 40  
   5.2.1 General overview of methodology............ 40  
   5.2.2 Strategy for the definition of the counterfactual/base case/comparison group......... 41  
   5.3 Timeframe of exposure............................. 42  
   5.4 Primary Data Collection........................... 42  
   5.4.1 International Roughness Index................ 42  
   5.4.2 Surface Distress................................. 43
5.4.3 Geometric Parameters

5.5 Summary table

5.6 Secondary quantitative data

5.7 Analysis plan

5.8 Integration of evaluation areas

6. Research Area 2: Maintenance

6.1 Evaluation Question 2A

6.2 Methodology

6.2.1 General overview of methodology

6.2.2 How MCA monitoring data/implementation information will be used

6.2.3 Strategy for the definition of the counterfactual/base case/comparison group

6.2.4 Timeframe of exposure

6.3 Primary Data Collection

6.3.1 Key Information Interviews

6.4 Summary table

6.5 Secondary quantitative data

6.6 Analysis plan

6.7 Integration of evaluation areas

6.8 Evaluation Question 2B

6.9 Methodology

6.9.1 General overview of methodology

6.9.2 How MCA monitoring data/implementation information will be used

6.9.3 Strategy for the definition of the counterfactual/base case/comparison group

6.10 Timeframe of exposure

6.11 Primary Data Collection

6.11.1 Key Information Interviews

6.12 Summary table

6.13 Secondary quantitative data

6.14 Analysis plan

6.15 Integration of evaluation areas

6.16 Evaluation Question 2C

6.17 Methodology

6.17.1 General overview of methodology

6.17.2 How MCA monitoring data/implementation information will be used

6.17.3 Strategy for the definition of the counterfactual/base case/comparison group

6.18 Timeframe of exposure
6.19 Primary Data Collection.............................................................................................................. 53
6.19.1 Key Information Interviews ................................................................................................ 53
6.20 Summary table .................................................................................................................................. 54
6.21 Secondary quantitative data– ...................................................................................................... 54
6.22 Analysis plan...................................................................................................................................... 54
6.23 Integration of evaluation areas..................................................................................................... 54

7. Research Area 3A: Road Usage Patterns ...................................................................................... 55
7.1 Methodology ..................................................................................................................................... 55
7.1.1 General overview of methodology .......................................................................................... 55
7.1.2 How MCA monitoring data/implementation information will be used .................................. 55
7.1.3 Strategy for the definition of the counterfactual/base case/comparison group ...................... 55
7.2 Timeframe of exposure .................................................................................................................. 55
7.3 Primary Data Collection ................................................................................................................ 56
7.3.1 Traffic Count Survey ................................................................................................................ 56
7.3.2 Origin Destination Survey ......................................................................................................... 57
7.3.3 Key Informant Interviews ......................................................................................................... 58
7.4 Summary table .................................................................................................................................. 59
7.5 Secondary quantitative data– ........................................................................................................ 60
7.6 Analysis plan – Question 3A asks six questions: ......................................................................... 60
7.7 Integration of evaluation areas....................................................................................................... 60
7.8 Evaluation Question 3B ................................................................................................................ 60
7.9 Methodology .................................................................................................................................. 61
7.9.1 General overview of methodology .......................................................................................... 61
7.9.2 How MCA monitoring data/implementation information will be used .................................. 61
7.9.3 Strategy for the definition of the counterfactual/base case/comparison group ...................... 61
7.10 Timeframe of exposure ................................................................................................................ 61
7.11 Primary Data Collection .............................................................................................................. 61
7.11.1 Key Informant Interviews ...................................................................................................... 61
7.12 Summary table .................................................................................................................................. 62
7.13 Secondary quantitative data– ........................................................................................................ 62
7.14 Analysis plan – Question 3B asks two unique questions: ........................................................... 63
7.15 Integration of evaluation areas..................................................................................................... 63

8. Research Area 4: Transportation Market Structure ...................................................................... 63
8.1 Methodology .................................................................................................................................. 63
8.1.1 General overview of methodology .......................................................................................... 63
8.1.2 How MCA monitoring data/implementation information will be used .................................. 64
8.1.3 Strategy for the definition of the counterfactual/base case/comparison group ................... 64
8.2 Timeframe of exposure ........................................................................................................ 64
8.3 Primary Data Collection..................................................................................................... 64
  8.3.1 Key Information Interviews ......................................................................................... 64
8.4 Summary table .................................................................................................................. 66
8.5 Secondary data— ................................................................................................................ 66
  8.5.1 Requirements related to data capture .......................................................................... 67
  8.5.2 Data quality ................................................................................................................ 68
8.6 Analysis plan...................................................................................................................... 68
8.7 Integration of evaluation areas .......................................................................................... 68
9. Challenges ......................................................................................................................... 69
  9.1 Summary of Methodology to Estimate Post Compact ERR ........................................ 69
    9.1.1 Key Parameters ........................................................................................................ 69
    9.1.2 Findings from the review of the previous HDM-workspaces ...................................... 70
10. Administration .................................................................................................................. 73
  10.1 Summary of IRB Requirements and Clearances .......................................................... 73
  10.2 Approval from National, Provincial and District Authorities ........................................ 73
  10.3 Data Protection, Access and Documentation ............................................................... 74
  10.4 IMPACT Database ....................................................................................................... 74
  10.5 Dissemination Plan ....................................................................................................... 74
  10.6 Evaluation Team Roles and Responsibilities ............................................................... 74
  10.7 Organogram ................................................................................................................ 76
  10.8 Table: Evaluation Timeline & Reporting Schedule ..................................................... 77
  10.9 Evaluation Timeline and Reporting Schedule .............................................................. 79
11. Annexes ............................................................................................................................. 81
    Annex A: Map of Traffic Count and O-D Survey Locations ........................................... 81
    Annex B: References ........................................................................................................ 82
    Annex C: Comments and Responses .............................................................................. 83
    Annex D: Data Collection Options Removed from EDR ................................................. 107
## List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Descriptive Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>AADT</td>
<td>Annual Average Daily Traffic</td>
</tr>
<tr>
<td>AfDB</td>
<td>African Development Bank</td>
</tr>
<tr>
<td>ADT</td>
<td>Average Daily Traffic</td>
</tr>
<tr>
<td>BB</td>
<td>Benkelman Beam</td>
</tr>
<tr>
<td>BI</td>
<td>Bump Integrators</td>
</tr>
<tr>
<td>CBA</td>
<td>Cost-Benefit Analysis</td>
</tr>
<tr>
<td>CBR</td>
<td>California Bearing Ratio</td>
</tr>
<tr>
<td>CP</td>
<td>Condition Precedent</td>
</tr>
<tr>
<td>DCP</td>
<td>Dynamic Cone Penetrometer</td>
</tr>
<tr>
<td>EDR</td>
<td>Evaluation Design Report</td>
</tr>
<tr>
<td>EMC</td>
<td>Evaluation Management Committee</td>
</tr>
<tr>
<td>EMP</td>
<td>Evaluation Management Process</td>
</tr>
<tr>
<td>ERR/EIRR</td>
<td>Economic (Internal) Rate of Return</td>
</tr>
<tr>
<td>ESAL</td>
<td>Equivalent Standard Axle Load</td>
</tr>
<tr>
<td>GOM</td>
<td>Government of Mozambique</td>
</tr>
<tr>
<td>GPR</td>
<td>Ground Penetrating Radar</td>
</tr>
<tr>
<td>HDM-4</td>
<td>Highway Development and Management</td>
</tr>
<tr>
<td>INATTER</td>
<td>Instituto Nacional dos Transportes Terrestres</td>
</tr>
<tr>
<td>IRB</td>
<td>Institutional Review Board</td>
</tr>
<tr>
<td>IRI</td>
<td>International Roughness Index</td>
</tr>
<tr>
<td>KII</td>
<td>Key Informant Interview</td>
</tr>
<tr>
<td>LOE</td>
<td>Level of Effort</td>
</tr>
<tr>
<td>LTPP</td>
<td>Long-Term Pavement Performance</td>
</tr>
<tr>
<td>M&amp;E</td>
<td>Monitoring and Evaluation</td>
</tr>
<tr>
<td>MCA-M</td>
<td>Millennium Challenge Account Mozambique</td>
</tr>
<tr>
<td>MCC</td>
<td>Millennium Challenge Corporation</td>
</tr>
<tr>
<td>MTC</td>
<td>Manual Traffic Count</td>
</tr>
<tr>
<td>NPV</td>
<td>Net Present Value</td>
</tr>
<tr>
<td>N-S</td>
<td>North-South</td>
</tr>
<tr>
<td>O-D</td>
<td>Origin-Destination</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Descriptive Name</td>
</tr>
<tr>
<td>--------------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>ORN</td>
<td>Overseas Road Note</td>
</tr>
<tr>
<td>PSR</td>
<td>Present Serviceability Rating</td>
</tr>
<tr>
<td>RED</td>
<td>Road Economic Decision</td>
</tr>
<tr>
<td>RQ(s)</td>
<td>Research Question(s)</td>
</tr>
<tr>
<td>RTRRRMS</td>
<td>Response Type Road Roughness Measuring System</td>
</tr>
<tr>
<td>SADC</td>
<td>Southern Africa Development Community</td>
</tr>
<tr>
<td>SN</td>
<td>Structural Number</td>
</tr>
<tr>
<td>SNP</td>
<td>Adjusted Structural Number</td>
</tr>
<tr>
<td>TA</td>
<td>Technical Assistance</td>
</tr>
<tr>
<td>VOC</td>
<td>Vehicle Operating Cost</td>
</tr>
</tbody>
</table>
1. Introduction and Background

1.1 Country Context

MCC and the Government of Mozambique signed a Compact on 13 July 2007 for a USD 506.9 million grant. The grant’s purpose was to provide investments in water supply and sanitation infrastructure, road rehabilitation, land tenure services, and farmers’ income support. The road rehabilitation investment, with a total budget of $176,307,480, is the object of this evaluation design report.

MCC and the Government of Mozambique included a roads rehabilitation project in the Compact because they had identified poor transportation networks as a contributor to poverty throughout the country. The Government of Mozambique’s Action Plan for the Reduction of Absolute Poverty 2006-2009 details the evidence that informed the problem diagnosis. The diagnosis was based on four studies that were conducted between 1995 and 2005. These studies aimed to determine causes of poverty among Mozambicans. When the government disaggregated the studies’ data by community, rather than individual, it determined that “the symptoms and causes of poverty are a lack of basic infrastructures such as roads.” The MCC Compact Completion Report concurs, stating that poor roads led to limited investment in high-potential sectors.

Led in part by this analysis, the Road’s project was launched in 2008 and completed in 2014. The remainder of this document describes the project and IMC’s approach to its evaluation.

1.2 Objective of this Evaluation Design Report

MCC has contracted IMC Worldwide, Inc. (IMC) to conduct an ex-post performance evaluation of the Mozambique Roads Rehabilitation Project; herein the Roads Project. The evaluation will be undertaken in three phases:

![Overview of Evaluation Phases](image)


2 IMC’s Call Order Contract 95332418A0132 from MCC.
This EDR (phase 1 task 2) was built upon an Evaluability Assessment\(^3\), which was the result of the first task under phase 1 of the evaluation. The EDR is based on review of available documentation and a discovery trip to Mozambique that the evaluation team took in December 2018. The document review included an assessment of evaluation plan, the project’s economic rate of return (ERR) model, and existing data that informed the ERR model. During the discovery trip, the evaluation team met with key partner institutions and stakeholders to discuss their perspectives on the Roads Project and to understand the degree to which information that the evaluation requires is available.

Additionally, the evaluation team used the discovery visit to conduct a preliminary inspection of the road sections to appreciate characteristics of the road that determine its economic rate of return. These characteristics include:

- The relevance of the designs, including structure composition and drainage requirements.
- The safety of the roads, which affects benefits.
- The quality of the construction, which affects the sustainability of the investment and maintenance budget requirements.

The discovery trip also provided an opportunity to collect geometric input data (rise and fall and curvatures that feed into HDM-4) through geo-referenced, high definition videos of the project roads.\(^4\) These videos included an additional portion of the Namialo – Rio Lurio road section that was not rehabilitated, providing valuable insight of the counterfactual no-intervention scenario.

The objective of the Evaluation Design Report (EDR) is\(^5\):

- To allow MCC to review the evaluation plan’s technical rigor,
- To ensure that potential evaluation findings are relevant to the agency and its policies,
- To describe operational risks and the risk mitigation strategies that are in place,
- To describe how local stakeholders have been consulted and demonstrated adequate commitment.

Additional objectives of the EDR include detailing the evaluations methodology, showing how results and costs are rationalized, and how research is connected from large research questions, through sub-questions, to data collection instruments. Along these lines, the EDR describes:

- The evaluation plan including approach, methodology, tools, and timeframe,
- Data analysis and quality control strategies,
- Sample populations and sampling strategy,
- The research and evaluation questions and the methodological options to address them

In this Evaluation Design Report, the evaluation team:

---

\(^3\) The EA focuses on: i) Identification and understanding the logic and assumptions underlying the theory of change (including linkages between activities and outputs and how outputs were expected to lead to specified outcomes and indicators); ii) Identification of sources of information and data sources (including availability and reliability) for both baseline (i.e. before road rehabilitation) and subsequently (i.e. after completion); iii) Identification of gaps in necessary data and information and consideration of necessary measures to plug said gaps (to be developed further in the EDR) or other constraints identified and; iv) Consideration of potential issues to be explored in Research Questions (RQs) (to be proposed in the EDR) and how the monitoring information may be most effectively used in answering RQs.

\(^4\) Namialo-Rio Lurio (149.7km) and Nampula-Rio Ligonha (103km).

i) Sets out an overview of the Compact and the Road Project;  
ii) Proposes quantitative and qualitative evaluation designs for all Research Questions, and;  
iii) Summarizes the evaluation’s administrative protocols.

This EDR incorporates feedback and recommendations from MCC and stakeholders in Mozambique.

2. Overview of The Compact and The Interventions Evaluated

2.1 Overview of the project and implementation plan

The Compact between MCC and the Government of Mozambique came into force on 22 September 2008 for a duration of 5 years ending on 22 September 2013. The Compact close-out period terminated on 20 January 2014. The goal of the Compact was to reduce poverty in Mozambique through economic growth. The Compact’s program objective was to increase productive capacity in four northern provinces of Mozambique; Nampula, Niassa, Zambezia and Cabo Delgado. The Compact’s project objectives, which described the investment areas for which the grant was intended, were:

- Water Supply and Sanitation Project – increased access to reliable sources of potable water and improved sanitation;
- Roads Project – increased access to productive resources and markets whilst reducing transport costs;
- Land Tenure Services Project – efficient and secure land access for households, communities and investors; and,
- Farmer Income Support Project – product and healthy coconut supply and diversify farmers’ income.

On September 28th, 2018, MCC engaged IMC worldwide to conduct an ex/post performance evaluation of only the Roads Project.

2.1.1 Original project description

The objectives of the Roads Project were to:

- Improve access to markets, resources and services;
- Reduce transport costs for the private sector to facilitate investment and commercial traffic;
- Expand connectivity across all the northern region, and with the southern half of the country; and,
- Increase public transport access for individuals to take advantage of employment and other economic opportunities.

The Roads Project originally planned to rehabilitate some 493.7 kilometers of high-priority roads in three provinces (Cabo Delgado, Nampula and Zambezia). The roads under consideration were:

- Rio Lurio – Metoro: 74 kilometers
- Namialo – Rio Lurio: 149.7 kilometers

---

7 Mozambique Compact section 1.1 – 1.3 defines the goal, program objectives, and project objectives of the compact
• Nampula – Rio Ligonha: 103 kilometers
• Nicoadala – Chimuara: 167 kilometers

However, a re-scoping in January 2011 resulted in a 50 percent reduction of the project’s planned outputs, such that the Compact funded the rehabilitation of only two road sections, representing a total of 252.7 kilometers. These roads were:

• Namialo – Rio Lurio: 149.7 kilometers; and
• Nampula – Rio Ligonha: 103 kilometers.

An important condition precedent of the project required that a national paved road maintenance program include periodic maintenance of the whole road network. Funds for maintenance of rehabilitated roads are, in principle, assured by Mozambique’s Road Fund. The details of the periodic maintenance program included the following:

• Rolling eight-year planning period\(^8\);
• Provision for an annual program update (based upon additions to the paved road network);
• Detailed listing of all paved roads subject to periodic maintenance by year; and,
• Funding plan that includes 100% of routine and periodic maintenance works such that these works will be gradually funded, in increasing amounts, to 100% by user fees as of 10 years after the initial paved roads maintenance program.

2.1.2 Project participants

Project participants are people that participated in the technical assistance component of the Roads Project. The participants in the technical assistance component were implementing entities and management unit staff. The component worked to build their capacity to manage projects, emphasizing contract management particularly. Additionally, four monitoring and evaluation and Roads project staff were trained in HDM-4. Some MCA staff were trained in communications and finance.

2.1.3 Geographical coverage

The four roads originally considered were in Zambezia, Nampula and Cabo Delgado Provinces\(^9\). After the re-scoping the two roads selected for rehabilitation were both in Nampula Province. The roads in Nampula were originally selected for several reasons\(^10\):

• The roads are part of the N1, Mozambique’s national north-south road.
• The roads might increase commuter and light truck traffic north of Niamialo.
• They might assist the GoM’s strategy in attracting investors to the ‘growth poles’ the government was creating in Tete and the Nampula-Nacala corridor

---

\(^8\) A rolling plan is one which is continuously updated by adding a further accounting or planning period when the earliest such period has expired. Each year actual results are reported, a further forecast period is added and intermediate forecasts are updated

\(^9\) I.e Rio Lurio – Metoro: 74 kilometers (Cabo Delgado Province); Namialo – Rio Lurio: 149.7 kilometers (Nampula Province); Nampula – Rio Ligonha: 103 kilometers (Nampula Province); Nicoadala – Chimuara: 167 kilometers (Zambezia Province)

\(^10\) Memo titled “Trip Report and ERR Findings”; December 15, 2010; Theresa Osborne, Lead Economist
The locations of all roads are shown in the map below:
2.1.4 Description of implementation to date

The Roads Project comprises two components:

- Technical Assistance for the Roads Project
- Rehabilitation of the Roads.

Technical Assistance Component

The Technical Assistance (TA) component of the Roads Project aimed at capacity building activities for implementing entities and management unit staff, with particular emphasis on FIDIC\(^1\) contract management training, project management, MCA management and procurement or personnel. In addition, four M&E and Roads Project personnel attended an HDM-4 training course in UK whilst MCA personnel also attended three MCC training courses (Communications and Finance).

The TA component provided assistance at three stages in the project cycle:

- Phase I (Base option): Feasibility Study and Environmental Impact Assessment (EIA);
- Phase II (First Option): Detailed Design and Project Affected Persons (PAP);
- Phase III (Second Option): Supervision of works.

The project funded the following activities related to technical assistance:

- Feasibility studies, detailed designs, environmental assessment (ESIAs and construction activities for the roads (EN1);
- Implementation of ESMPs and RAPs including payment of compensation for physical and economic displacement of individuals, residences and businesses affected by road rehabilitation\(^12\), and implementation of HIV/AIDS awareness plans;
- Design and construction of drainage structures;
- Design and construction of bridges and rehabilitation of existing bridge structures;
- Posting of signage and incorporation other safety improvements;
- Project management, supervision and auditing of such improvements and upgrades.

Road rehabilitation

The project rehabilitated two roads:

- Namialo – Rio Lurio: 149.7 km (this segment was split into two contracts Namialo – Metuchi Bridge approximately 75km and Metuchi Bridge - Rio Lurio approximately 75km)
- Nampula – Rio Ligonha: 103 km

The scope of works for both roads included\(^13\):

- Widening the road from 6.0m to 10.8m comprising a carriageway width of 6.8m carriageway, 1.5m surfaced shoulders and 1.0 meter of uncoated berms;

\(^{11}\) FIDIC contracts are a suite of standardized contracts put out by the French organization Federation Internationale des Ingenieurs-Conseil

\(^{12}\) In compliance with WB Operational Policy on Involuntary Resettlement (OP 4.12)

\(^{13}\) The Namialo – Rio Lurio road segment was subject to demining operations for the road reserve.
• Strengthening of the road pavement (sub-base and base) to support a load capacity of up to 3.6 million standard axles over an economic design life of 15 years\(^{14}\);
• New and rehabilitated drainage structures and bridges on the roads compatible with the geometry of the rehabilitated roads;
• Road signs\(^{15}\);
• Optimization of social benefits for local communities;
• Resettlement and compensation of PAPs (Project Affected Persons)\(^{16}\).

The following works contracts were awarded:

**Nampula – Rio Ligonha (103km)**

<table>
<thead>
<tr>
<th>Starting Date</th>
<th>June 29 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>End date</td>
<td>April 21 2013</td>
</tr>
<tr>
<td>Contractor</td>
<td>Joint Venture CMC/RAZEL (Italy/France)</td>
</tr>
<tr>
<td>Value of Project</td>
<td>40,135,444.50 USD</td>
</tr>
</tbody>
</table>

**Namialo–Mecutuchi Bridge (75km)**

<table>
<thead>
<tr>
<th>Starting Date</th>
<th>June 29 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>End date</td>
<td>January 21 2013</td>
</tr>
<tr>
<td>Contractor</td>
<td>CMC di Ravenna (Italy)</td>
</tr>
<tr>
<td>Value of Project</td>
<td>44,152,300.35 USD</td>
</tr>
</tbody>
</table>

**Mecutuchi Bridge – Rio Lurio (75km)**

<table>
<thead>
<tr>
<th>Starting Date</th>
<th>August 1 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>End date</td>
<td>January 21 2013</td>
</tr>
<tr>
<td>Contractor</td>
<td>Joint Venture Monte Adriano/Casais (Portugal)</td>
</tr>
<tr>
<td>Value of Project</td>
<td>46,286,933.20 USD</td>
</tr>
</tbody>
</table>

Other contracts were awarded for associated activities:

\(^{14}\) In compliance with Southern Africa Transport and Communications Commission (SATCC) standard. It is noteworthy that the structural design of the roads was for 15 years, which warrants a structural reinforcement after 15 years, to be taken into account in the HDM-4 economic assessment as a capital investment year 15. Per generally acceptable accounting principles, a capital investment extends the life of a pavement whereas a periodic maintenance maintains the structure without adding value to the asset. Therefore, this intervention year 15 is not a periodic maintenance but another capital investment.

\(^{15}\) In compliance with Southern Africa Transport and Communications Commission (SATCC) standards

\(^{16}\) In compliance with WB Operational Policy on Involuntary Resettlement (OP 4.12)
Nampula – Rio Ligonha (103km)
SMEC (Supervising Engineer); TDM/Televisa (relocation of fiber optic cables); N’weti (implementation of HIV/AIDS sensitization); EDM/ELECON (re-siting of electricity pylons).

Namialo–Mecutuchi Bridge (75km)
Scott Wilson (Supervising Engineer); PROSIR/Scott Wilson (implementation of RAP); TDM/Televisa (relocation of fiber optic cable); EDM (Electricity of Mozambique)/ELECON (relocation of electricity services); N’weti (implementation of HIV/AIDS sensitization).

Mecutuchi Bridge – Rio Lurio (75km)
Scott Wilson (Supervising Engineer); PROSIR/Scott Wilson (implementation of RAP); TDM (Telecommunications of Mozambique)/Televisa (relocation of fiber optic cable); EDM (Electricity of Mozambique)/ELECON (relocation of electricity services); N’weti (implementation of HIV/AIDS sensitization).

No contracts were completed within the contract periods. Also, not all construction activities were completed within the Compact period. Contractors completed the balance of the works after the Compact Close-out period, with GoM financing. The situation at Compact Close-out is summarized below for each works contract:

<table>
<thead>
<tr>
<th>Contract</th>
<th>Percent completed at Compact Close-out (21 Sept 2013)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nampula – Rio Ligonha</td>
</tr>
<tr>
<td>Earthworks</td>
<td>99</td>
</tr>
<tr>
<td>Sub-base</td>
<td>99</td>
</tr>
<tr>
<td>Base</td>
<td>98</td>
</tr>
<tr>
<td>Prime coat</td>
<td>98</td>
</tr>
<tr>
<td>Double seal</td>
<td>80</td>
</tr>
<tr>
<td>Bridges</td>
<td>91</td>
</tr>
<tr>
<td>Drainage structures</td>
<td>76</td>
</tr>
<tr>
<td>Overall progress</td>
<td>85</td>
</tr>
<tr>
<td>Take-over of works</td>
<td>23 Nov 2013 (partial)</td>
</tr>
</tbody>
</table>

It appears that the contractors, although experienced in implementing works contracts financed by IFIs, did not appreciate until late in the contract periods, that MCC funding for contract payments would cease upon Compact end date.
All contracts were subject to delays, which led to cash-flow problems for the contractors who filed claims for extensions of time and additional costs. Although there was a contract provision for liquidated damages in case of late delivery, there is no record of such penalties being applied\textsuperscript{18}.

The original Compact budget for the Roads component was USD 176.3 million\textsuperscript{19} and this budget was maintained after re-scoping (which reduced the length of roads to be rehabilitated by 50%). Of this budget 67.6\% was disbursed within the Compact period – see below.

<table>
<thead>
<tr>
<th>Budget USD millions</th>
<th>Disbursement USD millions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original &amp; after re-scoping</td>
<td>Year 1</td>
</tr>
<tr>
<td>Roads component</td>
<td>176.3</td>
</tr>
<tr>
<td>Compact total</td>
<td>506.9</td>
</tr>
</tbody>
</table>

2.2 Theory of Change

2.2.1 MCC Theory of Change

A program logic diagram\textsuperscript{21} set out in Annex III of the Compact Agreement, and the Project Logic for the Roads Project\textsuperscript{22} are copied below.

\textsuperscript{18} Such contractual provision for liquidated damages is not uncommon, however, the evaluator has no experience of such penalties actually being applied on roads sector contracts in Mozambique.

\textsuperscript{19} The total budget for the Roads component comprised: Works – USD 173.3 million of which USD 116.3 million was disbursed ie 67.1\%; TA – USD 3 million of which USD 2.9 million was disbursed ie 95.2\%

\textsuperscript{20} By way of comparison disbursement percentages for other compact components were reported as: Water supply and sanitation 84.5\%; Land tenure services 89.7\%; Farmer income support 88.8\%; M&E 39.2\%; Program administration and oversight 73.3\%

\textsuperscript{21} Described in Annex III of the Compact Agreement as “a visual representation of the Program showing the sequence of outcomes and causality from the Project Objectives.”

\textsuperscript{22} Supplied to the evaluation team by MCC 26 October 2018.
Figure 1 Program Logic Diagram for Mozambique Compact
(sourced from Mozambique Compact, Annex III)
These two models, provided by MCC, illustrate the program logic for the Mozambique Compact and the project logic for the Road Rehabilitation Component. The models are most clear at the outcome and output levels. At the outcome level, the models present objectives that differ from the outcomes the Roads Project measured according to the monitoring and evaluation plan.

The goal of the Compact, presented more clearly in the Compact’s logic model compared to other project documents, states that the highest-level goal was to contribute to poverty reduction through economic growth in Northern Mozambique. The overall objective of the Compact was to increase productivity in Northern Mozambique. Differently stated, the four Compact projects (components) were intended to increase productivity leading to reduced poverty.

It is unclear if the Compact’s authors and the Roads Project’s designers and implementers agreed on the outcome-level objectives that would produce those higher-level goals. As shown above, the Compact’s logic model describes the main outcome of the Roads Project as increasing access to resources and markets. The Roads Project’s logic lists both increased income to households, presumably through increased access to markets, and includes reduced costs, which were not included in the Compact model.

However, the outcomes described in the Compact logic model were not incorporated into the Roads Project’s monitoring and evaluation plans. The Compact-wide monitoring and evaluation plan does list “household income” as a Compact goal but does not include a measurement of the Road Project Logic’s contribution to that goal, as implied by the project logic model above. The Roads Project Logic’s indicator tracking table includes as its outcome indicators change in international roughness index (IRI), total time savings, and average annual daily volume. Road quality is listed as an output indicator in the project logic model, of which the IRI is a proxy indicator. Time savings is a component of reduced transportation costs, though not a sufficient measurement, and represented as an outcome objective in the project model. However, it is unclear
if the project designers connected average annual daily traffic volume in the project logic model to outcomes such as reduced costs and increased household income.

The monitoring and evaluation plan comments that project managers determined it was too costly to measure the connection between the Roads Project Logic’s outputs and intended outcomes such as “household income and welfare.” The plan commits to requiring that contractors produce “detailed social assessments.” However, at the time of writing, the evaluation team has not received evidence that these “detailed social assessments” (other than coverage in ESIAs) were actually produced.

2.3 Cost Benefit Analysis and Beneficiary Analysis

2.3.1 Cost Benefit Analysis

The project’s monitoring and evaluation plan illustrates how inputs, outputs, and outcomes are linked, and how an economic rate of return (ERR) is derived from their causal connection.

The Monitoring and Evaluation Plan from 2009 calculated the original ERR based on the World Bank’s Roads Economic Decision (RED) model methodology for estimating the benefits of reduced transportation costs. The model specifically estimated benefits from reduced vehicle operating costs and time savings. The project’s three outcome level indicators; IRI improvement, time savings, and traffic volume; are connected to the costs and time savings inputs into the RED.

In 2012, revised ERRs were calculated using the Highway Development and Maintenance Model (HDM-4). According to the Compact Closeout Monitoring and Evaluation Plan, the switch from the RED model to the HDM-4 model was justified considering that “1) the Namialo - Rio Lurio and the Nampula – Rio Ligonha road segments are properly classified as highways as opposed to rural roads and, therefore, traffic volumes should be given appropriate weights in the analysis and 2) the analysts’ wished to evaluate the probability of deterioration of the roads according to alternative ‘with’ and ‘without’ and ‘high’ versus ‘low’ maintenance cost scenarios.”

Regarding project inputs into HDM-4, such as condition data, structural strength, geometrical metrics, unit vehicle costs and characteristics, rehabilitation structures (thicknesses), timely maintenance interventions simulated, and budget items, it is not clear at this time whether these were appropriately captured.

2.3.2 Beneficiary Analysis

The Mozambique Investment Memo dated June 2007 describes the benefits that the project aimed to deliver to beneficiaries. These benefits included reduced vehicle operating costs, reduced

---

25 The HDM-4 is a computer program used for analysis of the total transport costs of alternative road improvement and maintenance strategies through a life-cycle economic evaluation. The HDM-4 computer program provides detailed modeling of pavement deterioration and maintenance effects and calculates the annual costs of road construction, maintenance, vehicle operation, and travel time needed to assess alternative improvement and/or maintenance strategies.
26 Given that the section of EN1 north of the MCC rehabilitated section (Namialo - Rio Lurio) has not been subsequently rehabilitated (ie Rio Lurio - Metoro) it should be possible to make ‘counter-factual’ comparison for this MCC road
travel time, increased safety, increased commercial traffic, and more efficient public transportation. The benefits were expected to result in a reduction in the price of goods and higher farm gate prices. Also, ease of transportation was expected to facilitate easier access to health and education, and more efficient access to previously less accessible employment opportunities. However, The assumption that beneficiaries will all benefit from better access to social facilities and economic opportunities due to rehabilitated roads potentially generates some bias due to the fact that other external shocks (i.e. increase in private consumption or subsidies to local transport services) can also contribute to expanded demand for better road services.

2.4 Literature Review

The goal of the Mozambique Compact was to reduce poverty through economic growth. The Roads project component contributed to this goal through its main objective "Increase access to productive resources and markets while reducing transportation costs." The objective assumed that achieving its results would lead to “increased investment and commercial traffic, and improve access to markets, resources, and services.” This section discusses existing literature and the degree to which it provides evidence for the idea that rehabilitated roads lead to the results that the Mozambique Compact targeted. The literature that the evaluation team reviewed provides evidence that transportation infrastructure investment, and particularly road investment, can achieve MCC’s objectives. However, it also highlights that road investment alone is not sufficient to achieve MCC’s targets and the importance of road investment coming in combination with other factors. The literature also presents evidence that the benefits of road investment are not equally distributed, and that realizing benefits may require significant trade-offs.

2.4.1 Access to resources

Four of the papers that the team reviewed discussed how investment in transportation infrastructure, and particularly roads, led to increased access to resources that increased household incomes, increased productivity, and reduced poverty.

“On Measuring The Benefits of Lower Transportation Costs” by Hanan Jacoby and Bart Minen seeks to develop a generalizable model for understanding the benefits of road projects in rural Africa. The model that the paper develops shows how incomes would increase due to the lower cost of transporting agricultural products. However, the paper also demonstrates that the income from reduced freight transportation is much smaller than increased access to non-farm earnings (Jacoby & Minen, 2008). (RQ1, RQ3, RQ4)

“Roads and Farming: The Effect of Infrastructure Improvement on Agricultural Input Use, Farm Productivity and Market Participation in Kenya” provides evidence that road improvements in Kenya increased access to improved agricultural inputs and technology. It found that areas in Kenya with improved roads had greater “use of maize hybrid seeds, chemical fertilizers, maize productivity and milk market participation.” This paper also showed that more remote areas, with

---

28 Mozambique Investment Memo, pg. 13
29 The Investment Memo (2007) stated “With over half of the population over working age, many families could benefit from improved employment opportunities as more accessible roads open up communities to neighboring areas.”
30 Evaluation ToR
31 Ibid
poorer road access before the road improvement, received greater benefit particularly in the initial phase of the improvement (Philemon Kiprono, 2014) \textbf{(RQ3A, RQ4)}

Shilpa Aggarwal also found that farmers adopt new technologies faster when road access is provided to rural areas. She studies a road construction project in rural India and found that farmers that had access to the new roads were more likely to adopt new technologies, “such as chemical fertilizer and hybrid seeds (Aggarwal, 2013). \textbf{(RQ3A, RQ4)}

In Brazil, The World Bank showed that improved rural roads were shown to change transportation choices, which allowed improved connections to resources and services. As usage of public buses and individual cars increased, school attendance increased, “particularly by girls.” The study also indicated, albeit with weak statistical evidence, that the road project had increased jobs in the agriculture sector (Atsushi limi, 2015). \textbf{(RQ3B, RQ4)}

\textbf{2.4.2 Poverty reduction}

Six of the papers that the evaluation team reviewed discussed the impact of new or improved roads on poverty reduction. The papers agreed that road and/or transportation infrastructure investment can lead to reduced poverty. However, the papers also point out that other factors must be in place for poverty reduction to occur.

The paper “The Brasilia Experiment: Road Access and Spatial Pattern” studied the impact of rapid road expansion on the economic activity and allocation of population across Brazil’s municipalities over a 30 year period. The paper is unique because it studies the history of Brasilia and its road network. Brasilia “was built from scratch between 1956 and 1960.” The builders of the city also created a road network intended to draw population and economic activity away from Brazil’s southern coast. The intentional construction created a historical experiment. The paper found that the creation of the road network “resulted in a fall in inequality across municipalities” among other findings. The paper explains that its results show how the design of a road network impacts economic development. Among the important variables to consider when improving road access is “where the improved access leads to,” and the initial economic conditions of the connected points. The paper points out that increases or decreases in population and GDP “can in part be explained by the initial economic characteristics of the end-points (Bird & Straub, 2014).” \textbf{(RQ1, 3A, 3B, 4)}

In the frequently cited paper, “On the Road: Access to Transportation Infrastructure and economic growth in China,” The authors estimate the economic outcomes that resulted from access to transportation networks. The paper looks at a period of rapid economic growth in China, and seeks to determine whether access to transportation networks had causal effect on per capita GDP levels. The paper found that access to transportation networks has a “moderate positive causal effect on per capita GDP levels across sectors, but not effect on per capita GDP growth.” The paper finds that investment in infrastructure might have brought economic growth for the economy as a whole, but did not see a difference in economic growth between areas connected to infrastructures and those that weren’t. The paper explains this result, saying that it “does not rule out the possibility that infrastructure had benefits for all of them, but the lack of factor mobility prevented the gains from being concentrated in relatively better-connected areas.” In other words, the transportation infrastructure was not sufficient, and factor mobility to connected areas was an important consideration. The paper goes on to state, “Transportation investment can promote economic development, but other factors are also important in its success (Banerjess, Duflo, & Qian, 2012).” \textbf{(RQ1, 3B, 4)}
“Rural Roads and Local Economic Development,” by Sam Asher and Paul Novosad agrees with the previous paper’s conclusion. This paper, which looks at the effects of rural road construction on Indian village economies during a period of rapid economic growth in India, finds that “Roads cause a substantial increase in the availability of transportation services, but we find no evidence for increases in agricultural production, assets, or income.” The paper concludes that “rural growth is constrained by more than the poor state of transportation infrastructure,” suggesting that factors must also be addressed in coordination with roads to reduce poverty. (RQ1, 4)

Other papers found a more direct relationship between decreased transportation costs and economic benefit. “The Effects of Roads on Trade and Migration: Evidence from a Planned Capital City” reflects on Brasília, as did Bird and Struab’s 2014 paper. This paper looks specifically at how decreased transportation costs affected welfare and migration. The paper finds that the road network “decreased migration costs by 11% and trade costs by 28%.” The paper finds the result of these decreased costs was a 13.3% increase in welfare (Morten & Oliveira, 2018). Similarly, “Transportation Costs and The Spatial Organization of Economic Activity” looked at the organization of economic activity and its relationship to transportation costs. This paper found that, “transportation infrastructure has similar effects on the organization of economic activity across a range of countries and levels of development,” implying that findings in this literature review’s other papers could reasonably be considered in the context of Mozambique. Also, among other findings, the paper stated “highways and railroads cause an increase in economic activity in rural areas near highways (Redding & Turner, 2014).” Finally, “The Impact of Agricultural Extension and Roads on Poverty and Consumption Growth in Fifteen Ethiopian Villages” found a causal relationship between the public investments in road quality and “faster consumption and lower rates of poverty” within its area of study (Dercon, Gilligan, Hoddinott, & Woldeanna, 2008). (RQ1, 3A, 3B, 4)

2.4.3 Trade offs

Several papers discussed the trade-offs that realizing benefits from improved transportation or road infrastructure may require.

“Transport Corridors and Their Wider Economic Benefits: A Critical Review of the Literature,” discusses benefits and trade-offs of transportation infrastructure, including roads. The authors recognize that “average impacts are beneficial.” They also point out that environmental and social inclusion results may not be positive. The paper also discusses the way that economic outcomes may be positive on average, but are not equal, and that some “segments of the population might lose in absolute terms.” The paper also finds that transportation infrastructure projects with urban end-points, or that connect to borders or ports “yield significantly smaller or less certain impacts than projects that target purely internal enhancements of connectivity (Roberts, Melecky, Bougna, & Zu, 2018).” (RQ4)

The previously discussed Redding and Turner 2014 paper also discusses trade-offs. The paper discusses several other pieces of research that found that “decreasing transportation costs leads population to migrate to the lower density periphery. Here, reductions in transportation costs reduce central city population density. Baum-Snow et al. (2012) finds that manufacturing decentralizes along with population.” Thus, an example is provided where improved roads or transportation infrastructure may result in localized negative economic results. Shilpa Aggarwal, in her study of rural road access in India, points to the potential for more specific trade-offs,
showing that increased rural road access in India led to higher rates of high-school students dropping out of school, with the potential lifetime decrease in wages of 6.9% (Aggarwal, 2013).

Ken Gwilliam’s thorough discussion of transportation infrastructure in Africa points out the difficulty in realizing economic benefits from road construction in Africa. His paper points out that “Roads are expensive and difficult to maintain,” and that “freight industries are corrupt.” He also shows that the fiscal burden of maintain road networks in Africa is higher than the world average (Gwilliam, 2011). (RQ2A, 2B)

Finally, Morten and Oliviera point out that road building may facilitate undesirable migration, particularly into very remote areas. They state that, “The implications of this form of rent-seeking for public investments and spatial development are potentially far-reaching (Morten & Oliveira, 2018).”

2.4.4 Policy Relevance of the Evaluation

Our literature review reflects on the factors that must combine with road infrastructure investment to realize MCC’s intended results. As the evaluation discovers the degree to which the Road’s project achieved objective level results such as the degree to which road users access productive resources and markets while reducing transportation costs, the evaluation will identify that complementary factors in place that allowed the realization of these results.

The evaluation’s comparison of a current HDM-4 model to the model used as a decision-making tool for road funding will allow the evaluation to demonstrate how well HDM-4 performed, and where it fell short, if at all. If the evaluation finds that HDM-4 fell short as a tool for making road investment decisions, the evaluation will look at external factors, like those discussed in the literature review, to determine how the tool could have been used better, and which factors most contributed to the project’s outcome level results.

3. Evaluation Design

3.1 Evaluation Questions

The evaluation will address the following research areas and questions:

Research Question 0, was the project implemented according to plan examines whether:

- Was the project implemented according to plan? Were there any deviations from the original design?

Answering RQ0 will determine the degree to which the project outputs were delivered according to plan and lead to identification of lessons and recommendations relevant to future Compact designs.

These questions will result in an understanding of changes during preparation and project re-scoping. The team will also understand the relevance, rigor and appropriateness of detailed designs, and subsequent design variations. The evaluation will assess the timeliness and costs of outputs and the perspectives of roads project stakeholders on efficiency and effectiveness of implementation.

Research Area 1, Engineering Analysis and Economic Model, calculates the economic rate of return (ERR) of the road investment. It makes this calculation through a calibration of the HDM-4 deterioration models based on the present condition of the roads, and a projection of future deterioration, which is based on a period of observation. The evaluation team will perform a
recalculation of the project ERR with HDM-4 based on the final rehabilitation/construction costs of the road improvements. The evaluation team will create a more reliable estimate of the vehicle operating costs and travel times based on the calibrated deterioration models and a traffic analysis on the improved roads to evaluate deviations in relation to initial forecasts.

The research area’s central question is What is the economic return – calculated in terms of vehicle operating cost (VOC) savings and travel time savings – of the road investment? What factors drove changes to the Economic Rate of Return (ERR) over time? How could the project have been designed to result in a higher ERR? [ERR provides an estimate of increased household income]

**Research Area 2, Maintenance** will identify ANE’s maintenance practices and determine if those practices will be maintained for the life of the investment. The research area will derive the set of maintenance assumptions the evaluation will use in the HDM-4 model and seek to understand the political influence and externally imposed maintenance budget constraints. Under this research area, the team will evaluate factors such as traffic volume, vehicle weights, environment variables that impact the roads. Analysis will also compare planned and actual maintenance on the network over the given period, records permitting.

**Primary Research Area 2 Questions:**

RQ2A: What are the relevant road authority’s current maintenance practices and what is the likelihood that MCC’s investment will remain adequately maintained for the life of the investment? Based on this assessment, what set of maintenance assumptions should be used in the HDM-4 model to yield the best estimate of the costs and benefits of the road investment? [MCC’s project logic assumes that proper maintenance leads to reduced transportation costs in the form of reduce VOCs and travel time.]

RQ2B: In cases where MCC invested in improving maintenance practices or included a maintenance Conditions Precedent in the Compact (applicable to Mozambique), what were the effects of those efforts and why? [MCC’s project logic assumes that proper maintenance leads to reduced transportation costs in the form of reduce VOCs and travel time.]

**Research Area 3, Road Usage Patterns,** will confirm the various categories of users and their patterns of use, measure current income and expenditures along the transport routes and analyze both supply side changes in terms of the changes in transportation modes, usage patterns and how products are being moved.

Central research area 3 question: Who is traveling on the road, why, what they are transporting, what they are paying for transport, and how long does it take to move along key routes? [MCC’s Roads Project logic model assumes that diverted and generated/induced traffic is generated by reduced transportation costs and leads to increased household incomes]:

**Evaluation Area 4, Transportation Market Structure,** will investigate the extent to which the MCC investment has had an effect on the efficiency of the overall market and the correlation between assumed cost savings and the transfer of pricing and other costs between providers and consumers. It will evaluate the actual distribution of benefits of the MCC road investment for road users and to understand how the vehicle operating savings resulting from road improvements are passed on to transport consumers and assess the transport market structure and what formal and informal governance and regulatory structures around this.

The research area 4 central question: How is the transportation market currently structured (and have any VOC savings resulting from the MCC investment been passed on to customers by
transport operators - freight and passengers)? [In order for MCC’s Roads Project logic model to hold true, consumers and producers must capture the benefits of reduced transportation costs, so diverted and generated traffic is incentivized and household incomes increase]

3.2 Evaluation Design Overview

In this section we provide an overview of the evaluation to show how the research areas and RQ0 are linked. This section provides a summary of the evaluation questions and how the team will answer them (Table 2). Table 2 also presents an estimated cost of answering the questions under each research area. Before presenting the summary table, we describe the data collection options and the relative level of precision with which each option can calculate the ERR. Finally, in this section, we provide a detailed methodology for answering each research question posed in the evaluation’s scope of work.

The methodology for this evaluation comprises a performance evaluation and an economic analysis. The economic analysis while not the central focus of the evaluation, is a pinnacle aspect of the evaluation. It seeks to discover whether investments financed by the MCC created the intended Economic Rate of Return (ERR). The evaluation also seeks to discover if and how economic benefits, in the form of reduced vehicle operating costs and time savings, are experienced and captured by stakeholders. In general terms, the economic analysis is a comparison between the costs necessary to improve roads in Mozambique to the expected benefits that result. Costs include rehabilitation and construction costs, and routine and periodic maintenance costs. The nature of benefits that are realized from improving roads can vary. As a proxy, and in line with MCC’s Principles to Practice research, the economic analysis estimates economic benefits by calculating the decline in vehicle operating costs and time savings for users of the roads built with MCC grants. A portion of the data collected under all research areas will feed into the assumptions that inform economic analysis.

The economic analysis identifies and unpacks the underpinning drivers of Economic Rate of Return changes over time and provides learning regarding what MCC can do to promote better ERR for future similar road investment projects. In HDM-IV, the evaluation’s economic analysis model, the primary drivers of the economic analysis are traffic count, vehicle operating cost (VOC), travel time, IRI, and investment costs. Examples of potential lessons the analysis may generate include ways to avoid under-designed roads that result in excessive maintenance costs or over-designed roads that result in excessive construction costs.

The performance evaluation will identify factors in project implementation that influenced economic results. It will also provide depth and narrative around economic analysis results so that economic results are better understood by the project’s stakeholders. The performance evaluation also complies with MCC’s requirement that each project conduct an independent evaluation that measures the achievement of results.

The evaluation design uses a mixed method approach, comprising qualitative and quantitative data collection from primary and relevant secondary sources. Primary data collection utilizes targeted sampling for the various proposed surveys, for example: Origin-Destination surveys, engineering assessments, traffic counts, journey times calculations, and axle loading measurements.

32 Note that the Other Direct Cost (ODC) budget of each estimate includes travel, transportation, perdiems, DBA, Database integration, Savings from Original Budget.
Appropriate sampling strategies have been developed which take the evaluability assessment findings into consideration.

### 3.3 Level of Precision Table

The HDM-4 software requires a number of inputs and defined assumptions to calculate the ERR of a road investment. Inputs are provided about the state of the road at the initiation of construction or rehabilitation activities, and the state of the road at some future period. The future period can be at the end of construction or some period beyond the end of construction when traffic characteristics have had an opportunity to change in reference to the new or rehabilitated infrastructure. Inputs from this future period can either be collected through primary data collection activities, or assumptions based on observation and review of secondary data. Inputs collected through primary data collection are most accurate, but they are also the most expensive means of collecting data for use with HDM-4 software. The cost of collecting primary data must be balanced against the level of accuracy that it provides. The table below shows the level of accuracy with which the evaluation team can use HDM-4 to estimate the Mozambique Roads Project’s ERR given the inclusion of different primary data collection tools, or their exclusion in favor of lower-cost but less accurate secondary data substitutions.
### Table 1 Precision Table

<table>
<thead>
<tr>
<th>Options</th>
<th>Option 1</th>
<th>Option 2</th>
<th>Option 3</th>
<th>Option 4</th>
<th>Option 5</th>
<th>Option 6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Excludes Deflection</td>
<td>Excludes Surface Distress</td>
<td>Excludes Geometric Parameters (curvature, rise and fall, altitude)</td>
<td>Excludes Traffic Count Survey</td>
<td>Excludes IRI</td>
<td>Excludes Geotechnical (boring &amp; coring samples)</td>
</tr>
<tr>
<td>Assumptions</td>
<td>• Evaluation team would use the deflection measures performed in 2009 and 2015.</td>
<td>• The evaluation team cannot assess the reliability of surface distress information collected in 2009. Assume use of video collected by evaluation team in 2018.</td>
<td>• Assume Google Earth and GIS tools will provide the adequate amount of information and data to assess geometric parameters, without using surveyors.</td>
<td>• Assumed traffic count figures are accurate, from 2009 data. The evaluation team cannot assess the reliability of traffic measures as they were collected in 2009, except to say that no quality control forms were provided with any supervisory input. Also, factors indicated in technical reports differ significantly from those in</td>
<td>• It is difficult to assess the accuracy of the IRI data as we are not aware of any calibration procedures or protocols that were taken during the data collection.</td>
<td>• The evaluation team, after thorough review of design and as built documents cannot determine the accurate composition of the roads. The evaluation team is uncertain as to whether a combination of asphalt and cement were used in the construction of both roads. Thus, the team assumes, by visual observation (when in country in December 2018) that cement was used as part of the base and/or subsurface of the road.</td>
</tr>
</tbody>
</table>
**Implications on analysis and interpretation**

- Deflection is required in HDM-4 before works. Only the deflections before the intervention are required as input in the HDM-4 simulation, therefore, a measurement in 2019 (after the intervention) is useless except to determine if the pavement is structurally sound.

- The evaluation team does not recommend collecting deflection data in 2019.

- The evaluation team proposes to obtain the distress data from the videos collected during the trip the which the team took in December 2018. This will allow the team to determine the evolution of road conditions after works in order to calibrate longitudinal and transversal cracking, edge cracking, raveling.

- Geometric parameters (curvature, rise and fall, altitude) are assessable via Google Earth. The use of surveyors is possible but would not justify the expense based on the marginal impact on the range of ERR.

- The evaluation team will assess traffic volume with traffic counts performed in 2019, loading composition from weight stations to be obtained in 2019, traffic growth to be deduced from the evolution in traffic between 2009 and 2019, and seasonality factors to be assessed in 2019.

- The vehicle user cost models require IRI as inputs. The evaluation team proposes to collect the IRI data in 2019. This data will be used to determine calibration factors for the HDM-4 IRI model.

- The evaluation team, based on the fact that we are uncertain of the full composition of the roads suggests that determining the pavement layer thicknesses, characteristics, structural coefficients and structural number are required to get any level of accuracy in the ERR HDM-4.
<table>
<thead>
<tr>
<th>Estimated Range of ERR&lt;sup&gt;33&lt;/sup&gt;</th>
<th>1%</th>
<th>17%</th>
<th>1%</th>
<th>10%</th>
<th>6%</th>
<th>N/A</th>
</tr>
</thead>
</table>

+/-40% the disparity between simulations (uncertainty of input as the full composition of the road is not clear). Based on the design and as built documents provided, and visual observations in December 2018, the evaluator strongly recommends conducting at least minimal boring & coring samples.

---

<sup>33</sup> Percentages provided indicate the relative error on the ERR should these data collection options not be exercised. Full Sensitivity analysis submitted with EDR
## Table 2: Evaluation Design Overview Table

<table>
<thead>
<tr>
<th>Evaluation Question</th>
<th>Program Logic Result</th>
<th>Indicator Name</th>
<th>Unit</th>
<th>Definition</th>
<th>Baseline Value &amp; Source</th>
<th>Closeout Value &amp; Source</th>
<th>Post-Compact: Proposed New Data Source</th>
<th>Data Quality Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>RQ0: Was the program implemented according to plan?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the project implemented according to plan? Were there any deviations from the original design?</td>
<td></td>
<td>Indicators we will use to measure project results</td>
<td></td>
<td>Feasibility studies, re-scoping reports, detailed designs, due diligence reports, construction contracts and programs (contractors/supervision consultants)</td>
<td>Closeout documentation and reports, CCR, Implementation progress reports, contract completion/hand over reports, closeout documentation and reports, CCR</td>
<td>Evaluation analysis - comparisons of targets as set out: originally, compact signature, feasibility stage, re-scoping stage, final Evaluation analysis - comparisons of designs and specifications - feasibility stage, detailed design, as built</td>
<td>Interviews with stakeholders during visit to Mozambique in December 2018; continual engagement with stakeholders throughout evaluation implementation</td>
<td></td>
</tr>
<tr>
<td>RA1 Engineering Analysis &amp; Economics Model</td>
<td></td>
<td>Engineering/ESIA Resettlement Implementation Construction Construction Supervision Social Infrastructure/GSI Administrative Costs Monitoring and evaluation</td>
<td>USD</td>
<td>The costs associated with engineering and environmental and social impact assessments. Costs associated with implementing any required resettlement do to road construction/rehabilitation. Actual cost of construction with 10 percent contingencies. Costs associated with the supervision</td>
<td>Estimated costs</td>
<td>SMEC ESIA The evaluation team has been provided with the last updated total costs (2014) of what appears to be the implemented alternatives for both roads.</td>
<td>(1) Actual costs from project documentation (2) The costs associated with engineering and environmental and social impact assessments, are based on construction costs. The reliability of construction costs is questioned below.</td>
<td></td>
</tr>
</tbody>
</table>

### Research Question 1:
What is the economic return – calculated in terms of vehicle operating cost (VOC) savings and travel time (TT) savings – of the road investment? What factors drove changes to the Economic Rate of Return (ERR) over time? How could the project have been designed to result in a higher ERR?
<table>
<thead>
<tr>
<th>Construction costs</th>
<th>Costs associated with Social Infrastructure/GSI</th>
<th>Administrative costs associated with road construction and rehabilitation</th>
<th>Costs associated with monitoring and evaluation related to road construction</th>
<th>No justification on the bill of Quantity (2010) and &quot;mcc-err-mozambique-roads-closeout.xlsx&quot; (2014), no post-construction documentation available.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Improvement</strong></td>
<td><strong>Maintenance Costs</strong></td>
<td><strong>USD</strong></td>
<td><strong>Guidance from MCC on how to estimate maintenance costs before the project was implemented</strong></td>
<td><strong>Missing Information</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Note:</strong> The evaluation team did not observe any performed local maintenance except possibly some vegetation control. To estimate maintenance costs, the evaluation team will make assumptions based on the bill of quantities prepared by the design engineer, inquire with ANE during the next mission and other documents provided by MCC with maintenance cost information.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Engagement with stakeholders throughout evaluation implementation to check data</strong></td>
</tr>
<tr>
<td>Reduced Transportation Costs</td>
<td>Reduced Transportation Costs / Reinforcement of the base course</td>
<td>Reduced Transportation Costs</td>
<td>Travel Time</td>
<td>USD</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>---------------------------------------------------------------</td>
<td>-----------------------------</td>
<td>-------------</td>
<td>-----</td>
</tr>
<tr>
<td>IRI</td>
<td>m/km or mm/m</td>
<td>Road roughness measurement according to the International Roughness Index</td>
<td>IRI and surface distress information collected in 2009 and 2015</td>
<td>Missing Information</td>
</tr>
<tr>
<td>Deflection</td>
<td>µm or mm</td>
<td>Vertical deflection distance</td>
<td>(Phase 1) – FWD Test Report » provides the deflection measures performed between Sunday November 29th, 2009 and Friday December 4th, 2009 using PRI 2100 FWD Deflectometer</td>
<td>Missing Information</td>
</tr>
<tr>
<td>Travel Time</td>
<td>USD</td>
<td>Monetized time savings between the rehabilitated road and the counterfactual</td>
<td>Missing Information</td>
<td>Missing Information</td>
</tr>
<tr>
<td>Vehicle operating costs</td>
<td>USD</td>
<td>Costs for vehicle operators to travel on the road</td>
<td>Missing Information</td>
<td>Missing Information</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Justification of all input and comments on all output of the HDM-5
### Accident costs USD
- **Related to injuries, fatalities and crashes**
- **Missing Information**
- **Missing Information**

1. The evaluation team will inquire regarding all available accident data before and after the works, and assess potential reduction in accidents and therefore, savings if any.
2. It should be noted that the article “Road traffic injuries in Mozambique”. Romão, et al. (2003) provides reliable figures for year 2000. These figures could use with an adequate accident growth rate. This paper demonstrates that data exist.

### Thickness and Composition
- **Core sample results**
- **The thickness and composition of the road to qualify the quality of the road and materials used.**
- **Missing Information**
- **Missing Information**
- **UCS and CBR tests.** At least three test boring and core samples have to be performed on both roads
- **Quality forms**

### Vehicle Fleet Description
- **Vehicl e types**
- **A categorization of vehicle types**
- **2009 traffic counts and previous HDM-4 workspace**
- **2010 traffic counts and previous HDM-4 workspace**
- **Traffic counts in 2019**
- **2019 traffic counts quality forms**

### Traffic Volume
- **(1) Number of vehicles per vehicle type and (2) Total volume of traffic estimated for a year and divided by 365 days**
- **2009-2010 traffic counts**
- **2009 and 2010 traffic counts**
- **The evaluation team will assess traffic volume with traffic counts performed in 2019 and seasonality factors to be assessed in 2019.**
- **2019 traffic counts quality forms**
<table>
<thead>
<tr>
<th>Loading Composition</th>
<th>Equivalent Single Axle Load (ESAL) Factor</th>
<th>Damage calculated as the number of standard loads</th>
<th>2009 traffic counts and previous HDM-4 workspace</th>
<th>2009 traffic counts and previous HDM-4 workspace</th>
<th>The evaluation team will assess loading composition from weight stations to be obtained in 2019 and seasonality factors to be assessed in 2019.</th>
<th>2019 traffic counts quality forms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic Growth Rate</td>
<td>Percentage</td>
<td>Annual growth rate</td>
<td>Previous HDM-4 workspaces</td>
<td>Previous HDM-4 workspaces</td>
<td>The evaluation team will assess traffic growth to be deduced from the evolution in traffic between 2009 and 2019.</td>
<td>2019 traffic counts quality forms</td>
</tr>
</tbody>
</table>

### RA2: Maintenance

**Research Question 2A:** What are the relevant road authority's current maintenance practices and what is the likelihood that MCC's investment will remain adequately maintained for the life of the investment? Based on this assessment, what set of

| Improved Maintenance | Maintenance Practices Condition Precedent Compliance Maintenance Adequacy | Qualitative Analysis | Description of the road authority's maintenance practices. Description of the degree to which a national paved road maintenance program, including periodic maintenance, has been implemented. Analysis of funding practices for the last ten years, and in | Compact Agreement and Condition Precedent, Feasibility studies, re-scoping documentation | Closeout documentation and reports, CCR | Evaluation analysis - comparison of requirements in CP with actual performance/delivery; ANE/FE documentation: annual/multi-annual work plans and budgets, annual reports, national network condition surveys and reports | Interviews with stakeholders to triangulate findings from document review |
### RA3: Road Usage Patterns

**RQ3A:** Who is traveling on the road, why, what they are transporting, what they are paying for transport, and how long does it take to move along key routes?

<table>
<thead>
<tr>
<th>Improved Maintenance Processes</th>
<th>Qualitative Analysis</th>
<th>Analysis of maintenance system and trends, Analysis of efficiency of maintenance related to MCC’s investment.</th>
<th>Compact Agreement and Condition Precedent, Feasibility studies, re-scoping documentation</th>
<th>Closeout documentation and reports, CCR</th>
<th>Evaluation analysis - comparison of requirements in CP with actual performance/delivery; ANE/FE documentation: annual/multi-annual work plans and budgets, annual reports, national network condition surveys and reports, Interviews with stakeholders to triangulate findings from document review</th>
</tr>
</thead>
</table>

**Numbers of user by type**

| Reduced Transport Costs | Change in Road Users Freight Types Journey Time | Numbers of users by type | Number of freight by type | Time required to travel the road by segment | Analysis of current road users, patterns, and freight types Analysis of past and current types of freight and how freight types and transportation patterns have changed because of the MCC investment Change in time to move between destinations due to MCC investment. | 2009 OD Survey, feasibility studies, ANE and Road Fund Data | Closeout documentation and reports, CCR | All surveys to be undertaken in strict compliance with international standards and best practices |

- OD Survey, Roadside Interviews, Secondary data sources, Other stakeholder interviews.
<table>
<thead>
<tr>
<th>RQ3B: Have road usage patterns changed, in terms of who is traveling on the road, why, what they are transporting, what they are paying for transport, and how long it takes to move along key routes?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generated Traffic</td>
</tr>
<tr>
<td>2009 OD Survey, feasibility studies, ANE and Road Fund Data</td>
</tr>
<tr>
<td>Resource cost of transport, Passenger and freight price, change in VOCs, Change in journey prices</td>
</tr>
<tr>
<td>OD Survey, Roadside Interviews, Secondary data sources, Other stakeholder interviews.</td>
</tr>
<tr>
<td>RA4: Transportation Market Structure</td>
</tr>
<tr>
<td>RQ4: How is the transportation market currently structured (and have any VOC savings resulting from the MCC investment been passed on to customers by transport operators - freight and passengers)?</td>
</tr>
</tbody>
</table>

| Change in Road Usage Patterns | Qualitative Analysis | The change in road users transportation processes due to MCC's investment. The change in journey time between points as a result of MCC's investment. |
| Change in Freight Transportation Numbers of vehicle types | The change in numbers of freight transporters using the road. |

| Reduced Transportation Costs | Passenger Transportation Change in Cost | USD | The change in operating costs for passenger transportation. |
| Reduced Transportation Costs | Freight Transportation Change in Cost | USD | The change in operating costs for freight transportation. |
| Reduced Transportation Costs | Passenger Transportation Change in Travel Time | Hours/Minutes | The change in required journey time for passenger transport. |

| Compact Agreement and Condition Precedent, Feasibility studies, re-scoping documentation | Closeout documentation and reports, CCR | Evaluation analysis - comparison of findings on transport market structure at baseline, as estimated at feasibility stage, re-scoping and actual (2019); Surveys: O&D, roadside interviews (component of surveys noted above under EQ1), interviews with road users (haulers, public transport services operators (including 'chapas'), transportation associations, travelers. Additional secondary data |

| Closeout documentation and reports, CCR | All surveys to be undertaken in strict compliance with international standards and best practices |

<p>| All surveys to be undertaken in strict compliance with international standards and best practices |</p>
<table>
<thead>
<tr>
<th>Reduced Transportation Costs</th>
<th>Freight Transport Change in Travel Time</th>
<th>Hours/Minutes</th>
<th>The change in required journey time for freight transport.</th>
<th>Compact Agreement and Condition Precedent, Feasibility studies, re-scoping documentation</th>
<th>Closeout documentation and reports, CCR</th>
<th>All surveys to be undertaken in strict compliance with international standards and best practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced Transportation Costs</td>
<td>Savings captured by transport customers</td>
<td>USD</td>
<td>The degree to which savings generated for passenger transportation operators is captured by passenger transportation customers.</td>
<td>Compact Agreement and Condition Precedent, Feasibility studies, re-scoping documentation</td>
<td>Closeout documentation and reports, CCR</td>
<td>Evaluation analysis - comparison of findings on transport market structure - Baseline, as estimated at feasibility stage, re-scoping and actual (2019); Surveys: O&amp;D, roadside interviews (component of surveys noted above under EQ1), interviews with road users (haulers, public transport services operators (including 'chapas'), transportation associations, travelers. Interviews with transport users, farmer’s associations etc.</td>
</tr>
<tr>
<td>Reduced Transportation Costs</td>
<td>Savings captured by transporters of their own products</td>
<td>USD</td>
<td>The degree to which savings generated for freight transportation operators is captured by freight transportation customers.</td>
<td>Compact Agreement and Condition Precedent, Feasibility studies, re-scoping documentation</td>
<td>Closeout documentation and reports, CCR</td>
<td>All surveys to be undertaken in strict compliance with international standards and best practices</td>
</tr>
<tr>
<td>Reduced Transportation Costs</td>
<td>Evaluation Design Report May 2019</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td>----------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transport Market Description</td>
<td>Compact Agreement and Condition Precedent, Feasibility studies, re-scoping documentation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Qualitative Analysis</td>
<td>Closeout documentation and reports, CCR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Analysis of the northern Mozambican transport market including the assessment of benefit distribution of the MCC-funded road investment.

Evaluation analysis - comparison of findings on transport market structure - Baseline, as estimated at feasibility stage, re-scoping and actual (2019); Surveys: O&D, roadside interviews (component of surveys noted above under EQ1), interviews with road users (haulers, public transport services operators (including 'chapas'), transportation associations, travelers

Interviews conducted with stakeholders to verify findings from secondary documentation.
4. Research Question 0

Research Question 0: Was the program implemented according to plan?

4.1 Overview

The purpose of this question is to determine the degree to which the project outputs were delivered according to plan and to elicit a description of any deviations from the original design. The evaluation team will describe and document any deviations.

4.2 Data Collection and Review

The evaluation team will continue to conduct a desk review to develop a detailed timeline and description of the project’s implementation. Details will include the beginning and end of data collection and analysis, decision making processes and timeframes, authorization and implementation procedures, processes for change orders, and supervision of project implementation.

Following the desk review, the evaluation team will continue interviews with key stakeholders to explore the motivation behind changes in design and purpose. The description will also include a description of the relevance, efficiency, and effectiveness with which changes happened and were authorized.

5. Research Area 1 (RA1): Engineering Analysis & Economic Model

5.1 Research Area 1

Research Question 1: What is the economic return - calculated in terms of vehicle operating cost (VOC) savings and travel time (TT) savings - of the road investment? What factors drove changes to the Economic Rate of Return (ERR) over time? How could the project have been designed to result in a higher ERR?

5.2 Methodology –

5.2.1 General overview of methodology

Evaluation question 1 asks three questions

- What is the ERR of the road investment?
- What factors drove changes to the ERR over time?
- How could the project have been designed to result in a higher ERR?

Answering the first question requires that the evaluation team calculate the ERR on the road using HDM-4, as specified in the evaluation’s terms of reference. The ERR is the discount rate at which the present value of the project’s economic benefits equals the value of the project’s costs at the base year. HDM-4 calculates this rate by comparing the benefits realized from the new road to the costs incurred to construct and manage the new road. Using HDM-4 to make this calculation requires that the evaluation team take measurements and collect secondary data that serve as inputs into the HDM-4 calculation. The required inputs into HDM-4 are the following:

- Actual construction, environmental, resettlement, and rehabilitation costs. The evaluation team understands that costs incurred after that end of the Compact are not available. – Data provided by MCC
- Equivalent Single Axle Load Factor (ESALF) data. – Acquired from ANE or other source
• Road agency maintenance costs. – Data collected under RA2
• An estimate of monetized accident savings, if any. – Secondary data to be collected
• An IRI value calculated in 2009 and 2015. – Provided by MCC
• A new IRI value calculated in 2019. – Collected by the evaluation team
• Surface distress description created in 2009. – Provided by MCC
• A surface distress description created for 2019. – Collected by the evaluation team
• A description of traffic characteristics in 2009, including volume, loading composition, growth rate, and seasonality. – Provided by MCC
• A description of the same traffic characteristics in 2019. – Data collected under RA3
• A deflection measurement performed during the rainy season taken in 2009 and 2015. – Provided by MCC
• A summary of geotechnical conditions, including the SNC, in 2009. – Provided by MCC
• A description of the road’s geometric parameters. – Collected by the evaluation team.

Once these inputs to HDM-4 are collected, they are used to calculate the ERR of the road investment. Because the inputs have different weights, scenario analysis can describe which factors drove changes to the ERR.

The HDM-4 data, combined with results of RA3 and RA4 will provide information on how the project could have been designed to increase the ERR. While the evaluation team strongly suspects that the ERR will rely heavily on volume of traffic, market structure and the behavior of road users also play a large role in the ERR’s ultimate result. The evaluation team will look at the complete data set from all research questions to understand and describe how the project could have been designed to result in a higher ERR.

5.2.2 Strategy for the definition of the counterfactual/base case/comparison group

The evaluation team will use the HDM-4 input values from SMEC and Scot Wilson, which were collected before works began, to calibrate the counterfactual. These included IRI inputs, deflection, maintenance assumptions, and other input quantities.

IMC recommends using the Rio Lurio – Metoro as a comparison segment. The approach is submitted below for consideration. While the two sections were constructed about 5 years apart, the designs are reported to be identical. We will verify this assumption.

1. Per the Volume 1 Executive Summary Report of Scott Wilson dated November 13, 2018, the initial pre-2009 designs of the Namialo – Rio Lurio and Rio Lurio Metoro road sections are identical. To confirm this, it is recommended that three (3) bore samples be performed on the Rio Lurio – Metoro to compare results with the geotechnical investigations conducted by the Scott Wilson and reported in the same reference. IMC understands that MCC has chosen not to fund the collection of these bore samples.
2. Video of the Namialo – Rio Lurio and a sufficiently representative part of the Rio Lurio – Metoro road sections;
3. Analysis of the videos of the Namialo – Rio Lurio road section and part of the Rio Lurio – Metoro road section;

34 No deflection test is recommended on this road in 2019 because there is no deterioration model for deflection in HDM-4. Only the values in 2009, supplied by MCC, are important for the HDM-4 simulations.
4. Determination of all the HDM-4 distress and IRI on both sections;
5. Calibration of the HDM-4 distress and IRI models for the do-nothing strategy (Rio Lurio – Metoro) and the one that was rehabilitated in 2010-2011 (Namialo – Rio Lurio).
Perform HDM-4 runs comparing the MCC option implemented on Namialo – Rio Lurio and Rio Lurio Metoro (counterfactual).

5.3 Timeframe of exposure
MCC sets targets for economic rates of returns over a long-time frame, usually around 20 years\(^{35}\). Understanding whether or not a project is on track to reach ERR targets usually requires sufficient time to pass between the completion of works and the estimation of the ERR. As MCC’s “Principles to Practice, Lessons from MCC’s Investment in Roads” paper makes clear, in the case of Roads construction, several years are required to pass before traffic changes occur. At 5.5 years since the completion of road construction, sufficient time has passed to calculate an estimation of the current ERR and to project if the project is on track to achieve its targeted ERR.

5.4 Primary Data Collection

5.4.1 International Roughness Index
1. Sample unit(s) – The IRI will be measured on all project roads in the most trafficked direction.
2. Sample size – the evaluation will measure the entirety of both roads
3. Sample frame – N/A
4. Sampling strategy – The evaluation team will measure the International Roughness index (IRI) in the outer wheel path along the length of both roads according to the American Society for Testing and Materials (ASTM) standards using a profiling device that exceeds the performance requirements of a class 3 device.
5. Instruments – The evaluation team will use calibrated RoughometerIII (Manufactured by AARB) which was developed to provide a highly accurate measure of the roughness and condition of roads.
6. Rounds, locations and timing – IRI measurement will take place in mid-July or August, on the full length of both roads.
7. Respondent(s) within the sample unit – N/A
8. Staff – IRI collection will be managed by two trained technicians and two specialists, with one serving as supervisor
9. Data processing – Analysis will be conducted utilizing Roadruf software, as software package developed by Gabriel Assaf based on Sayer’s publication.

\(^{35}\) See MCC’s Guidelines for Economic and Beneficiary Analysis
10. Data quality – Calibration of the roughness system will initially focus on checking the distance measured and on ensuring that the roughness profile recorded by the system is behaving sensibly for calculating IRI. A set of test sites will then be established on the road network to check and calibrate the measurement of distance and IRI against a reference device.

11. Safety Procedures/Precautions - Technicians and other staff will wear high visibility vests and other gear whenever they are near the road, both on and off duty. Traffic cones will be used to provide a buffer between work and traffic areas. Survey supervisors will ensure safety protocols are followed. Proper signage will guide traffic around work areas.

5.4.2 Surface Distress

1. Sample unit(s) – The evaluation team recorded the videos for the two roads during the December 2018 trip. Both roads were recorded in their entirety.

2. Sample size - Both roads were recorded in their entirety.

3. Sample frame – N/A

4. Sampling strategy – We will carry out an evaluation of the road condition to record any distress present in accordance with the Long-Term Performance Program (LTPP) Distress Identification Manual or an equivalent methodology as agreed with MCC prior to commencing the data collection process.

5. Instruments – Data collected through a Garmin VIRB Ultra high definition camera

6. Rounds, locations and timing – Videos already taken during the December 2018 evaluability assessment trip.

7. Respondent(s) within the sample unit – N/A

8. Staff – The evaluation team took the videos and will conduct analysis.

9. Data processing – Visual assessment will be performed. The distress data will be classified based on their type, severity and extent. No automatic detection system is used.

10. Data quality – Data is crosschecked by three analysts with qualifications in the technology.

11. Safety Procedures/Precautions – N/A

5.4.3 Geometric Parameters

1. Sample unit(s) – N/A

2. Sample size – The entire road

3. Sample frame – N/A
4. Sampling strategy – The geometric characteristics will be assessed via Google Earth.

Relevant government agencies will be relied upon to provide details such as pavement type before intervention, the last rehabilitation date, the last resurfacing date, the last preventative treatment date, the structural number of the road, and the most recent surfacing thickness. The structural number of the road after the intervention will be calculated based on the results of the borings.

5. Instruments – Google Earth

6. Rounds, locations and timing – July or August, 2019 along with other data collection activities.

7. Respondent(s) within the sample unit – N/A

8. Staff – The evaluation team Road Maintenance Expert and associates will conduct the analysis.

9. Data processing – We will collect information on road characteristics using Google Earth and include this information into our database to overlay with the IRI, traffic, O-D data and all applicable road condition evaluation data. The characteristics include road section length, number of lanes, climatic zone, road class, lateral drainage characteristics, pavement type before intervention, the last rehabilitation date, the last resurfacing date, the last preventative treatment date, the most recent surfacing thickness, and the structural number

10. Data quality – N/A

11. Safety Procedures/Precautions – N/A

5.5 Summary table

<table>
<thead>
<tr>
<th>Data collection</th>
<th>Timing MM/YYYY (include multiple rounds)</th>
<th>Sample Unit/Respondent</th>
<th>Sample Size</th>
<th>Relevant instruments/modules</th>
</tr>
</thead>
<tbody>
<tr>
<td>IRI</td>
<td>Next data collection mission</td>
<td>Road Segments</td>
<td>100%</td>
<td>RoughometerIII</td>
</tr>
<tr>
<td>Surface Distress</td>
<td>Completed December 2018</td>
<td>Road Segments</td>
<td>100%</td>
<td>Video</td>
</tr>
<tr>
<td>Geometric Parameters</td>
<td>May – Next data collection mission</td>
<td>Road</td>
<td>100%</td>
<td>Google Earth and GIS tools</td>
</tr>
</tbody>
</table>

5.6 Secondary quantitative data
Producing reliable results with HDM-4 requires ensuring that the data that serves as its inputs accurately represent real conditions at the time of project launch in 2009 and at the time of evaluation in 2019. For the Mozambique Roads Project evaluation, the evaluation team will use secondary data sources to check on the 2009 conditions in the HDM-4 model, to serve as inputs for data sources not measured through primary data collection in 2019, and to ensure that HDM-4 is properly calibrated. For this evaluation, ensuring the quality and triangulation of secondary sources is particularly important for estimating deterioration rates and costs and benefits of the road. Secondary data sources also minimize bias that can result from the conditions under which the evaluation team takes measurements through primary data collection. During the option period, the evaluation team will collect secondary data and check it for accuracy and reliability. A detailed review of some of the secondary data required under RA1 is discussed in section 9.1.2 – Findings from the review of the previous HDM workspaces.

12. The evaluation team will seek secondary sources for the following data:

- Accident data to calculate an estimate of monetized accident savings. The evaluation team has identified the article “Road traffic injuries in Mozambique”. Romão, et al. (2003) provides reliable figures for year 2000. These figures could use with an adequate accident growth rate. This paper demonstrates that data exist.
- A reference rate used to calculate travel time in 2009, or data that the evaluation team can use to estimate a reference rate.
- Equivalent Single Axle Load Factor (ESALF) data. The evaluation team may acquire this data from ANE, which could provide the last axle weight counts from any weight station in the country or the ESALF used in the design report or the HDM-4 workspace.
- Other data sources that triangulate primary data that the evaluation team collects.

13. Requirements related to data capture – N/A.

14. In addition, please describe how the quality of the data will be assessed prior to using. – N/A

5.7 Analysis plan

The evaluation team will use the inputs described in this section, along with prior data that MCC has provided, to calculate an ERR using the HDM-4 software package. In addition to calculating an ERR, the HDM-4 package will calculate VOC and travel time savings that the road investment produced. Once those calculations are complete, the evaluation team will conduct scenario analysis to show which factors, in the form of HDM-4 inputs, drove the ERR over time. These factors include road characteristics, traffic volume, construction and maintenance costs, and others.

The evaluation team will also combine HDM-4 results with the data collected under research areas 2, 3 and 4 to understand how a different design may have led to a higher ERR. Traffic patterns, operator behavior, transportation market structure, and other findings from research areas will inform this analysis.

5.8 Integration of evaluation areas
Research Area 2: Maintenance, works with RA1 to develop a consistent set of assumptions about road maintenance and policy that are important to the ERR calculation and projects. RA3 works with RA1 to develop a consistent understanding of traffic patterns, characteristics, and how they changed over the course of the intervention to the date of the evaluation. RA4 works with RA1 to understand what the benefits of the road construction were, as quantified by VOC savings and travel time savings, and how those benefits are distributed among stakeholders.

6. Research Area 2: Maintenance

6.1 Evaluation Question 2A

What are the relevant road authority's current maintenance practices and what is the likelihood that MCC's investment will remain adequately maintained for the life of the investment? Based on this assessment, what set of maintenance assumptions should be used in the HDM-4 model to yield the best estimate of the costs and benefits of the road investment?

6.2 Methodology

6.2.1 General overview of methodology

Question 2A requires that the evaluation team produce:

- An estimation of the likelihood that MCC's investment will remain adequately maintained.
- Maintenance assumptions to be used in HDM-4.

To produce those outputs, the evaluation team must create the following inputs to analysis:

- a descriptive summary of ANE’s current maintenance policy, including periodical and routine maintenance.
- a descriptive summary of ANE’s current and historical maintenance practices.
- a technical assessment of policy and practices.
- an analysis of Road Fund budgets and expenditures from the most recent five-year period.

The documentation will inform maintenance spending per km calculations.

The evaluation team will create a time series analysis to show the how the relationship between projected maintenance needs and actual maintenance funding has or has not evolved over time, controlling for different types of roads, road locations, and other variables. The team will compare current policy and needs to actual resources and expenditure. These analysis activities will produce a trend of maintenance practices that the evaluation team will use to project the likelihood of MCC’s investment remaining adequately maintained. The evaluation team will also conduct interviews with key informants to reality check the projection and add narrative to explain descriptive summaries of policy and practice.

The remainder of this section details the evaluation team’s methodology for creating analysis inputs and producing analysis required to answer question 2A.

6.2.2 How MCA monitoring data/implementation information will be used

N/A

6.2.3 Strategy for the definition of the counterfactual/base case/comparison group

N/A
6.2.4 Timeframe of exposure

There is no compelling justification for collecting data to answer RQ2A at this time except that the question is asked as part of the evaluation, and maintenance budgets and expenditures are required as inputs into the HDM-4 model. Considering the low traffic volumes, the strength (stabilized) of the two pavements, the absence of distress and the fact that most of the two alignments are on a fill, the evaluation team believes that the two roads will have limited issues of insufficient maintenance or sustainability during the expected design life.

6.3 Primary Data Collection

6.3.1 Key Information Interviews

1. Sample unit(s) – Approximately five-seven interviews.
2. Sample size and associated assumptions – N/A
3. Sample frame – N/A
4. Sampling strategy – N/A
5. Instruments – The evaluation team will create an interview guide for each type of staff to be interviewed. Questions in the interview guide will be pre-coded according to the output (listed in D.i.1 of this section) that each question is intended to contribute to ensure that information gathered tracks back to main research questions and analysis tools, described below.
6. Rounds, locations and timing – The evaluation team will conduct the interviews over the course of two days in Maputo. The team expects interviews to happen in mid-July or August.
7. Respondent(s) within the sample unit – ANE and Road Fund senior and mid-level staff.
8. Staff – Members of the evaluation team will conduct the interviews.
9. Data processing – The interviews will be guided by the interview guide. The interviewee will conduct the interview as a semi-structured discussion, following useful tangents and divergences as they occur. The interviewer will take notes in a notebook or computer according to the interviewer’s preference. Interviewers will write up interview notes at the end of each work day to ensure that notes are accurate, of high quality, and main points are fresh in the interviewer’s mind. An evaluation team member will read through the interview notes when they are completed, identifying key themes and patterns, that the team member will name and use to code the interviews. The team member will create an excel spreadsheet with individual interviews as rows and codes as columns. The team member will interview specific responses from each interview under each code. This qualitative
data will be used to add explanation and narrative depth to the policy and practice summaries created to answer the question.

10. Data quality – Data will be recorded promptly after interviews are conducted. Interviewers will be trained on asking non-leading questions, and identifying information critical to the evaluation.

11. Safety Procedures/Precautions – N/A

6.4 Summary table

<table>
<thead>
<tr>
<th>Data collection</th>
<th>Timing MM/YYYY (include multiple rounds)</th>
<th>Sample Unit/Respondent</th>
<th>Sample Size</th>
<th>Relevant instruments/modules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key Informant Interviews</td>
<td>July or August 2019</td>
<td>Key Informant 5-7 Interview Guide</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.5 Secondary quantitative data

The majority of data collection and model building in RA2 is based on secondary data. In order to answer RA2 questions, the evaluation team must collect data from the Roads Fund, ANE, and other appropriate ministries, clean the data,36 and build models to ensure that the data is relevant to the RA. Policy and practice analysis requires collecting information on ANE and the Road Funds current policies, understanding how they’ve changed over the intervention period, and collecting data on the policies and practices of comparable countries as points of comparison. The team will also code secondary data and information using the same coding scheme utilized for RA1 and RA3 to ensure that analysis triangulates information under those research areas.

1. The evaluation team will conduct analysis using the following documents:
   • The Road Fund’s budgets from the last five years.
   • The Road Fund’s audited financial statements from the last five years.
   • ANE financial plans and budgets from the last five years.
   • ANE financial statements from the last five years.

2. Requirements related to data capture – The evaluation team requires that the data exist and is available for transfer. The evaluation team prefers that it be available in electronic format, but will utilize any format available to the best of the team’s ability.

3. Data quality – The evaluation team will check the data to make sure that none of it was transposed during entry, as was found in some data provided by Mozambique’s statistics agency. Financial data will be checked to make sure that cost and budget codes are consistent, and that reporting is complete across all periods.

36 Cleaning data produced by the GoM may take considerable effort. Reviewing data related to the transportation sector that the GoM maintains online reveals multiple errors, transpositions, and unclear labeling.
6.6 Analysis plan

To produce the descriptive summary of ANE’s current maintenance policy, including periodical and routine maintenance, the evaluation team will summarize ANE’s written policies and compare these to the information gathered through interviews. The resulting description will show the targets and outcomes ANE is aiming for as described in its official policy and compare it to actual practice as described in interviews.

To produce the descriptive summary of ANE’s current and historical maintenance practices, the evaluation team will combine summaries of secondary reports, results from interviews with ANE and Road Fund staff, and results of budgetary and financial analysis. The resulting analysis will show the degree to which maintenance needs have been met, financing has met maintenance needs, and the overall quality of maintenance management.

The evaluation team Roads expert will conduct a technical analysis of maintenance policy and practices. The analysis will describe the degree to which policy and practice meets international standards, and the degree to which it meets the MCC’s definition of adequate maintenance over the life of the investment.

The evaluation team will produce a budget versus expenditure analysis to understand the degree to which actual maintenance has been adequately budgeted for, what portion of maintenance the relevant government authorities commit to funding and how that has changed over time, and the degree to which actual financing has met government commitments. The evaluation team will assess the amount of maintenance funds transferred from the Roads Fund to ANE for each year as recorded in the Roads Fund financial statements, the percentage of those funds that appear on ANE’s books, the percentage of maintenance funds actually spent on road maintenance (ideally from audited financial statements), whether there is a gap between maintenance funds and real investment on road maintenance, and reasons for that gap, if it exists.

These outputs will be combined to create an estimation of the likelihood that MCCs investment will remain adequately maintained and the maintenance assumptions to be used in HDM-4.

6.7 Integration of evaluation areas

The estimation of maintenance costs from maintenance financial analysis provides input into HDM-4. The results of understanding maintenance policy and practice may feed into explanations of changes in VOC and vehicle operator choice regarding destinations and reasons for using the road.

6.8 Evaluation Question 2B

In cases where MCC invested in improving maintenance practices or included a maintenance Conditions Precedent in the Compact (applicable to Mozambique), what were the effects of those efforts and why?

6.9 Methodology

6.9.1 General overview of methodology
Road maintenance was the subject of a condition precedent which required that the national paved road maintenance program include a periodic maintenance program for the whole paved roads network including the following:

- Rolling eight-year planning period;
- Provision for annual updating of the program (based upon additions to the paved road network);
- Detailed listing of all paved roads subject to periodic maintenance by year; and,
- Funding plan that includes 100 percent of routine and periodic maintenance works such that these works will be funded in increasing amounts to 100 percent by user fees as of 10 years after the initial paved roads maintenance program.

Question 2B requires that the evaluation team create the following outputs:

- A summary of documentation that demonstrates Mozambique’s progress in creating a maintenance program and the degree to which it is on target for eight-year period.
- A description of the degree to which ANE and the Roads Fund have provided for an annual updating of the maintenance program.
- The degree to which a detailed listing of paved roads and their maintenance needs is current.
- A description of the degree to which the Roads Fund has a funding plan that is on track to achieve 100 percent funding through user fees ten years following completion of the intervention.
- A summary analysis of the effects of MCC’s efforts and the reasons beyond those effects.

To produce those outputs, the evaluation team must:

- Conduct interviews at ANE and the Roads Fund to understand the degree to which the condition precedent created its intended results.
- Identify roads similar in characteristics to the roads rehabilitated with MCC financing to research their history of construction and maintenance to assess if maintenance changed as a result of the conditions precedent.
- Review documentation from ANE and the Roads Fund to check on progress toward meeting the Conditions Precedent.

The evaluations team analysis under this question will draw from KIIs, documentation, and an inspection of a limited number of comparison roads. The result will be a description of the effects of MCC’s efforts to improve maintenance practices. The remainder of this section details the evaluation team’s methodology for creating analysis inputs and producing analysis required to answer question 2B.

6.9.2 How MCA monitoring data/implementation information will be used
N/A

6.9.3 Strategy for the definition of the counterfactual/base case/comparison group
N/A

---

37 A rolling plan is one which is continuously updated by adding a further accounting or planning period when the earliest such period has expired. Each year actual results are reported, a further forecast period is added and intermediate forecasts are updated.
6.10 **Timeframe of exposure**

There is no compelling justification for collecting data to answer RQ2B at this time except that it serves as a check on Mozambique’s progress complying with the condition precedent during the eight year roll out period and then ten-year funding plan requirement.

6.11 **Primary Data Collection**

6.11.1 **Key Information Interviews**

1. Sample unit(s) – Approximately five interviews.
2. Sample size and associated assumptions – N/A
3. Sample frame – N/A
4. Sampling strategy – N/A
5. Instruments – The evaluation team will create an interview guide for each type of staff to be interviewed. Questions in the interview guide will be pre-coded according to the output (listed in D.i.1 of this section) that each question is intended to contribute to ensure that information gathered tracks back to main research questions and analysis tools, described below.
6. Rounds, locations and timing – The evaluation team will conduct the interviews over the course of two days in Maputo. The team expects interviews to happen in mid-July or August.
7. Respondent(s) within the sample unit – ANE and Road Fund senior and mid-level staff.
8. Staff – Members of the evaluation team will conduct the interviews.
9. Data processing – The interviews will be guided by a guide. The interviewee will conduct the interview as a semi-structured discussion, following useful tangents and divergences as they occur. The interviewer will take notes in a notebook or computer according to the interviewer’s preference. Interviewers will write up interview notes at the end of each workday to ensure that notes are accurate, of high quality, and main points are fresh in the interviewer’s mind. An evaluation team member will read through the interview notes when they are completed, identifying key themes and patterns, that the team member will name and use to code the interviews. The team member will create an excel spreadsheet with individual interviews as rows and codes as columns. The team member will interview specific responses from each interview under each code. This qualitative data will be used to add explanation and narrative depth to the policy and practice summaries created to answer the question.
10. Data quality – Data will be recorded promptly after interviews are conducted. Interviewers will be trained on asking non-leading questions, and identifying information critical to the evaluation.
11. Safety Procedures/Precautions – N/A

6.12 **Summary table**
### 6.13 Secondary quantitative data

1. The evaluation team will conduct analysis using the following documents:
   - Planning documents produced as a result of ANE and the Roads Fund’s compliance with the conditions precedent.

2. Requirements related to data capture – The evaluation team requires that the data exist and is available for transfer. The evaluation team prefers that it be available in electronic format, but will utilize any format available to the best of the team’s ability.

3. Data quality – The evaluation team will cross check documents with interviews to make sure that there is consistent reporting and information.

### 6.14 Analysis plan

The evaluation team will triangulate information from documents produced to comply with the condition’s precedent, maintenance reports and records, and information gathered through key informant interviews. Additionally, the evaluation team will identify and inspect a limited number of comparison roads to assess the degree to which documentation and qualitative data matches with maintenance practice.

### 6.15 Integration of evaluation areas

The results of understanding improvements in maintenance practice that occur as a result of MCC’s efforts may feed into explanations of changes in VOC and vehicle operator choice regarding destinations and reasons for using the road. They also demonstrate the degree to which MCC was able to assess Mozambique’s ability to comply with MCC requirements.

### 6.16 Evaluation Question 2C

Research Question 2C: What political, and economic incentives are shaping road maintenance decisions in the country? And what other key factors are influencing actual maintenance practices?

### 6.17 Methodology

#### 6.17.1 General overview of methodology

The majority of information needed to answer question 2C is collected in response to questions 2A and 2B. Under this evaluation question, the evaluation team will include an assessment of the relationship between the Roads Fund and ANE, the timing of roads maintenance practices to understand if they coincide with political events, and a review of broader political issues, such as
how the road may connect different political populations or affect the transfer of goods and services between different demographic and political populations.

**6.17.2 How MCA monitoring data/implementation information will be used**

N/A

**6.17.3 Strategy for the definition of the counterfactual/base case/comparison group**

N/A

**6.18 Timeframe of exposure**

There is no compelling evidence based on relevant literature to justify collecting additional qualitative data to answer RQ2C outside of the proposed interviews relevant to RQ 2A and 2B.

**6.19 Primary Data Collection**

**6.19.1 Key Information Interviews**

1. Sample unit(s) – Approximately five interviews.

2. Sample size and associated assumptions – N/A

3. Sample frame – N/A

4. Sampling strategy – N/A

5. Instruments – The evaluation team will create an interview guide for each type of staff to be interviewed. Questions in the interview guide will be pre-coded according to the output (listed in D.i.1 of this section) that each question is intended to contribute to ensure that information gathered tracks back to main research questions and analysis tools, described below.

6. Rounds, locations and timing – The evaluation team will conduct the interviews over the course of two days in Maputo. The team expects interviews to happen in mid-July or August.

7. Respondent(s) within the sample unit – ANE and Road Fund senior and mid-level staff.

8. Staff – Members of the evaluation team will conduct the interviews.

9. Data processing – The interviews will be guided by a guide. The interviewee will conduct the interview as a semi-structured discussion, following useful tangents and divergences as they occur. The interviewer will take notes in a notebook or computer according to the interviewer’s preference. Interviewers will write up interview notes at the end of each workday to ensure that notes are accurate, of high quality, and main points are fresh in the interviewer’s mind. An evaluation team member will read through the interview notes when they are completed, identifying key themes and patterns, which the team member will name and use to code the interviews. The team
member will create an excel spreadsheet with individual interviews as rows and codes as columns. The team member will interview specific responses from each interview under each code. This qualitative data will be used to add explanation and narrative depth to the policy and practice summaries created to answer the question.

10. Data quality – Data will be recorded promptly after interviews are conducted. Interviewers will be trained on asking non-leading questions and identifying information critical to the evaluation.

11. Safety Procedures/Precautions – N/A

### 6.20 Summary table

<table>
<thead>
<tr>
<th>Data collection</th>
<th>Timing MM/YYYY (include multiple rounds)</th>
<th>Sample Unit/Respondent</th>
<th>Sample Size</th>
<th>Relevant instruments/modules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key Informant Interviews</td>
<td>July or August 2019</td>
<td>Key Informant</td>
<td>5-7</td>
<td>Interview Guide</td>
</tr>
</tbody>
</table>

### 6.21 Secondary quantitative data–

1. The evaluation team will conduct analysis using the following documents:
   - Review documentation related to the political environment of infrastructure improvement in Africa, such as Ken Gwilliams “Africa's Transport Infrastructure: Mainstreaming Maintenance and Management.”

2. Requirements related to data capture – N/A

3. Data quality – The evaluation team will cross check documents with interviews to make sure that there is consistent reporting and information.

### 6.22 Analysis plan

The evaluation team will compare maintenance records to the timing of political events. The team will also track funding and decision making across and within ANE, the Roads Fund, and other related industries to understand how funding decisions happen. The team will track maintenance practices along with other political and demographic information to see if political factors influence maintenance policy and practice.

### 6.23 Integration of evaluation areas

The results of understanding the political economy of road maintenance may inform research area 4’s discussion of the distribution of benefits from the Roads Project.
7. Research Area 3A: Road Usage Patterns

Research Question 3A: Who is traveling on the road, why, what they are transporting, what they are paying for transport, and how long does it take to move along key routes?

7.1 Methodology

7.1.1 General overview of methodology

Question 3A asks six questions:

- Who is traveling on the road?
- Why are they traveling on the road?
- What are they transporting?
- What are they paying for transport?
- What are key routes on the road?
- How long does it take to move along key routes?

To answer these questions, the evaluation team will employ three types of data collection:

A Traffic Count Survey to take an accurate measurement of the traffic volume and types of vehicles traveling on the road. This evaluation will take a manual count of traffic as was conducted by SMEC/ANE during the feasibility study phase of the project. Traffic count data is crucial for conducting statistical analysis in response to question 3A and serves as an important component of HDM-4.

An Origin-Destination (O-D) survey will focus on categorizing users and transportation patterns. A range of information will be gathered, including: vehicle type, number of passengers, demographic data, origin location, destination location, estimated time of trip, general category of trip purpose, and estimated time of travel. O-D surveys collect statistically significant data to create an accurate and general description of road user characteristics. However, O-D surveys do not describe the reasons behind those characteristics or road users’ perspective on the road and the benefits it creates. The O-D surveys also contribute to vehicle fleet description, an important component of HDM-4.

Key Informant Interviews in the transportation sector, specifically with operator staff, transportation workers, and municipal authorities. These interviews add new data points and depth of narrative to the data collected with other instruments. They also add information about expected costs and time for various types of travel along key routes. Information collected will also serve RA 1.

7.1.2 How MCA monitoring data/implementation information will be used

N/A

7.1.3 Strategy for the definition of the counterfactual/base case/comparison group

N/A

7.2 Timeframe of exposure

MCC guidance advises that regular traffic data should be taken before an evaluation is conducted to understand if “traffic has increased enough to see changes in high level outcomes.” Traffic data
collection on the targeted roads either have not occurred or the data is not available to the evaluation team. In situations where traffic data isn’t available, MCC advises that “a few years” from the end of the intervention are sufficient for changes to have occurred. As this evaluation is occurring five and a half years since the end of the interventions, sufficient time should have passed for traffic usage and patterns to have changed.  

7.3 Primary Data Collection

7.3.1 Traffic Count Survey

1. Sample unit(s) – The sample unit for OD surveys is a vehicle traveling on the road.
2. Sample size and associated assumptions – N/A
3. Sample frame – vehicles traveling on the road during the times of data collection.
4. Sampling strategy:

A manual traffic count will be conducted in 15-minute intervals for each direction of flow on both roads as outlined in Annex A. The Manual Traffic Count will be conducted using A4 or letter size notebooks or sheets of paper with space for four 15-minute intervals will be used with pre-set depictions of numerical and vehicle categorization.

5. Instruments – The subcontractor will use paper or handheld devices with android operating systems to conduct the survey. The survey will be digitized using Open Data Kit software. The Traffic Count survey will additionally be supported through the use of Validata, a software that is attached to Open Data Kit and provides real time data validation, minimizing errors and reducing the need for data cleaning. Each data collection site will have two enumerators working together and two supervisors will travel among sites to ensure security and quality control.

6. Rounds, locations and timing – The evaluation team will conduct the survey over three 24-hour time periods comprising two weekdays and one weekend day in mid-July or August.
7. Respondent(s) within the sample unit – N/A
8. Staff – The evaluation team will subcontract the implementation of the Traffic Count survey to a local data collection firm. The subcontractor will use paper or handheld devices with android operating systems to conduct the survey. The survey will be digitized using Open Data Kit software. The Traffic Count survey will additionally be supported through the use of Validata, a software that is attached to Open Data Kit and provides real time data validation, minimizing errors and reducing the need for data cleaning. Each data collection site will have two enumerators working together and two supervisors will travel among sites to ensure security and quality control.
9. Data processing – Data collected on enumerators devices is uploaded to a central server managed on the Google Cloud Platform. Data transferred from each counting station will be used to formulate bi-directional (two way) traffic flows by vehicle class for each day.

---

38 Patel, Shreena “Principles into Practice: Lessons from MCC’s Investment in Roads”, November 2017; pg. 19
and calculate the 3-day average to estimate the average daily traffic (ADT). We will then convert the ADT data to annual average daily traffic (AADT) by applying a seasonal correction factor to be provided by ANE.

10. Data quality – The Traffic Count survey will additionally be supported through the use of Validata, a software that is attached to Open Data Kit and provides real time data validation, minimizing errors and reducing the need for data cleaning. Each data collection site will have two enumerators working together and two supervisors will travel among sites to ensure security and quality control.

11. Safety Procedures/Precautions – The evaluation team has chosen locations for surveys that allow ample clearance from the street. Surveys will be conducted with the support of traffic police. Enumerators will wear high visibility vests and other gear whenever they are near the road, both on and off duty. Traffic cones will be used to designate survey areas. Survey supervisors will circulate among enumerators to ensure proper procedures are followed. Chairs, cover, and sufficient water and food will be provided to enumerators to ensure that they have a proper rest area and remain hydrated and fed during survey implementation.

### 7.3.2 Origin Destination Survey

1. Sample unit(s) – The sample unit for OD surveys is a vehicle traveling on the road. Drivers of vehicles will serve as the survey’s respondents.

2. Sample size and associated assumptions – The team aims for a 30 percent sample rate over the time of the survey. The team assumes that traffic volume is large enough that a 30 percent rate will lead to an oversample of vehicles. If traffic is low on the roads, the targeted rate may increase.

3. Sample frame – vehicles traveling on the road during the times of data collection.

4. Sampling strategy:

   The evaluation team will conduct the survey over three 24-hour time periods comprising two weekdays and one weekend day.

   O-D Surveys will be completed on each of the main road sections. For suggested locations of O-D enumerators, please see the maps included as Annex A. The aim of intercept locations is to ensure that diversions are unavailable and that a high proportion of travelers are engaged. Interviewers will be trained prior to undertaking the surveys. Each enumerator will use a handheld electronic device to record respondents’ answers to specific questions. Enumerators will explain the purpose of each question to respondents and the potential use of the data to maximize the chance of complete and thorough responses to questions.

   The evaluation will use map analysis to better understand origin – destination data. Data collected through traffic counts and origin and destination surveys will allow the team to estimate results for the total road user population.

5. Instruments – The enumerator will use handheld devices with android operating systems to conduct the survey. The survey will be digitized using Open Data Kit
software. The OD survey will additionally be supported through the use of Validata, a software that is attached to Open Data Kit and provides real time data validation, minimizing errors and reducing the need for data cleaning.

The survey will cover time of interview, type of vehicle, number of people traveling in the vehicle, trip origin, trip destination, driver’s estimated time of travel, purpose category, category of cargo if applicable, and the frequency with which the driver takes the trip. Other questions may be included.

6. Rounds, locations and timing – The evaluation team will conduct the survey over three 24-hour time periods comprising two weekdays and one weekend day in mid-July or August.

7. Respondent(s) within the sample unit – Vehicle operator

8. Staff – The evaluation team will subcontract the implementation of the OD survey to a local data collection firm. Each data collection site will have two enumerators working together and two supervisors will travel among sites to ensure security and quality control.

9. Data processing – Data collected on enumerators devices is uploaded to a central server managed on the Google Cloud Platform. Data will be analyzed using the R statistical environment to provide summary statistics on the data collected through the survey.

10. Data quality – Quality control is provided on site by data collection supervisors. The survey is also supported by Validata, a real time data cleaning software that alerts data collection supervisors to outliers in the data as it is entered. Validata ensures that enumerators are asking questions correctly and entering data appropriately before large amounts of time or respondents are lost.

11. Safety Procedures/Precautions – Each location includes a safe survey area where the survey can be conducted. At each location, enumerators will intercept vehicles with the assistance of police officers. Enumerators will wear safety clothing and follow safety standards established for roadside data collection. Police officers will also ensure that laws and regulations are observed. Site supervisors will travel among the sites to ensure that safety procedures are followed.

7.3.3 Key Informant Interviews

1. Sample unit(s) – Approximately 20 interviews.
2. Sample size and associated assumptions – N/A
3. Sample frame – N/A
4. Sampling strategy – N/A
5. Instruments – The evaluation team will create an interview guide for each type of staff to be interviewed. Questions in the interview guide will be pre-coded according to the output identified for this research area that each question is intended to contribute to ensure that information gathered tracks back to main research questions and analysis tools, described below.
6. Rounds, locations and timing – The evaluation team will conduct the interviews over the course of four days in Maputo and Nampula as required. The team expects interviews to happen in mid-July or August.

7. Respondent(s) within the sample unit – operator staff, transportation workers, and municipal authorities.

8. Staff – Members of the evaluation team will conduct the interviews.

9. Data processing – The interviews will be guided by the interview guide. The interviewee will conduct the interview as a semi-structured discussion, following useful tangents and divergences as they occur. The interviewer will take notes in a notebook or computer according to the interviewer’s preference. Interviewers will write up interview notes at the end of each workday to ensure that notes are accurate, of high quality, and main points are fresh in the interviewer’s mind. An evaluation team member will read through the interview notes when they are completed, identifying key themes and patterns, that the team member will name and use to code the interviews. The team member will create an excel spreadsheet with individual interviews as rows and codes as columns. The team member will interview specific responses from each interview under each code. This qualitative data will be used to add explanation and narrative depth to the traffic data collected to answer the question.

10. Data quality – Data will be recorded promptly after interviews are conducted. Interviewers will be trained on asking non-leading questions, and identifying information critical to the evaluation.

11. Safety Procedures/Precautions – N/A

### 7.4 Summary table

<table>
<thead>
<tr>
<th>Data collection</th>
<th>Timing MM/YYYY (include multiple rounds)</th>
<th>Sample Unit/Respondent</th>
<th>Sample Size</th>
<th>Relevant instruments/modules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic Count Survey</td>
<td>July/August 2019</td>
<td>N/A</td>
<td>N/A</td>
<td>Traffic Count Survey Instrument</td>
</tr>
<tr>
<td>OD Survey</td>
<td>July/August 2019</td>
<td>Vehicle Operator</td>
<td>30 percent of vehicles</td>
<td>OD Survey</td>
</tr>
<tr>
<td>KII s</td>
<td>July/August 2019</td>
<td>Operator staff, transportation workers,</td>
<td>20</td>
<td>Interview guide</td>
</tr>
</tbody>
</table>
7.5 Secondary quantitative data–

The 2009 position described in the feasibility study for the Compact will be used as a base case for RA3 analysis. KIIs will be used to understand how conditions and behaviors changed between 2009 and the evaluation.

1. The evaluation team will conduct analysis using the following documents:
   - O-D survey, sourced from the 2009 feasibility study for the Compact:
     Contains information on road usage patterns before the MCC-funded road rehabilitations took place.

2. Requirements related to data capture – N/A

3. Data quality – N/A

7.6 Analysis plan – Question 3A asks six questions:

- Who is traveling on the road?
- Why are they traveling on the road?
- What are they transporting?
- What are they paying for transport?
- What are key routes on the road?
- How long does it take to move along key routes?

To answer these questions, the evaluation team will rely on data from the three sources described in the methodology overview. These sources work together to provide a complete picture of road travelers and their experience. Summary statistics from the O-D survey provide a description of who is traveling on the road, including a broad category of reason for travel and what if anything they are transporting. The O-D survey will also identify key routes along the roads and the operators estimated time to travel key routes.

KIIs under question 3A provide considered perspectives by stakeholders and road managers to important research questions. KIIs occur of the course of 45-60 minutes. Respondents to KIIs are municipal managers, cargo transporters, fleet owners, and other parties who have unique information and insight into the benefits of the road and its uses.

7.7 Integration of evaluation areas.

Evaluation Area 3 will analyze data on road usage patterns, examining who is using the roads, what freight is being transported, frequency of road use, and journey purposes, times and costs. Besides Evaluation Area 3, insights on journey purposes and times will inform Evaluation Area 1. In addition, information on journey prices will support responses to Evaluation Area 4, supporting the investigation on whether VOC savings have been passed on to customers.

7.8 Evaluation Question 3B
Research Question 3B: Have road usage patterns changed, in terms of who is traveling on the road, why, what they are transporting, what they are paying for transport, and how long it takes to move along key routes?

7.9 Methodology

7.9.1 General overview of methodology

Question 3B asks six questions:

- Have road usage patterns changed in terms of who is traveling on the road?
- Why have road usage patterns changed?
- What are they transporting? – Also asked in question 3A
- What are they paying for transport? – Also asked in question 3A
- What are key routes on the road? – Also asked in question 3A
- How long does it take to move along key routes? – Also asked in question 3A

Question 3B asks the evaluator to compare the usage patterns described by the data collected in response to question 3A to patterns in previous time periods. The 2009 position described in the feasibility study for the Compact will be used as a base case for this analysis, while the data gathered in 2019 will serve as post-intervention scenario. The evaluation team will create a list of drivers that may have created an increase in traffic volume for specific operator and vehicle types, and a list of drivers that may have had a dampening effect on traffic volumes for each type. KIIs will be used to reality check the items on each list, as well as test which were the most likely to have contributed to changes in traffic patterns. This qualitative data will be used in conjunction with data collected under question 3A to describe if and why road usage patterns have or have not changed.

7.9.2 How MCA monitoring data/implementation information will be used

2009 feasibility study information will serve as a baseline case for describing road usage pattern changes.

7.9.3 Strategy for the definition of the counterfactual/base case/comparison group

N/A

7.10 Timeframe of exposure

MCC guidance advises that regular traffic data should be taken before an evaluation is conducted to understand if “traffic has increased enough to see changes in high level outcomes.” Traffic data collection on the targeted roads either has not occurred or the data is not available to the evaluation team. In situations where traffic data isn’t available, MCC advises that “a few years” from the end of the intervention are sufficient for changes to have occurred. As this evaluation is occurring five and a half years since the end of the interventions, sufficient time should have passed for traffic usage and patterns to have changed.

7.11 Primary Data Collection

7.11.1 Key Informant Interviews

---

39 Patel, Shreena “Principles into Practice: Lessons from MCC’s Investment in Roads”, November 2017; pg. 19
1. Sample unit(s) – Approximately 20 interviews.
2. Sample size and associated assumptions – N/A
3. Sample frame – N/A
4. Sampling strategy – N/A
5. Instruments – The evaluation team will create an interview guide for each type of staff to be interviewed. Questions in the interview guide will be pre-coded according to the output identified for this research area that each question. In this case, questions added to the guide will enquire about the respondents understanding of how road usage has changed along the roads of interest.
6. Rounds, locations and timing – The evaluation team will conduct the interviews over the course of four days in Maputo and Nampula as required. The team expects interviews to happen in mid-July or August.
7. Respondent(s) within the sample unit – operator staff, transportation workers, and municipal authorities.
8. Staff – Members of the evaluation team will conduct the interviews.
9. Data processing – The interviews will be guided by the interview guide. The interviewee will conduct the interview as a semi-structured discussion, following useful tangents and divergences as they occur. The interviewer will take notes in a notebook or computer according to the interviewer’s preference. Interviewers will write up interview notes at the end of each work day to ensure that notes are accurate, of high quality, and main points are fresh in the interviewer’s mind. An evaluation team member will read through the interview notes when they are completed, identifying key themes and patterns, that the team member will name and use to code the interviews. The team member will create an excel spreadsheet with individual interviews as rows and codes as columns. The team member will interview specific responses from each interview under each code. This qualitative data will be used to add explanation and narrative depth to the explanations of how road usage has changed.
10. Data quality – Data will be recorded promptly after interviews are conducted. Interviewers will be trained on asking non-leading questions, and identifying information critical to the evaluation.
11. Safety Procedures/Precautions – N/A

### 7.12 Summary table

<table>
<thead>
<tr>
<th>Data collection</th>
<th>Timing MM/YYYY (include multiple rounds)</th>
<th>Sample Unit/Respondent</th>
<th>Sample Size</th>
<th>Relevant instruments/modules</th>
</tr>
</thead>
<tbody>
<tr>
<td>KIIss</td>
<td>July or August 2019</td>
<td>Operator staff, transportation workers, municipal authorities</td>
<td>N/A</td>
<td>Interview guide</td>
</tr>
</tbody>
</table>

### 7.13 Secondary quantitative data–
The 2009 position described in the feasibility study for the Compact will be used as a base case for RA3 analysis. KIIIs will be used to understand how conditions and behaviors changed between 2009 and the evaluation.

1. The evaluation team will conduct analysis using the following documents:
   - O-D survey, sourced from the 2009 feasibility study for the Compact:
     Contains information on road usage patterns before the MCC-funded road rehabilitations took place.
2. Requirements related to data capture – N/A
3. Data quality – N/A

7.14 Analysis plan – Question 3B asks two unique questions:

Question 3B asks six questions:
- Have road usage patterns changed in terms of who is traveling on the road?
- Why have road usage patterns changed?

The evaluation team will use the processed data provided in response to question 3A and compare it to information in the 2009 feasibility studies to describe change in traffic patterns, if any, and the reasons behind changes. Qualitative data gathered through KIIIs be used to provide explanations for these changes.

7.15 Integration of evaluation areas

Evaluation Area 3 will analyze data on road usage patterns, examining who is using the roads, what freight is being transported, frequency of road use, and journey purposes, times and costs. Besides Evaluation Area 3, insights on journey purposes and times will inform Evaluation Area 1. In addition, information on journey prices will support responses to Evaluation Area 4, supporting the investigation on whether VOC savings have been passed on to customers.

8. Research Area 4: Transportation Market Structure

Research Question 4: How is the transportation market structured and what is the likelihood that VOC savings will be passed on to consumers of transportation services?

8.1 Methodology

8.1.1 General overview of methodology

Question 4 asks two questions:
- How is the transportation market structured?
- What is the likelihood that VOC savings will be passed on to consumers of transportation services?

Given the scope of the evaluation and the limited volume of traffic on the road, the evaluation team understands this question to ask how the market is structured for the users of the assessed road, and what forces allocate the VOC cost savings around those users.

To answer question 4, the evaluation team must create the following outputs:
• A description of the transportation market accessed by road users, particularly freight and passenger transport users.
• An understanding of conditions of competition, barriers to entry, possible substitute forms of transportation, categories of customers and their relative negotiating power, and other factors that make up the structure of the transportation market.
• The agents, institutions, and regulations the govern the market.

The evaluation team will rely on secondary research to understand the market structure, including data provided by the GoM statistics bureau. With this secondary data, the evaluation team will form a hypothesis about how the market is structured and the relative negotiating power of consumers of transportation services. Following secondary research, the evaluation team will conduct primary research in the form of KIIIs in the transportation sector and interviews with customers of transportation services that frequent the Nacala corridor.

8.1.2 How MCA monitoring data/implementation information will be used
N/A

8.1.3 Strategy for the definition of the counterfactual/base case/comparison group
N/A

8.2 Timeframe of exposure
MCC guidance advises that regular traffic data should be taken before an evaluation is conducted to understand if “traffic has increased enough to see changes in high level outcomes.” Traffic data collection on the targeted roads either have not occurred or the data is not available to the evaluation team. In situations where traffic data isn’t available, MCC advises that “a few years” from the end of the intervention are sufficient for changes to have occurred. As this evaluation is occurring five and a half years since the end of the interventions, sufficient time should have passed for traffic usage and patterns to have changed.  

8.3 Primary Data Collection

8.3.1 Key Information Interviews
1. Sample unit(s) – Approximately 20 interviews.
2. Sample size and associated assumptions – N/A
3. Sample frame – The evaluation team will conduct sample frame information before data collection begins. Target respondents will belong to one of three categories within the (northern) Mozambican transport market:
   i. Operator staff;
   ii. Transportation workers;
   iii. Freight forwarding agents;

Patel, Shreena “Principles into Practice: Lessons from MCC’s Investment in Roads”, November 2017; pg. 19
iv. Municipal authorities.

4. Sampling strategy – Interviews will be conducted in Nampula and Nacala, and possibly in Maputo. Targeted interviewees will be agents in (northern) Mozambique’s transport sector, including operator staff, transportation workers and municipal authorities. The Evaluation Team believes that the majority of the traffic using the roads will be local in nature and therefore, as Nampula and Nacala are expected to be the main sources of that local and regional traffic. We will compare this assumption against O-D survey results before finalizing the list of respondents under RA4. These have been chosen as the focus of the Key Informant Interviews. We are also aware that the main transport operators in Mozambique are likely to be based in Maputo, and therefore we included this place in the KIIs to cover these firms.

5. Instruments – The evaluation team will create an interview guide for each type of respondent to be interviewed. The Evaluator intends to conduct the KIIs through interviews with a non-rigid structure. This type of structure will guide the discussion on topics relevant to Evaluation Area 4, while at the same time leaving room for discussion. The Evaluator should ask follow-up questions to gather further detailed information on relevant topics.

6. Rounds, locations and timing – The evaluation team will conduct the interviews over the course of five days in Maputo and other locations as indicated by the O-D survey. The team expects interviews to happen in mid-July to early August.

7. Respondent(s) within the sample unit – Transport owners, operators, and transportation market customers.

8. Staff – Members of the evaluation team will conduct the interviews.

9. Data processing – KIIs will be recorded using digital audio recorders. Afterwards, recordings will be transcribed by appropriate local staff and reviewed by the interviewer. Transcriptions will be made in Portuguese, and later be translated by Junior Economist. The qualitative data collected in KIIs will be organized in Excel worksheets, which will be formatted to ease data manipulation and analysis. An evaluation team member will read through the interview notes when they are completed, identifying key themes and patterns, that the team member will name and use to code the interviews. The team member will create an excel spreadsheet with individual interviews as rows and codes as columns. The team member will interview specific responses from each interview under each code. This qualitative data will be used to add explanation and narrative depth to the data collected through secondary research and the O-D survey.

10. Data quality – Key informant-type interviews will be undertaken on a freeform basis with responses being recorded in note form. For these interviews, surveyors will

41 This assumption is based on the World Bank Trade and Transportation Facilitation Audit. While quite outdated (2004) the audit investigates the use of regional/domestic transportation corridors (roads, railways and ports) and how the main international corridors and secondary corridors usage patterns have developed and their main beneficiaries.
initially accompany the Key-personnel and local survey/interview manager who will undertake the first batch. By this method surveyors will be trained in how to think their way through any interviews, to amend the line of questioning based upon previous answers and to allow the building in of check questions to confirm the details of a response.

11. Safety Procedures/Precautions – Interviewers will be well trained and follow safety protocols outlined in interview guides.

### 8.4 Summary table

<table>
<thead>
<tr>
<th>Data collection</th>
<th>Timing MM/YYYY (include multiple rounds)</th>
<th>Sample Unit/Respondent</th>
<th>Sample Size</th>
<th>Relevant instruments/modules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key Informant Interviews</td>
<td>July - August 2019</td>
<td>Key Informant</td>
<td>20</td>
<td>Interview Guide</td>
</tr>
</tbody>
</table>

### 8.5 Secondary data–

RA4 requires that the evaluation team understand the forces that determine which actors capture value from the increased efficiencies that the Roads Project created. The power to capture value is determined by the relative negotiating position of transportation sector suppliers, customers of transportation services, availability of substitutes to traveling on the road, barriers to transportation sector entry, and the nature of competition among firms on the road. Much of this information has already been captured by other researchers and is most efficiently included in the present evaluation through review of their work. The primary data collection that the evaluation team conducts under this RA will be informed in large part by questions developed through the secondary research review.

The evaluation team will request the following information from appropriate government agencies and other secondary sources:

- Data on transportation market structure, agents and the institutions (both formal and informal) that regulate and direct it;
- Traffic characterization data;
- Data on transportation in the Nacala corridor.

The Evaluator will also refer to several documents in the public domain as sources of secondary data (both quantitative and qualitative). Some of these sources will be:

   A. Contains information on Nacala port, Nacala Special Exports Terminal (TEEN), railway and road networks and nodes, economic impacts of improvements in corridor and traffic forecasts for the corridor.
   A. Contains information on road freight transport market agents.
   A. Contains information on the transportation sector, including road network length by roads class and condition, transportation costs by region to cities and ports, and institutional framework.
   A. Contains information on road freight market and agents, road freight associations, security concerns (e.g. unofficial bribes and fines).
   A. Contains information on trade facilitation, including time to import/export, cost to import/export, border compliance and domestic transport.
   A. Contains information on trade facilitation and transportation sector characterization.
   A. Contains information on connectivity in Southern Africa, road condition, railways and port performance and regional infrastructure funding/spending.
   A. Contains information on the Mozambican road network and trucking companies.
   A. Contains information on the Nacala port, including traffic, productivity, tariffs, duel times and capacity, among others.
    A. Contains information on the Nacala corridor, including vision and development goals, population and labor force and gross regional domestic product, among others.
11. Quente-Quente bulletin with weekly information on agricultural markets, produced by Mozambique’s Agricultural Markets Information System.
    A. Contains data on food staple prices in Mozambique, including producer prices and transportation prices.

8.5.1 Requirements related to data capture
The evaluation team requires that the data exist and is available for transfer. The evaluation team prefers that it be available in electronic format, but will utilize any format available to the best of the team’s ability.

### 8.5.2 Data quality

The evaluation team will check the data to make sure that none of it was transposed during entry, as was found in some data provided by Mozambique’s statistics agency. Financial data will be checked to make sure that cost and budget codes are consistent, and that reporting is complete across all periods.

### 8.6 Analysis plan

The evaluation team will create a description of the transportation market that serves road users. The structure of the market will include a description of the firms, including their types, that provide services in the market and the level and nature of competition among those firms. It will also include an assessment of barriers to entry to the transportation services markets, the alternative options to using the road for transportation, the power of suppliers that provide inputs to the industry, and the power of transportation services customers to negotiate or shop for prices and services. The description of the market structure will identify market actors that have the power to capture value in the marketplace and the likelihood that realizations of VOC savings will be realized by transportation services customers.

### 8.7 Integration of evaluation areas

Primary data collection efforts for Evaluation Area 4 will include surveys with farmers at local markets and key informant interviews in the transportation sector. Especially considering that the KII s will not have a rigid structure, some of the data collected may not only concern transportation market structure, but also end up providing details on any changes to road usage patterns since implementation of the Compact took place. As such, the Evaluator expects that the answer to Evaluation Area 4 is likely to support the analysis in Evaluation Area 3.
9. Challenges

The following issues present challenges to conducting the evaluation and accurately conducting the ERR.

Limitations on Comparability
- As indicated in RA1, much of the baseline data was collected in 2009. However, road construction did not start until 2011.
- The previous HDM4 workspace assumed that key agency costs were a percentage of total estimated cost, rather than including the actual agency costs.

Missing or Insufficient Data
- The reference rate for time travel isn’t included in the project’s documentation.
- Original figures for estimating accident costs aren’t included in the project’s documentation.
- Adequate baseline road usage comparable data is not available for the period between 2009 and 2019.
- Adequate baseline market structure comparable data is not available for the period between 2009 and 2019.

Baseline data quality
- Lack of quality control indications and supervisory approval for the 2009 data, including
  - IRI data
  - 2009 data for calibration
  - Traffic characteristic values such as volume, loading composition, growth rate, seasonal factors
  - Deflection measures from 2009
  - Geotechnical data

9.1 Summary of Methodology to Estimate Post Compact ERR

9.1.1 Key Parameters

The key parameters for conducting cost benefit analysis for the Mozambique Roads project evaluation are the inputs into the HDM-4. This section identifies HDM-4 data collection tools and input needs.

Calibration data
- Videos for distress assessment in accordance with HDM-4 protocol to calibrate the HDM-4 deterioration curves and conform with the HDM-4 distress units.
- RoughometerIII for surface roughness in the wheel paths with proper calibration for IRI to calibrate the IRI deterioration curve.

Geometric data
- Cumulative rise and fall (m/km) and number of rise and fall, curvature (degrees/km), speed limit, elevation, carriageway width, and shoulder width.
- These parameters shall be assessed based on the RoughometerIII GPS log data, videos (from the primary data collection) and visualized using GIS tools.
Road Characteristics

Google Earth, videos, satellite imagery and ANE documents to assess road section length, number of lanes, climatic zone, road class, lateral drainage characteristics, pavement type before intervention, the last rehabilitation date, the last resurfacing state, the last preventative treatment date, the most recent surfacing thickness, and the structural number.

Vehicle fleet description

- For the selection of the most representative vehicle fleet, there are three tools:
  - the OD study;
  - the traffic counts considering there will be a video support to identify the most prevailing vehicle per vehicle class;
  - the previous workspace developed for the project with verification for personal vehicles and light trucks. We recommend this approach.

These tools will identify

- All vehicle types and classes on the road section,
- All characteristics for each vehicle type (number of passengers, number of wheels, number of axles, average annual number of kilometers, average life, equivalent single axle load, etc.).
- Economic costs for each vehicle type (new vehicle price, replacement tire, fuel, lubricating oil and maintenance labor costs, passenger working time, etc.).
- The assessment of the annual average daily traffic per vehicle type.

Rehabilitation and maintenance characteristics

- The design (pavement type, surface thickness, base thickness, base resilient modulus, etc.)
- The definition of the intervention trigger (related to traffic, distress or year)
- The expected effects on the road condition

Rehabilitation cost and maintenance

- For the rehabilitation cost, the evaluation team recommends using the final cost of rehabilitating the roads data including works, signalization, drainage improvements, administration, resettlement, industry mobilization and demobilization costs, social infrastructure costs if any, security infrastructure costs if any, gender initiative costs if any, contingencies, tender and supervision costs.
- For maintenance cost, the evaluation team recommends using the costs provided in the project workspace and verify its reasonability based on awarded maintenance projects.

Accident data calculations utilize

- The accident data before and after the project, obtained from the police.
- The accident savings shall be monetized, based on the difference in accidents before and after project implementation.
- This allows to identify the accident class based on the number of fatal accidents, injuries and damage.

9.1.2 Findings from the review of the previous HDM-workspaces
The evaluation team performed a thorough review of the HDM-4 workspaces in order to identify shortcomings and highlight data needed. The section below summarizes the review and identifies additional data collection needs.

Traffic

The HDM-4 workspace is composed of: (1) “Vehicle fleet” file, (2) “Road network” file, and (3) “Work standard” file. In “Project”, the user can assign a work standard to a road network associated with a vehicle fleet and a traffic growth rate by vehicle type.

For each vehicle type, the following data are required and justified with proper documentation and source:

**Basic characteristics**
- Passenger car space equivalent
- Number of wheels
- Number of axles
- Tire type
- Base number of recaps (for tires)
- Retread cost (for tires) in %
- Annual number of kilometers (in km)
- Working hours (in hours)
- Average life (in years)
- Private use in %
- Number of passengers
- Work related passenger-trips in %
- ESAL
- Operating weight in tons

**Economic Unit Costs**
- Price of a new vehicle
- Replacement type cost
- Price of fuel per liter (excluding taxes)
- Price of lubricating oil per liter
- Maintenance labor cost (per hour)
- Crew wages (per hour)
- Annual overhead
- Annual interest (in %)
- Passenger working time (per hour)
- Passenger non-working time (per hour)
- Cargo (per hour)

For each vehicle type, the traffic growth rate has to be estimated. One option for estimating traffic growth is to assume a traffic growth rate equal to the GDP growth (*in 2010, 6.6 % based on World Bank data shown in the graph below*). This option is inexpensive, but also inaccurate.
A second option, which the evaluation team recommends, is to calculate the traffic growth rate by performing a current traffic count and comparing it to the traffic counts done in 2009 and in 2015. For HDM-4 runs performed in 2019, 2009 will serve as the base reference year. A traffic growth rate for each vehicle type will be obtained based on the values measured in 2019.

Traffic data for 2009 and 2010 are available on the HDM-4 workspace. However, the data is incomplete. From the counts performed in 2009, only counts on 98 km of the road section are available. The traffic counts for the third section, which total over 8,000 vehicles a day, are not provided. For the 2015 counts, only data from 84 km of the road is available.

The evaluation team will also require Equivalent Single Axle Load Factor (ESALF) data. The evaluation team may acquire this data from ANE, which could provide the last axle weight counts from any weight station in the country, or MCC will have to determine whether the evaluation team should utilize the ESALF used in the design report or the HDM-4 workspace.

**IRI**

In order to validate the IRI data, the following is required:

- Previously collected data with the date, the GPS coordinates, and other identifying information;
- The calibration forms;
- The IRI measurement report (providing the method and the equipment used);
- The data collected during the calibration of the equipment (10 runs) to measure the accuracy and repeatability.

When HDM-4 runs are performed in 2019, the base reference year will be 2009. An IRI deterioration curve is embedded in the program with a default progression factor for IRI. The 2019
values for IRI will be used to calibrate that deterioration model. The IRI after work will be assumed at 3.5 m/km and used to calibrate that deterioration model as well as the 2019 measures for IRI, so that, the IRI curve matches the value measured in 2019.

**Distress**

In order to validate the input distress data, the following is required:

- The distress survey report signed by the technicians and their supervisor;
- The data collected with the date, the GPS coordinates, and other recorded data;
- The photos/videos of the road to assess the distress.

When HDM-4 runs are performed in 2019, the base reference year will be 2009. A deterioration curve for every distress is embedded in the program with default initiation and progression factors. The 2019 values for every distress will be used to calibrate each respective deterioration model.

**Thickness and composition**

At least three test boring and core samples have to be performed on the whole road to determine the composition of the road (surface, base and subbase layer thicknesses) and qualify the materials used (resistance, modulus) for each section since. The three samples represent the roads three homogenous, subsection portions.

### 10. Administration

**10.1 Summary of IRB Requirements and Clearances**

The evaluation team will prepare and submit an Institutional Review Board (IRB) application to an IRB registered with the Office for Human Research Protections with the US Department of Health and Human Services for approval of the research and data collection plan involving human subjects. The team expects the following data collection to involve human subjects:

- Origin-Destination survey
- Public Transport User survey
- Expanded Road User Survey
- Key Informant Interviews

The application materials for IRB will include four sets of documents: 1) a copy of the Design Report, 2) a copy of survey protocols, 3) a copy of all data collection instruments that will be used for the survey, and 4) a completed IRB application form summarizing protection of participant’s rights and data safety. All materials will be translated into Portuguese before submission. The team anticipates only minimal psychosocial stress and related risks for the research participants.

The selection of the participants of the surveys will respect the principle of equity since participants will be randomly selected among the road users on MCC-funded road segments. The O-D survey, Public Transport User survey, and the Expanded Road User survey procedures will be based on the principles of voluntary participation and informed consent. Prior to participating in the survey, the road users interviewed will be given sufficient information on the objective of the survey and the use of the data collected to decide whether they wish to participate in the survey. The informed consent statement will follow the guidelines provided by MCC.

**10.2 Approval from National, Provincial and District Authorities**
For the collection of field data, the evaluation team will contact the necessary authorities (at national, provincial and district levels) early and work closely to ensure their timely cooperation. For data collection that requires traffic control or traffic diversion, the team will work with ANE (at national and provincial levels) and provincial and district authorities including police to acquire official approval and cooperation well in advance. The evaluation team will work closely with other local institutions such as the local transport centers, bus and ‘chapa’ and other local institutions stations as needed for approval prior to starting data collection.

10.3 Data Protection, Access and Documentation

The study will ensure that the confidentiality of information obtained from or about human participants is maintained. The evaluation team will ensure that the raw datasets are cleaned and de-identified closely following MCC’s guidelines for public use of data. The obtained data will be stored in a secured server with limited access to key project personnel who signed the non-disclosure agreement. The evaluation team will provide a clean, de-identified dataset to MCC for public and internal use. The public-use dataset will be free of personal or geographic identifiers that would permit identification of individual respondents. Any additional variables with risk of divulging identity of individual subjects will be removed. In order to facilitate access to and usability of data, all datasets delivered to MCC will be accompanied with completed documentation in the form of standardized metadata.

10.4 IMPACT Database

To the extent feasible study data, including video, will be collected with geospatial attributes. This will maximize the analytical utility and allow for loading into the IMPACT database for MCC and IMC team use during the study period. In addition, satellite imagery, public domain and GoM supplied data relevant to the research questions will also be included as map layers and other user-controlled tools. The IMPACT database will also serve as a single quality-controlled source of study geospatial data used in map products for both study activities and in formal reporting.

10.5 Dissemination Plan

A draft Evaluation Report (in English and Portuguese) will be submitted to MCC in February 2020 together with final datasets (a raw dataset and a de-identified dataset) and the analysis files. Feedback from MCC and in-country stakeholders will be incorporated to produce the final report together with Public Statement(s) of Difference/Support (in English and Portuguese) to be submitted to MCC in October 2020. After review by the Evaluation Management Committee (EMC), the evaluation team will present the results of the evaluation in Mozambique and Washington DC. The entire contents of the project library will be submitted to MCC in good order properly indexed and marked in both digital and paper copy.

10.6 Evaluation Team Roles and Responsibilities

The evaluation team has seven key personnel working closely together. The table and organigram below present each of the key personnel on the evaluation team and their responsibilities. The Program Director and Home Office Program Coordinator provide technical and administrative support to project activities and delivery of MCC’s goal and objectives.
<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jason Wares</td>
<td>Team Leader</td>
<td>Overall lead of project implementation and oversight of key-personnel activities. Oversight of data collection, analysis, reports and presentations Management of evaluation team in coordination with the Project Director, Key Personnel and In-Country Coordinator Presentation of draft and final results to MCC</td>
</tr>
<tr>
<td>Gabriel Assaf</td>
<td>Road Maintenance Expert, HDM-IV/REDS Specialist Roads/Pavement Engineer</td>
<td>Roads/Pavement Engineer - Technical Lead for all engineering data collection, survey design, calibrations and all roads/pavement testing designs. Also responsible for oversight of local engineers, equipment and testing standards as well as data quality oversight. HDM-IV Specialist - Technical lead on HDM-4 analysis: planning, management and appraisal of road maintenance, improvements and investment viability.</td>
</tr>
<tr>
<td>Jason Wares</td>
<td>Evaluation Expert</td>
<td>Evaluation Specialist - Technical Lead for all mixed methods research, evaluation, survey design and data collection Managing data collection subcontractors, survey templates, tools, data collection and analysis. Data Collection QA/QC; and will assist with graphics and visualization of results</td>
</tr>
<tr>
<td>James Reeves</td>
<td>Transport Economist</td>
<td>Senior Transport Economist - Oversight and technical input on ERR, CBA analysis, structure and competitiveness of the transportation sector. Assistance with developing methodology with regards to RA3 and RA4.</td>
</tr>
<tr>
<td>Jose Chiburre</td>
<td>In-Country Coordinator</td>
<td>In-Country Coordinator - Coordination of all in-country logistics, operations, meetings and interactions with in country stakeholders</td>
</tr>
<tr>
<td>Imad Abousleiman</td>
<td>Program Director</td>
<td>Program Director – Management of project oversight, communications with MCC and overall performance of the project, in coordination with the Team Leader.</td>
</tr>
<tr>
<td>Benjamin Larsson</td>
<td>Home Office Program Coordinator</td>
<td>Home Office Program Coordinator - Assistance with reviewing and editing deliverables; coordinating subcontractor and consultant, on-boarding, travel logistics and project implementation and coordination.</td>
</tr>
</tbody>
</table>
10.7 Organogram
## Table: Evaluation Timeline & Reporting Schedule

<table>
<thead>
<tr>
<th>Phase</th>
<th>Task Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Project Administration/Management</td>
</tr>
<tr>
<td></td>
<td>Monthly Progress Reporting</td>
</tr>
<tr>
<td></td>
<td>Literature review of existing documentation/models</td>
</tr>
<tr>
<td></td>
<td>Prepare work plan with expected deliverables deadlines</td>
</tr>
<tr>
<td></td>
<td>MCC review of WorkPlan and Approval to Proceed</td>
</tr>
<tr>
<td></td>
<td>MCC Review of Evaluability Assessment Report</td>
</tr>
<tr>
<td></td>
<td>Finalize Evaluability Assessment</td>
</tr>
<tr>
<td></td>
<td>Logistical planning for field visits</td>
</tr>
<tr>
<td></td>
<td>Country field missions including stakeholder meetings &amp; workshops</td>
</tr>
<tr>
<td></td>
<td>Draft Evaluation Design Report</td>
</tr>
<tr>
<td></td>
<td>Development of CBA model/ERR methodology (incl HDM-4 Calib)</td>
</tr>
<tr>
<td></td>
<td>MCC Review of Draft Evaluation Design Report</td>
</tr>
<tr>
<td></td>
<td>Final Evaluation Design Report (to remain a live document and updated throughout the evaluation as required)</td>
</tr>
<tr>
<td></td>
<td>Nesstar Metadata Template for Evaluation Catalog entry</td>
</tr>
<tr>
<td></td>
<td>MCC review &amp; authorization to proceed</td>
</tr>
<tr>
<td>Task 4: Undertake data collection</td>
<td>Finalize data collection scope with partner firms (TORs) and MMC approval</td>
</tr>
<tr>
<td></td>
<td>Draft English questionnaires/ data collection manuals / data collection instruments and protocols/ Prep</td>
</tr>
<tr>
<td></td>
<td>Pre-testing of questionnaires and back-translation activities</td>
</tr>
<tr>
<td></td>
<td>Finalize English and Portuguese (local language) questionnaires/ data collection manuals/ other data collection instruments and protocols /IRB package</td>
</tr>
<tr>
<td>Task 5: Develop Evaluation Materials</td>
<td>Reason for data collection methodology and protocols</td>
</tr>
<tr>
<td></td>
<td>Preparing of data collection staff</td>
</tr>
<tr>
<td></td>
<td>Traffic counts (including seasonal verifications)</td>
</tr>
<tr>
<td></td>
<td>Other Traffic surveys (including O-D, Axle load surveys, Travel time survey, Smart Phone Survey (tweets))</td>
</tr>
<tr>
<td></td>
<td>Road data collection - Rd Condition incl. IR, Deflection, Geotechnical</td>
</tr>
<tr>
<td></td>
<td>Road surveys - Control survey</td>
</tr>
<tr>
<td></td>
<td>Pilot testing of Quality Control checks and written summary</td>
</tr>
<tr>
<td></td>
<td>Quality control checks, primary analysis and live operational support</td>
</tr>
</tbody>
</table>

### Key:
- **Red**: August 2018-2019 - 6 months
- **Blue**: May 2019 - 12 months
- **Green**: Q1 2020-Q4 2020

### Evaluation Design Report
IMC Worldwide  
MCC Mozambique  
May 2019
<table>
<thead>
<tr>
<th>Phase</th>
<th>Task Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Analysis and Reporting</td>
</tr>
<tr>
<td></td>
<td>Task 5: Develop Final Report</td>
</tr>
<tr>
<td></td>
<td>MCC provide contract modification form</td>
</tr>
<tr>
<td></td>
<td>Review MCC Evaluation Microdata Guidelines</td>
</tr>
<tr>
<td></td>
<td>Raw data cleaning</td>
</tr>
<tr>
<td></td>
<td>Analyse raw survey data, HDM-4 comparison with CBA and ERR</td>
</tr>
<tr>
<td></td>
<td>Develop GIS database platform</td>
</tr>
<tr>
<td></td>
<td>Develop draft Final Report</td>
</tr>
<tr>
<td></td>
<td>Validate local stakeholder feedback including workshops</td>
</tr>
<tr>
<td></td>
<td>Develop data package as per MCC evaluation guidelines</td>
</tr>
<tr>
<td></td>
<td>MCC review and feedback, public statement of difference/support</td>
</tr>
<tr>
<td></td>
<td>Final Report presented to MCC and Evaluation Management Committee</td>
</tr>
<tr>
<td></td>
<td>Task 6: Disseminate Final Report</td>
</tr>
<tr>
<td></td>
<td>Presentation at MCC HQ</td>
</tr>
<tr>
<td></td>
<td>Develop Data Package and inventory</td>
</tr>
<tr>
<td></td>
<td>Update Nexstar Metadata for MCC Evaluation Catalog</td>
</tr>
<tr>
<td></td>
<td>Review of MCC public relations materials</td>
</tr>
<tr>
<td></td>
<td>Participation in MCC touring events &amp; forums</td>
</tr>
<tr>
<td></td>
<td>Prepare draft Policy Brief with key findings and lessons learnt</td>
</tr>
<tr>
<td></td>
<td>MCC review and feedback</td>
</tr>
<tr>
<td></td>
<td>Final Policy Brief prepared and finalised translation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Base Phase 2018-2019 - 6 months</th>
<th>Data Collection (optional period 1) 2019-2020 - 12 months</th>
<th>Optional 2019-2020 - 10 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>October</td>
<td>November</td>
<td>December</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Evaluation Timeline and Reporting Schedule

<table>
<thead>
<tr>
<th>Task</th>
<th>Deliverable</th>
<th>% of Task Completed</th>
<th>Estimated Due Date</th>
<th>Date Submitted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1. Assess Evaluation Plan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Work Plan with expected deliverable deadlines</td>
<td>100</td>
<td>October 12, 2018</td>
<td>October 12, 2018</td>
</tr>
<tr>
<td></td>
<td>Draft Evaluability Assessment</td>
<td>100</td>
<td>November 16, 2018</td>
<td>November 16, 2018</td>
</tr>
<tr>
<td></td>
<td>Evaluability Assessment (Written assessment of program logic, review of evidence, ERR and beneficiary analysis)</td>
<td>100</td>
<td>January 20, 2019</td>
<td>February 12, 2019</td>
</tr>
<tr>
<td>2</td>
<td>2. Develop Evaluation Design Report</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SOW, Trip Report for each country visit</td>
<td>100</td>
<td>December 17, 2018</td>
<td>December 17, 2018</td>
</tr>
<tr>
<td></td>
<td>Draft Evaluation Design Report</td>
<td>100</td>
<td>February 8, 2019</td>
<td>February 8, 2019</td>
</tr>
<tr>
<td></td>
<td>Final Evaluation Design Report (updated as needed throughout the Evaluation)</td>
<td>100</td>
<td>March 15, 2019</td>
<td>Final version: May 24, 2019</td>
</tr>
<tr>
<td></td>
<td>Level I HDM-IV Calibration (Excel File)</td>
<td>100</td>
<td>February 15, 2019</td>
<td>Submitted with EDR</td>
</tr>
<tr>
<td></td>
<td>Nesstar Metadata Template for Evaluation Catalog entry</td>
<td>100</td>
<td>June 21, 2019</td>
<td>June 21, 2019</td>
</tr>
<tr>
<td>3</td>
<td>3. Develop Evaluation Materials</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Draft Data Collection firm TORs</td>
<td></td>
<td>July 15, 2019</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Draft English and Portuguese questionnaires, data collection manuals, and other data collection instruments and protocols</td>
<td></td>
<td>July 22, 2019</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SOW, Trip Report for each country visit</td>
<td></td>
<td>July 22, 2019</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Summary of pre test for any data collection</td>
<td></td>
<td>August 16, 2019</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Written review of back translation</td>
<td></td>
<td>August 16, 2019</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Final English and Portuguese questionnaires, data collection manuals and other data collection instruments and protocols</td>
<td></td>
<td>August 30, 2019</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IRB package (research protocol, other documentation, approval/clearances, informed consent statement(s))</td>
<td></td>
<td>September 13, 2019</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>4. Prepare and Undertake Data collection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SOW, Trip Report for each country visit</td>
<td></td>
<td>September 20, 2019</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Written minutes of meetings with data collection firm(s)</td>
<td></td>
<td>September 16, 2019</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Summary of enumerator training and pilot test</td>
<td></td>
<td>October 25, 2019</td>
<td>TBD</td>
</tr>
<tr>
<td></td>
<td>Data Collection Report summarizing results and quality control checks (multiple offer shall include a specific list of the anticipated data collection efforts and the corresponding price)</td>
<td></td>
<td>February 28, 2020</td>
<td></td>
</tr>
</tbody>
</table>
5. Develop Final Report

<table>
<thead>
<tr>
<th>Task</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOW, Trip Report of each country visit</td>
<td>August 14, 2020</td>
</tr>
<tr>
<td>Draft Evaluation Report, English and Portuguese</td>
<td></td>
</tr>
<tr>
<td>Data Package as per MCC Evaluation Microdata Guidelines (See Section J) (questionnaire(s), informed consent(s), Data Package Worksheet, public-use and/or restricted-access microdata package, and analysis code)</td>
<td>September 14, 2020</td>
</tr>
<tr>
<td>Data Collection Inventory</td>
<td>September 21, 2020</td>
</tr>
<tr>
<td>Aerial imagery of each road, overlaid with the IRI, traffic, O-D, Adjusted Structural Number, and any road condition evaluation data</td>
<td>September 28, 2020</td>
</tr>
<tr>
<td>Final Evaluation Report; Public Statement(s) of Difference/Support (both in English and Portuguese)</td>
<td>October 29, 2020</td>
</tr>
</tbody>
</table>

6. Disseminate Final Report

<table>
<thead>
<tr>
<th>Task</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOW, Trip Report of each country visit</td>
<td>January 18, 2021</td>
</tr>
<tr>
<td>Policy Brief in English and Portuguese</td>
<td>January 21, 2021</td>
</tr>
<tr>
<td>Presentation materials; updates to Nesstar template (as necessary)</td>
<td>January 26, 2021</td>
</tr>
</tbody>
</table>
11. Annexes

Annex A: Map of Traffic Count and O-D Survey Locations

MCC Roads O-D Traffic Count Stations

Nampula-Rio Ligonha

Namialo-Rio Lurio

Legend

- O-D Survey Locations
- MCC Roads
  - Contracted
- Major Roads
  - Trunk
  - Primary
  - Secondary
  - Tertiary
Annex B: References


<table>
<thead>
<tr>
<th>Page Number</th>
<th>Comment</th>
<th>IMC Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Geotechnical data collection</td>
<td>MCC does not approve geotechnical data collection at this time. Remove from EDR (can put in an annex) and remove from the budget. We can add it later if the following conditions are met: 1) Photographic evidence of the cement from IMC; 2) Concurrence from MCC Transport that we have reason to doubt the as-built drawings (this is an evaluation and not an audit) and 3) concurrence from MCC Econ (after reviewing IMC’s HDM-4 files used for the sensitivity analysis) that the cement IMC sees is enough to change the ERR by +/- 40 percentage points, given the low current traffic on the roads.</td>
</tr>
<tr>
<td></td>
<td>Roadside interviews</td>
<td>MCC does not approve road side interviews as part of this evaluation. Remove from EDR (can put in an annex) and remove from the budget. As described, the OD survey is sufficient to answer the evaluation question. There does not appear to be an added value of the road side interviews to the evaluation questions.</td>
</tr>
<tr>
<td></td>
<td>Travel Time Survey</td>
<td>MCC does not approve of a time travel survey as part of this evaluation. Remove from EDR (can put in an annex) and remove from the budget. As described, the OD survey is sufficient to answer the evaluation question.</td>
</tr>
<tr>
<td></td>
<td>Budget</td>
<td>§ There are no KIIs for RA #1 described in the EDR, so these must be removed from the budget.</td>
</tr>
<tr>
<td></td>
<td>IMPACT database</td>
<td>§ As part of the IMPACT database, submitted at the end of the evaluation, MCC would like to see an interactive map of the findings from the Origin-Destination Survey and the Traffic Counts. This should include: the most common origins and destinations (wherever in the world they are – likely before and after our road segments), travel times, traffic composition, trip purpose, type and value of commodity carried.</td>
</tr>
<tr>
<td></td>
<td>Budget</td>
<td>§ IMC must remove the incorrect budget (page 106) so there is no confusion.</td>
</tr>
<tr>
<td></td>
<td>General</td>
<td>§ IMC must plan for better quality control than the EDR for the final evaluation report.</td>
</tr>
<tr>
<td></td>
<td>Comments</td>
<td>§ IMC should remove the “Reviewer Name/Institution” column from the comments &amp; responses, for the public version of the EDR.</td>
</tr>
<tr>
<td>Page Number</td>
<td>Comment</td>
<td>IMC Responses</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
<td>---------------</td>
</tr>
<tr>
<td>Comments</td>
<td>§ In the replies to comments (p 81), the use of a comparison road is proposed, but it is not yet incorporated into the EDR. It must be for the final EDR version. Suggest section 5.2.2 and 6.2.3.</td>
<td>Added to Section 5.2.2</td>
</tr>
<tr>
<td>Comments</td>
<td>§ In the replies to comments (p 89), the sample for the OD Survey is not rigorously described – “We will interview as many vehicles as possible” – do not do this, instead stick to the 30% sample rate described in the body of the EDR.</td>
<td>Noted, this has been changed in Annex C.</td>
</tr>
<tr>
<td>Comments</td>
<td>§ In the replies to comments (p 90), there is a statement that “we believe the majority of traffic to be local”. This is not supported by evidence. IMC must use the OD survey to inform the sampling approach for the Evaluation Area 4 KIIs. This has been changed in the responses: The OD survey and stakeholder KIIs will provide data enabling IMC to determine local and non-local traffic.</td>
<td></td>
</tr>
<tr>
<td>Comments</td>
<td>§ In the replies to comments, IMC states that IRI and geotechnical data collection should be $10k each, and that the higher estimates include team members’ travel. This does not make sense, because the budget with the higher estimate includes a separate line item for team members’ travel. Therefore, the budget estimates for IRI and geotechnical must be revised to $10k each.</td>
<td>The budgeted has been edited to reflect the points in the comment.</td>
</tr>
<tr>
<td>Geotechnical data collection</td>
<td>IMC did not provide evidence (such as a photo) that the roads were not consistent with the as-built drawings. That said, as Cindy mentioned below, we should tell IMC we do not approve this data collection at this time. We can add it back in later (and increase the budget accordingly) if the conditions above are met.</td>
<td>Geotechnical data collection removed from the EDR and budget; we will add as an annex in the event that IMC is able to adequately provide evidence based on the 3 points/criteria listed.</td>
</tr>
<tr>
<td>Roadside interviews</td>
<td>these seem to be duplicative with the OD survey, while providing no real advantage in understanding RA3 (road usage patterns).</td>
<td>Roadside interviews removed from the EDR and budget.</td>
</tr>
<tr>
<td>Travel Time Surveys</td>
<td>Seem to be duplicative with the OD survey and does not provide a methodology to distinguish the travel time survey from the OD survey. Remove from EDR.</td>
<td>Travel time surveys removed from the EDR and budget.</td>
</tr>
<tr>
<td>KII for RA1</td>
<td>While present in the budget, KII for RA1 is not described in the methodology section, therefore we have no rationale/evidence to support this data collection. Remove from EDR.</td>
<td>RA 1 KIIs removed from the EDR and budget.</td>
</tr>
<tr>
<td>Page Number</td>
<td>Comment</td>
<td>IMC Responses</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
<td>---------------</td>
</tr>
<tr>
<td>Secondary analysis of RA1</td>
<td>IMC proposed $65,000 for this analysis; MCC believed this estimate to be too high. Discussing with Economist in EMC, this analysis would require 40 hours of labor at most: -1 day to visit weight stations for axle load -2 days to enter code or data, if necessary -1 day to review paper -negligible time to acquire a reference rate to calculate travel time in 2009 -1 extra day for spill over At the most expensive rate ($244.90/hour), the analysis would cost $9,800. Therefore, we partially fund the analysis of RA1 at $9,800.</td>
<td>Noted, we will adjust the budget accordingly.</td>
</tr>
<tr>
<td>Annex D, Page 107</td>
<td>MCC cannot fund the $98k unspecified amount</td>
<td>Noted.</td>
</tr>
<tr>
<td>Annex D, Page 107</td>
<td>Many of the figures in the budget do not add up. Please provide decimals to the subcontract column to specify. In addition, the final total is off by a cent.</td>
<td>We will double check the budget and ensure excel &quot;rounding up&quot; is turned off.</td>
</tr>
<tr>
<td>Annex C</td>
<td>I wrote written comments in a document, they are repeated below and should be integrated into Annex C.</td>
<td>These have all now been added to Annex C, with IMC's responses</td>
</tr>
<tr>
<td>14/15</td>
<td>Other contracts awarded for associated activities: It will be good to have also the starting date, end date, and the contract amount for all the activities listed. This information will help the consultant on the rehabilitation cost and maintenance as listed in page 67</td>
<td>We have received partial information on the end/start date and funding amounts for other activities. If more data is available, we request that it is shared and we will incorporate it.</td>
</tr>
<tr>
<td>24</td>
<td>I think that the RQ1 is missing. You jumped from RQ0 to RQ2</td>
<td>Research Area 1 and all other Research Areas (including Research Question 0) are included in the referenced section.</td>
</tr>
<tr>
<td>27/28</td>
<td>There is deflection and roughness measurements performed by ANE in 2015. I think that this information can be useful for the evaluation</td>
<td>Thank you. We are aware of this, and have received partial (1 road) IRI and deflection data from 2015.</td>
</tr>
<tr>
<td>34</td>
<td>5.4 billet 4. the consultant says that the measurement will be done in outer wheel path. This roads a single carriageway one line each direction. I don’t understand which wheel path the consultant is referring for this specific case.</td>
<td>The outer wheel path is the wheel path closest to the shoulder in either direction.</td>
</tr>
<tr>
<td>36</td>
<td>last paragraph: it is important to mention that no rehabilitating, surfacing has been done in these roads. As I'm aware only routine maintenance works and some drainage improvements have been done after completion of MCC compact</td>
<td>Agreed. We have proposed KIIIs to determine the exact level of maintenance and the regime.</td>
</tr>
<tr>
<td>Page Number</td>
<td>Comment</td>
<td>IMC Responses</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
<td>---------------</td>
</tr>
<tr>
<td>38</td>
<td>12- first bullet: I recommend to get this information from INATTER they should have all information about accidents</td>
<td>Thank you, we will request this information from INATTER, upon MCC approval.</td>
</tr>
</tbody>
</table>

**Section 3.3 Summary of Alternative Data Collection**

In the proposed budget, you suggest that to answer EQ0, you would need $88,000 of LOE. While the sub-questions you propose are useful, and we like the way they are thinking about it, the budget suggests more effort than we intended for this question. On the scoping trip, we explained that there should be a light touch to address this question. We propose that you answer these questions the best you can based on what you’ve done to prepare the EDR, but not spend any additional LOE in the data collection option period.

This change is showed in the EDR budget and LOE allocation for EQ0.

**HDM-4 Sensitivity Analysis Table**

Please take a look at the example table I sent in late March and follow it as closely as possible.

We have followed the template as closely as possible.

I asked for a table of HDM-4 inputs you think are important to the model, then remove 1 variable and understand the impact of that variable on the ERR, described as a range. I believe what you have provided is something quite different; it looks like you may be looking at individual contributions of each variable. In addition, I am not sure what “Percentage ERR” means in your table, and in particular how layer characteristics result in 100%.

Please see Table 1: Precision Table.

In the example table, the evaluator also mentions what existing data or estimates could be used instead of this primary data collection (in the Assumptions row). Please include this.

This has been added under section 5.4.
<table>
<thead>
<tr>
<th>Page Number</th>
<th>Comment</th>
<th>IMC Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 5 Research Area 1 (RA1): Engineering Analysis and Economic Model</td>
<td>• In general, I find this section confusing. This section should contain what IMC proposes for data collection and eventual analysis. As an example, you list deflection in the prose, but then suggest that it is non-essential in the discussion box. Perhaps an acceptable format is this: o Identify data that is weak in the MCC-produced closeout HDM-4 model and explain why (estimates, discrepancies from the design, data is old) o Table containing sensitivity analysis o What do you propose to collect (including justifications from literature, when necessary, sensitivity analysis) o What does not make sense to collect and why (including justifications from literature, the sensitivity analysis, or claiming that MCC’s closeout ERR data for this input is sufficient)</td>
<td>We have completely rewritten this section following MCC guidance and the EDR template - Starting on page 32: Section 5.</td>
</tr>
<tr>
<td>Section 5 Research Area 1 (RA1): Engineering Analysis and Economic Model</td>
<td>• At the end of the day, data collection suggested in the EDR should be a result of the outline I mentioned above (e.g., (1) what is weak from the last HDM-4 model, (2) what will have a big impact on the ERR, and what is IMC collecting anyway for Research Areas 0, 2, 3, and 4)</td>
<td>We have completely rewritten this section following MCC guidance and the EDR template - Starting on page 32: Section 5.</td>
</tr>
<tr>
<td>Section 5 Research Area 1 (RA1): Engineering Analysis and Economic Model</td>
<td>• To be clear, you should include data collection such as deflection in the sensitivity analysis, even though you suspect it may not affect the HDM-4 very much. Part of the reason we ask for the sensitivity analysis is understand the justification for or against primary data collection. This will prove your point clearly.</td>
<td>We have completely rewritten this section following MCC guidance and the EDR template - Starting on page 32: Section 5.</td>
</tr>
<tr>
<td>Section 5 Research Area 1 (RA1): Engineering Analysis and Economic Model</td>
<td>• Since the EMC has given you some direction regarding the discussion point boxes, please remove these boxes as we move to a finalized EDR.</td>
<td>All discussion boxes have been removed.</td>
</tr>
<tr>
<td>Page Number (please reference the number at the bottom of the page)</td>
<td>Comment</td>
<td>IMC Responses</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Section 5 Research Area 1 (RA1): Engineering Analysis and Economic Model</td>
<td>Discussion Point B: I have final topline MCC expenditures on the roads projects. Am I correct in assuming you don’t need the itemized values listed in this section? Is the topline sufficient? You should know that I only have MCC’s expenditures, and part of the project was funded by GoM after the compact ended. I e-mailed Emilio to try and acquire this figure.</td>
<td>Yes, topline is sufficient. However if itemized values are available we can use those.</td>
</tr>
<tr>
<td>Section 5 Research Area 1 (RA1): Engineering Analysis and Economic Model</td>
<td>On the phone, Gabriel mentioned that Geotechnical data collection is required because the roads are discrepant from the as-built drawings. Gabriel cited seeing cement on the roads (and ANE corroborated that the roads are made of cement), but the as-built drawings made no mention of cement. For this reason, Gabriel is interested in collecting the geotechnical data. However, this does not come across in the EDR. Please do elaborate on this point as a justification for why you would want to collect deflection. In addition, this claim should be substantiated by any citations available.</td>
<td>Geotechnical data collection removed from the EDR and budget; we will add as an annex in the event that IMC is able to adequately provide evidence based on the 3 points/criteria listed.</td>
</tr>
<tr>
<td>Section 5 Research Area 1 (RA1): Engineering Analysis and Economic Model</td>
<td>Table 5.4 is not the correct way to think about exposure period. We think about an exposure period as how much time the project beneficiaries were exposed to the intervention at the time of data collection. You note this correctly in section 6.1 Timeframe Exposure, so I believe you understand what MCC is looking for. Perhaps you should create two tables—(1) the summary table as you have it minus the exposure period, (2) another with exposure period.</td>
<td>We have edited the &quot;timeframe of exposure&quot; throughout the EDR based on this feedback.</td>
</tr>
<tr>
<td>Section 5 Research Area 1 (RA1): Engineering Analysis and Economic Model</td>
<td>The stated benefit of “high frequency data collection” is that it collects data overnight, but why not conduct traditional traffic counts overnight? The OD survey is proposed to last overnight as well. The added value of high frequency data collection is not clear.</td>
<td>We have removed this from the EDR and budget, as the value added, in this instance, did not justify the cost.</td>
</tr>
<tr>
<td>Research Area 2: Maintenance</td>
<td>I wouldn’t say that the maintenance research area has two purposes, of which one is to collect data for the ERR. The ERR is secondary to research area 2.</td>
<td>Noted, we have addressed this in Research Area 2.</td>
</tr>
<tr>
<td>Research Area 2: Maintenance</td>
<td>If distress is a minor concern, as you note in this section, then why do you suggest we should collect that data for research area 1?</td>
<td>Distress measurement is required for the HDM-4 model and it is low cost to collect distress data.</td>
</tr>
<tr>
<td>Research Area 2: Maintenance</td>
<td>Data Processing: I ask that you provide a more robust, detailed description of how your data (quantitative and qualitative) will be analyzed. A good example of this, should you need one, would be the Mozambique Urban Water Evaluation EDR.</td>
<td>We have rewritten this section to provide a more robust and detailed approach.</td>
</tr>
<tr>
<td>Page Number (please reference the number at the bottom of the page)</td>
<td>Comment</td>
<td>IMC Responses</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td>---------</td>
<td>---------------</td>
</tr>
<tr>
<td>Research Area 2: Maintenance</td>
<td>· Road Usage Counterfactual: what evidence substantiates the balancing of the two opposite forces?</td>
<td>We have completely rewritten Research Area 2, this was removed.</td>
</tr>
<tr>
<td>Research Area 2: Maintenance</td>
<td>· You don’t have to repeat the exposure period in this section—just one exposure period per road. Once is sufficient.</td>
<td>Removed.</td>
</tr>
<tr>
<td>EMC Review Responses</td>
<td>· Please incorporate your response to the sixth comment from the evaluation lead regarding the comparison into the body of the EDR.</td>
<td>The comment has been addressed.</td>
</tr>
<tr>
<td>EMC Review Responses</td>
<td>· Please incorporate your response to the 12th comment from the evaluation lead regarding the comparison into the body of the EDR. I also didn’t quite understand what “efficiency gains” meant.</td>
<td>We have added this to section 5.4.</td>
</tr>
<tr>
<td>EMC Review Responses</td>
<td>· Your response to Evaluation Lead comment “This is only appropriate if there is evidence…” does not suitably address our concern. Your experience is not sufficient evidence to support your claim. Please present evidence.</td>
<td>We have reworded the language to remove assumptions that were not felt as accurate. This specific comment is addressed on page .</td>
</tr>
<tr>
<td>EMC Review Responses</td>
<td>· Please adequately address the following comment by the Evaluation Lead. We do not agree that the scope of work places the economic analysis as the central focus. While the economic analysis is critical to MCC’s work at the compact development phase, at the end of the compact and evaluation phase, we are validating and updating the closeout ERR based on new data that is collected from research areas 0, 2, 3, and 4. A heavy hand is not required on the ERR, because at this phase, the ERR is not decisional.</td>
<td>Agreed, we have edited this section to more adequately address and outline these concerns.</td>
</tr>
<tr>
<td>EMC Review Responses</td>
<td>· You suggest that there are likely to be many mini-buses. How do you know this? We didn’t see many on the roads during the scoping trip.</td>
<td>This is based on the traffic counts conducted in 2010, referenced in the EDR.</td>
</tr>
<tr>
<td>EMC Review Responses</td>
<td>· Your response to Evaluation Lead comment “What is the rationale for the locations of Nampula…” does not suitably address our concern. We would like to see the evidence base.</td>
<td>This is partially based on a World Bank audit of the Mozambique domestic and regional transportation corridors. Showing the usage patterns for major and secondary road corridors and the users/beneficiaries. Added as a footnote reference on page 50.</td>
</tr>
<tr>
<td>General</td>
<td>· Please copy edit. Some of the tables are missing headers. For example, there is a table 2, but I don’t think I saw a table 1.</td>
<td>Table 1 was submitted as an annex. We have edited and ensured all annex are attached as 1 document (EDR main annex)</td>
</tr>
<tr>
<td>Page Number</td>
<td>Comment</td>
<td>IMC Responses</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
<td>---------------</td>
</tr>
<tr>
<td><strong>9,</strong> Section 2.1.1</td>
<td>Be sure the OD survey instrument includes questions that enable you to answer whether the four objectives in this section were met by the project (i.e. whether people are travelling for markets, resources, services or employment, whether the private sector is using the road, etc.)</td>
<td>IMC will include questions in the origin and destination survey that track vehicle operators’ origins, destinations, reasons for travel, and a classification of vehicles traveling the road, according to the objectives of the evaluation.</td>
</tr>
<tr>
<td><strong>17,</strong> Figure 4</td>
<td>This is an older version of the MCC transportation project logic. Please use the newer version.</td>
<td>It is unclear which figure the comment refers to. The EDR has two figured on page 17, Figure 1, the compact logic model, and figure 2, the Road Rehabilitation Component Project logic (created in 2018).</td>
</tr>
<tr>
<td><strong>18,</strong> first paragraph</td>
<td>MCC M&amp;E uses only &quot;output&quot; and &quot;outcome&quot; to describe results (see our policy for more details). Please clarify which one &quot;impact&quot; is meant to be in this paragraph.</td>
<td>Sentence changed to indicate that “impact” referred to “outcome.”</td>
</tr>
<tr>
<td><strong>18,</strong> third paragraph</td>
<td>The MCC transportation project logic was drafted in 2018, so does not support the thesis of this paragraph. Please cite another logic model instead to support the point.</td>
<td>Thank you. Sentence edited to clarify that it describes the Compact logic model.</td>
</tr>
<tr>
<td><strong>19,</strong> first line</td>
<td>IRI is an output measure in the project logic (a measure of road quality)</td>
<td>Yes, however, the 2009 monitoring and evaluation plan lists IRI under outcome indicators in its “Indicator Definition and Tracking Table” which was Annex 2 to the 2009 Monitoring and Evaluation Plan.</td>
</tr>
<tr>
<td>General</td>
<td>Do you propose to use Rio Lurio-Metoro as a comparison segment? It is mentioned in the text, but I don't see the approach proposed. If so, what makes it a good comparison? What are some of it's weaknesses as comparison? For which evaluation questions will it be used? Please incorporate into the text where relevant.</td>
<td>IMC recommends using the Rio Lurio – Metoro as a comparison segment. The approach is submitted below for consideration. While the two sections were constructed about 5 years apart, the designs are reported to be identical. We will verify this assumption.</td>
</tr>
</tbody>
</table>

Per the Volume 1 Executive Summary Report of Scott Wilson dated November 13, 2018, the initial pre-2009 designs of the Namialo – Rio Lurio and Rio Lurio Metoro road sections are...
<table>
<thead>
<tr>
<th>Page Number</th>
<th>Comment</th>
<th>IMC Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.4.1, Summary of existing evidence &amp; 2.4.2 Gaps in literature</td>
<td>This section should describe existing evidence to support (or not support) the causal linkages in the project logic. See existing MCC transportation EDRs for examples - please don't copy those, but you can cite them and build on them if you have anything to add.</td>
<td>The section has been edited to describe evidence that supported the causal linkages among the project and the logic models objective and goal. We have also included a discussion of gaps in the evidence specific to this project. The section focuses on how the Mozambique specific evidence either justified or did not justify applying the Compact logic model to Mozambique. It also focuses on evidence that the Roads Project would produce a sufficient economic rate of return as describing results related to access to markets and resources and reduction in poverty is beyond the scope of this evaluation.</td>
</tr>
<tr>
<td>Page Number (please reference the number at the bottom of the page)</td>
<td>Comment</td>
<td>IMC Responses</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Final Project Costs</td>
<td>Those can be provided by MCC M&amp;E from our financial records.</td>
<td>Thank you. We will follow up</td>
</tr>
<tr>
<td>24, RQ2.5</td>
<td>Suggest asking this same question on roads that are similar to the MCC-rehabilitated roads, but older, to see the likelihood that maintenance will be completed in the future on the MCC road.</td>
<td>Thank you. Suggestion noted on page 24</td>
</tr>
<tr>
<td>24, Central research area 3 question</td>
<td>Please copy the question from the scope of work</td>
<td>Corrected and highlighted on page 24.</td>
</tr>
<tr>
<td>General</td>
<td>In the OD survey, it is critical to get an actual measure of travel times as part of the evaluation. The HDM-4 estimates do not suffice - those are just estimates. Is it possible to do the same thing for VOCs, in the OD survey or elsewhere?</td>
<td>We will include questions about travel times in the OD survey, and compare the answers with the HDM-4 estimates to gauge accuracy – in our experience, drivers will usually provide accurate travel times for their journey. Unfortunately, it is not possible to do the same thing for VOCs, as drivers do not tend to know these values (at most they have an idea of how much they have spent on fuel, but VOCs go way beyond that measure). Thus, we have found that using HDM-4 is the best way to calculate VOCs.</td>
</tr>
<tr>
<td>25, RQ4.1</td>
<td>What do you mean by &quot;efficiency gains&quot;?</td>
<td>By efficiency gains we mean decreases in costs and travel times for both passenger and freight transport, particularly where these might create fleet management and utilization benefits that are beyond the normal VOC and travel time savings.</td>
</tr>
<tr>
<td>25, “This data includes information on planned and unplanned stops in journeys…”</td>
<td>Not just stops, but all costs in journeys should be measured (bribes, licenses, etc….)</td>
<td>This issue is something we have considered. Since it is expected that surveyors will be accompanied by local police when conducting the surveys, if we include a question such as “how much do you typically pay in bribes to local police in your journey?”, we might be putting respondents in an awkward position. Also, the answers received are likely to be imprecise. Alternatives to this approach include asking how long respondents usually spend</td>
</tr>
<tr>
<td>Page Number</td>
<td>Comment</td>
<td>IMC Responses</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
<td>---------------</td>
</tr>
<tr>
<td>RQ4.3</td>
<td>&quot;The purpose of this Research Question is to characterize the (northern) Mozambican transport market&quot;</td>
<td>This is only appropriate if there is evidence that a significant number of journeys, as evidenced in an OD survey, start and/or end in these locations. Please present this evidence. While the purpose of improving these roads was to improve long distance connectivity, our experience is that in most cases the traffic using this kind of road will be predominately local in nature. We therefore consider that, considering the character of the transport industry in northern Mozambique, and specifically the area around the roads being studied, is appropriate and will yield the information that we are looking for.</td>
</tr>
<tr>
<td>26, Evaluation Design Overview</td>
<td>There's a misunderstanding here. Evaluation Question is the economic analysis, but the evaluation is Evaluation Questions 2, 3 and 4. The performance evaluation is the central focus of this scope of work, not the economic analysis. The scope of work for the evaluation places the economic analysis as the central focus of the evaluation. The scope of work for this evaluation, included in IMC’s contract states, “The economic analysis is critical to MCC’s work.” And “The performance evaluation components of this requirement seek to complement the economic analysis by answering descriptive questions that provide context to and enhance the knowledge gained through the economic analysis.”</td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>Will the travel times that are measured as part of evaluation area 3 be used in calculating the ERR, if they are different from those modelled by HDM-4?</td>
<td>Travel times measured as part of evaluation area 3 represent real travel time measures and will therefore be compared with HDM-4 estimated travel time values to verify upstream input parameters to HDM-4 such as representative</td>
</tr>
<tr>
<td>Page Number</td>
<td>Comment</td>
<td>IMC Responses</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
<td>---------------</td>
</tr>
<tr>
<td>27, &quot;the performance evaluation...&quot;</td>
<td>It is much more important than this: MCC is required to do an independent evaluation of all projects, measuring the achievement of results. The HDM-4 estimations do not fulfill this requirement, and are therefore less important to the final product.</td>
<td>Thank you. We’ve edited the sentence to reflect MCC’s requirement. However, our consultation with MCC project management staff and the specific scope of work for this evaluation makes clear that the performance evaluation “seek(s) to complement the economic analysis by answering descriptive questions.”</td>
</tr>
<tr>
<td>Table 5</td>
<td>Please only include quantitative indicators on this table. Several evaluation questions don't appear to have quantitative indicators but they can (they are even mentioned in the EDR text further down, like on page 66) and should. Please specify the values (write a number) in the Baseline and Closeout columns that will be used, and note the source they are from.</td>
<td>Changes requested have been made to Evaluation Design Overview Table, which is now a stand-alone excel document.</td>
</tr>
<tr>
<td>Table 5</td>
<td>Please align the information in the cost columns by rows, so the cost number is next to the indicator it is associated with.</td>
<td>Changes requested have been made to Evaluation Design Overview Table</td>
</tr>
<tr>
<td>Table 5</td>
<td>Shouldn't the indicators for 3A and 3B be the same?</td>
<td>Question 3.1 (part of 3A) only asks about road usage patterns, whereas question 3.2 (part of 3B) requires us to study the factors (cost) that will affect whether people make a particular journey; hence the indicators used are different.</td>
</tr>
<tr>
<td>Table 5</td>
<td>I don't see &quot;Generated Traffic&quot; and &quot;Diverted Traffic&quot; in the &quot;Program Logic Result&quot; column. Please add.</td>
<td>Added under section 3.1. Thank you.</td>
</tr>
<tr>
<td>Page/Number</td>
<td>Comment</td>
<td>IMC Responses</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
<td>---------------</td>
</tr>
<tr>
<td><strong>Table 5, Indicator Name: Change in vehicle operator costs</strong></td>
<td>How will this be measured in the OD Survey?</td>
<td>We do not recommend measuring VOC in the OD survey. Unfortunately, in our experience it is not possible to get accurate VOC estimates solely by asking about it in an OD survey.</td>
</tr>
<tr>
<td><strong>3.4.3 Budget for CBA</strong></td>
<td>To clarify, here we are looking for just the marginal cost of evaluation question, on top of the other evaluation questions.</td>
<td>The evaluation team interprets this comment to mean that the commenter would like to see the budget broken down by question. We’ve included a breakdown by question. Labor and ODCs are spread evenly across each RA and EQ0 because it is difficult to know the cost of ODCs if MCC opts to answer only some questions and not others.</td>
</tr>
</tbody>
</table>
| **59, Discussion Point H** | How will traffic growth beyond 2019 be estimated? Will you use the same rate as between 2009-2019, or something else? | Following international best practice and methodology used at length by IMC Worldwide in past projects, traffic growth beyond 2019 will be estimated with basis on:  
- Car transport: proxied by GDP per capita growth rate  
- Freight transport: proxied by GDP growth rate  
- Bus transport: proxied by population growth |
| **General (all "Timeframe of Exposure" sections)** | Where did you find the "MCC desired time frame of five years"? When does the literature say we should expect to see full traffic adjustment to the new transportation costs from the rehabilitated road? When is periodic maintenance expected to be needed on the MCC investments? Are these consistent or not with the MCC CBA? These factors should drive when you propose to collect data. | 5-year time frame: From page 16 of IMC’s contract for this evaluation: “Note that the Road Project was completed in September 2013, and MCC generally expects to collect ex-post data within 5 years of completion of works. MCC will consider well-justified recommendations by the Independent Evaluator for the time frame of data collection, but the timing should be carefully considered.”  
Full traffic adjustment and maintenance: This will be determined when the distress survey, the roughness assessment, the pavement structure...
<table>
<thead>
<tr>
<th>Page Number</th>
<th>Comment</th>
<th>IMC Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>compositions and the geotechnical characterization have been conducted/obtained. While these have not yet been performed, it nonetheless appears, based on the observations during the December 2018 mission, that periodic maintenance is due for both road sections in the next 2 to 3 years maximum.</td>
<td></td>
</tr>
<tr>
<td>66, first bullet</td>
<td>do you mean roads that are similar but also older? I don't understand how roads that are similar but not older would help</td>
<td>Because we need the maintenance regime on comparable road(s) with regards to characteristics, but same age or older. Both are valuable. Similarity is meant for the characteristics, properties, thicknesses, traffic, soils, that determines pavement age performance curve and not referring to age.</td>
</tr>
<tr>
<td>67, OD Surveys</td>
<td>Will you survey in the same locations as the baseline OD survey? That is critical to answering evaluation question 2B, unless there are serious flaws with the choice of those locations.</td>
<td>Yes, we intend to survey in the same locations as the baseline OD surveys.</td>
</tr>
<tr>
<td>68, OD sample unit</td>
<td>Are there likely to be many buses? If so, how will you gather their information?</td>
<td>There are likely to be many mini-buses (“chapas”). These are small vans of about 15 seats, responsible for most collective transportation in the country and seemingly vital for the commercial dynamic of smaller cities, responsible for moving around a considerable amount of agricultural output. We intend on gathering information from them in the OD surveys by asking the driver for the basic information about origin and destination.</td>
</tr>
<tr>
<td>68, OD sampling strategy</td>
<td>What is the rationale for this sample rate? Considering the low levels of traffic, it seems a higher rate is likely very possible.</td>
<td>The strategy for sampling traffic will be to interview 30% of vehicles. Where traffic levels are low, the aim will be to interview all traffic. Where this is not possible, we will ensure that the sample as far as possible reflects the vehicle mix, ensuring that the sample achieved for the less common vehicle types is as statistically robust as possible. Before starting the surveys, we will refer to</td>
</tr>
<tr>
<td>Page</td>
<td>Number</td>
<td>Comment</td>
</tr>
<tr>
<td>------</td>
<td>--------</td>
<td>---------</td>
</tr>
<tr>
<td>69, 69</td>
<td>Roadside interviews sampling approach</td>
<td>This sampling approach is vague. Suggest shifting to an achievable random sample rate, even if it is small. If the existing approach is maintained, the &quot;relevant assessment of data adequacy&quot; must be thoroughly and objectively described in the EDR. The strategy for sampling traffic will be to interview 30% of vehicles. Where traffic levels are low, the aim will be to interview all traffic. Where this is not possible, we will ensure that the sample as far as possible reflects the vehicle mix, ensuring that the sample achieved for the less common vehicle types is as statistically robust as possible. Before starting the surveys, we will refer to international best practice on sampling for roadside interviews.</td>
</tr>
<tr>
<td>69</td>
<td>Since it seems unlikely that much of the traffic is local to the OD survey locations, local market days don't make sense to target for a survey. Suggest using the traffic count information to inform the approach.</td>
<td>In our experience, much of the traffic associated with these types of roads tends to be local and increase considerably on market days – hence the importance of conducting OD surveys on market, as well as non-market, days. This will also help provide a good comparison between local and non-local traffic. The only reason not to do so would be if the original OD survey locations were very far from the market.</td>
</tr>
<tr>
<td>70, 7.4: Secondary Quantitative Data</td>
<td>Please explain how 1, 2, and 3 will be analyzed to answer the evaluation question.</td>
<td>The listed sources provide data that the evaluation team may use to triangulate the data gathered through data collection instruments, and provide possible explanations for evaluation findings.</td>
</tr>
<tr>
<td>72, Transportation Market Counterfactual</td>
<td>Why is a counterfactual necessary? MCC didn't aim to change the transportation market structure, but do you have evidence to believe the project did?</td>
<td>To conduct any evaluation of a project’s impact, we need to establish a counterfactual which sets out what would have happened without the project. We currently have no evidence that the project did create a change in market structure, but it seems prudent at this stage to include for the possibility of this analysis.</td>
</tr>
<tr>
<td>Page Number</td>
<td>Comment</td>
<td>IMC Responses</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
<td>---------------</td>
</tr>
<tr>
<td>72, 8.3</td>
<td>What is the rationale for the locations of Nampula, Nacala and possible Maputo? Shouldn't you want to target stakeholders that use (or who's businesses use) the road? And how do you know the locations of these people already, without an OD survey? Please provide this evidence.</td>
<td>The OD survey and stakeholder KIIs will provide data enabling IMC to determine local and non-local traffic. We are also aware that the main transport operators in Mozambique are likely to be based in Maputo, and therefore we included this place in the KIIs to cover these firms.</td>
</tr>
<tr>
<td>Annex 3, Evaluation Budget</td>
<td>This doesn't match the budget shown in the main text of the EDR, but it should. Please include the original budget, and the revised in columns next to it, based on the evaluator's recommend design. Please include the revision suggested in this version of the EDR, along with any revisions suggested in future EDR versions, all next to each other.</td>
<td>We’ve added a column to the budget in Annex three providing details on our recommended budget, which matches the budget in the main text.</td>
</tr>
<tr>
<td>EDR - pg. 8</td>
<td>I'm not sure I would call this portion of the road Namialo - Rio Lurio or that I would call it a counterfactual. The road was north of Rio Lurio and led to Cabo Delgado, so I don't think Namialo - Rio Lurio is an accurate moniker because Namialo is not the origin or destination. Additionally, it is not a true counterfactual because there are sources of non-comparability: (1) who constructed the original roads and the methods/materials used to construct the roads may have been different, (2) the Namialo - Rio Lurio and the section just north of it are governed by different provinces (Nampula vs Cabo Delgado) and provincial maintenance practices could be different. In the absence of properly vetting this section of the road as a counterfactual, I would lean towards calling the CB road a &quot;soft comparison&quot;.</td>
<td>Please refer to Q&amp;A #6 above as well as:</td>
</tr>
<tr>
<td>Page Number (please reference the number at the bottom of the page)</td>
<td>Comment</td>
<td>IMC Responses</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>EDR - pg. 10</td>
<td>Project documentation claims that there were 1.2 million beneficiaries in districts adjoining the roads and stated that they would have improved access in Nampula province by 2028 (i.e. 368,477 beneficiaries – Namialo to Rio Lurio road; 869,257 beneficiaries – Nampula to Rio Ligonha road). I think this should be clarified. Improved access to what, exactly? Do beneficiaries have improved access to markets or better access to roads or both?</td>
<td>As the paragraph states, and as is stated in the Compact, “access to health, education, and employment.” This is as specific as MCC’s documentation gets as relates to access. Whether or not people have benefited from that access is beyond the scope of this evaluation.</td>
</tr>
<tr>
<td>EDR - pg. 10 - 11</td>
<td>Might be worth noting what changed from the IM to the updated beneficiary numbers? What factors did MCC reconsider?</td>
<td>Section edited. Though the reason behind the reduction in beneficiary numbers is unclear, it may have at least in part been related to the rescoping of the Road Project.</td>
</tr>
<tr>
<td>EDR - pgs. 11-12</td>
<td>The Geographic Coverage section should explain why these activities were implemented in Nampula.</td>
<td>Section edited to include reasons for construction in and around Nampula.</td>
</tr>
<tr>
<td>EDR - pg. 18</td>
<td>Since IMC identifies inconsistencies in the models, IMC could propose a model</td>
<td>The section is merely descriptive. The evaluation does not require a theory of change model because is focused on output level results and outcome level results limited to road users. That said, the Evaluability Assessment does present a basic alternative model.</td>
</tr>
<tr>
<td>EDR - pg. 18</td>
<td>I think this page can benefit from constituent terminology. Perhaps distinguishing and then utilizing the terms &quot;Compact Logic&quot; and &quot;2018 Roads Rehabilitation Logic&quot; will clarify this section.</td>
<td>Thank you. Section edited for clarity.</td>
</tr>
<tr>
<td>EDR - pg. 21</td>
<td>I believe ANE’s role should also be summarized in the table</td>
<td>Thank you. ANE’s role has been added</td>
</tr>
<tr>
<td>EDR - pg. 22</td>
<td>Gaps in literature section should reach beyond project documentation. This section should review academic literature on road rehabilitation/creation and poverty reduction.</td>
<td>The evaluation team has been instructed not to focus on the connection between the project and higher order outcomes or goal’s such as poverty reduction. The evaluation team believes that conducting a literature review on road rehabilitation and creation is beyond the scope of this evaluation.</td>
</tr>
<tr>
<td>Page Number</td>
<td>Comment</td>
<td>IMC Responses</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
<td>---------------</td>
</tr>
<tr>
<td>EDR - pg. 20 -22</td>
<td>Literature review section does not cover policy relevance of the evaluation. The EDR outline recommends addressing the policy relevant of the evaluation.</td>
<td>Thank you. A comment on policy has been added.</td>
</tr>
<tr>
<td>EDR - pg. 22</td>
<td>I think cost-effectiveness (RQ0.2) should be addressed with a light touch, unless inexpensive to address it more thoroughly. In fact, this question overall should be informed by the documents you’ve already reviewed. I am not sure how the suggested $100,000 was derived.</td>
<td>Noted. Thank you.</td>
</tr>
<tr>
<td>EDR - pg. 24</td>
<td>[what were the effects of those efforts and why?] In general, I'm wary of using &quot;effect&quot; as this is not an impact evaluation.</td>
<td>Assessment of impact of CPs on road maintenance funding removed.</td>
</tr>
<tr>
<td>EDR - pg. 25</td>
<td>[Central research area 3 question: What are current road usage patterns (and have they changed as a result of the MCC investment)?] Again, I'm wary of &quot;as a result of the MCC investment&quot; because this is not an impact evaluation.</td>
<td>Thank you. This question is taken from the evaluation’s scope of work, which states in part, “Research Question 3B: Have road usage patterns changed, in terms of who is traveling on the road, why, what they are transporting, what they are paying for transport, and how long it takes to move along key routes? This question will explore changes in the structure of transportation demands, possibly addressing whether a change may have occurred as a result of MCC road investments or other complementary investments, or due to unrelated factors.”</td>
</tr>
<tr>
<td>EDR - pg. 31</td>
<td>To inform research area 0, wouldn't you want to include former MCA staff in KII? Is this what is meant by &quot;stakeholder perspective&quot;?</td>
<td>MCA staff are certainly included among stakeholders</td>
</tr>
<tr>
<td>EDR - pg. 31</td>
<td>Could provide more detail regarding &quot;evaluation analysis of stakeholder responses&quot;?</td>
<td>The evaluation team does not see where this phrase appears in the EDR. However, evaluation analysis of stakeholder responses could refer to the qualitative data analysis that is conducted after interviews.</td>
</tr>
<tr>
<td>EDR - pg. 36 - 38</td>
<td>Please provide costs associated with measuring deflection, conducting a travel time survey, measuring load factor data, quality forms.</td>
<td>These costs are provided in the program budget, in section 3.3.3 (budget for CBA analysis) and in the EDR table.</td>
</tr>
<tr>
<td>Page Number</td>
<td>Comment</td>
<td>IMC Responses</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
<td>---------------</td>
</tr>
<tr>
<td>EDR - pg. 45</td>
<td>Please provide greater detail about what secondary sources you plan to use to answer RQ3.1.</td>
<td>Please refer to point 7.4 in page 69 for further information.</td>
</tr>
<tr>
<td>EDR - pg. 46</td>
<td>What added value will roadside interviews give?</td>
<td>O-D surveys and traffic counts provide quantitative data about categories of travelers and categories of road use. Qualitative data collection, like roadside interviews provides narrative around quantitative data, answering why the data appears as it is and providing alternative explanations for observed phenomena. Additionally, interviews allow the evaluation team to check the assumptions that inform the HDM-4 model.</td>
</tr>
<tr>
<td>EDR - pg. 54</td>
<td>What added value does the high-frequency data collection have over O-D and travel time surveys? What additional precision are we getting?</td>
<td>The value is in that it tracks data throughout the night. If cargo is transported along the roads in high volumes at night, high frequency data collection would provide considerable additional precision. However, the evaluation team believes it is unlikely that there is significant traffic during night hours.</td>
</tr>
<tr>
<td>EDR - pg. 65</td>
<td>[Considering the low traffic volumes, the strength (stabilized) of the two pavements, the absence of distress and the fact that most of the two alignments are on a fill, the evaluation team believes that the two roads will have no issue of sustainability during the expected design life.] Since this is the case, is it possible to evaluate sustainability after a certain number of vehicles have utilized the roads? To me, evaluating the sustainability of a road over a time period has no real meaning if the traffic volumes are low, because ultimately we want to understand how much the road is sustained after a certain amount of use.</td>
<td>Both time and vehicle use per time period are factors in road sustainability. The evaluation team believes that the roads were built to sustain vehicle use per period many multiples higher than is currently the case, so sustainability isn’t determined by the number of vehicles that use the roads.</td>
</tr>
<tr>
<td>EDR - pg. 64</td>
<td>Please include when the intervention date began (e.g., when road construction was completed), and when IMC plans to collect data.</td>
<td>Included. Thank you.</td>
</tr>
<tr>
<td>Page Number</td>
<td>Comment</td>
<td>IMC Responses</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
<td>---------------</td>
</tr>
<tr>
<td>EDR - pg. 69</td>
<td>There are limitations of road side surveys. For example, you may only capture a subsect of the population that is wealthy enough to take the survey (time is an economic constraint). Please discuss the bias and limitations of the sampling strategy.</td>
<td>Thank you. Section added.</td>
</tr>
<tr>
<td>EDR - pg. 70</td>
<td>[Data processing] Please discuss any tags you might include in the transcripts (gender, age, location, SES)</td>
<td>Thank you. Information on how data will be coded added to the section.</td>
</tr>
<tr>
<td>Discussion Point B: Do we have the actual numbers? Recommend using actuals if available.</td>
<td></td>
<td>In the mcc-err-Mozambique-roads-closeout workbook on the “Cost Benefit Summary” sheet, there are 2 scenarios, i.e. high scenario and low scenario. These were developed in 2014 (after the works were completed). Actuals are not available therefore we suggest to use the high scenario and low scenario values.</td>
</tr>
<tr>
<td>Discussion Point C: Recommend that IMC develop routine and periodic maintenance costs based on figures provided by GoM.</td>
<td>IMC will make assumptions based on the Bill of quantities and other documents provided by MCC.</td>
<td></td>
</tr>
<tr>
<td>Discussion Point D: recommend using proposed calibration approach unless we have a calibrated model somewhere.</td>
<td>Well noted. The available HDM-4 models are not calibrated for both road sections.</td>
<td></td>
</tr>
<tr>
<td>Discussion Point E: recommend the evaluator determine and justify the TT rate to be used.</td>
<td>Noted, adjusted in Discussion Point E</td>
<td></td>
</tr>
<tr>
<td>Discussion Point F: ok for accident calculations if reliable figures pre intervention exist.</td>
<td>The evaluation team did not have access to accident data. The article “Road traffic injuries in Mozambique”. Romão, et al. (2003) provides reliable figures for year 2000 that we could use with an adequate accident growth rate. This paper demonstrates that data exist.</td>
<td></td>
</tr>
<tr>
<td>Page Number</td>
<td>Comment</td>
<td>IMC Responses</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
<td>---------------</td>
</tr>
<tr>
<td></td>
<td><strong>Discussion Point G:</strong> IRI, what does the evaluator recommend to determine the IRI given the points raised? Note that the evaluator mentions on page 79 that they will use the 2019 IRI measurement with the IRI progression factor in HDM-4 and fit a curve. If this is correct, what are the drawbacks to this approach?</td>
<td>IMC will inquire regarding all available accident data before and after the works, and assess potential reduction in accidents and therefore, savings if any.</td>
</tr>
<tr>
<td></td>
<td><strong>Discussion Point H:</strong> what does the evaluator recommend to determine the traffic numbers?</td>
<td>The 2009 IRI value from SMEC, is an HDM-4 input before works. IMC will also use the 2009 IRI values to calibrate the counterfactual on the Rio Ligonha-Nampula. The IRI after work will be assumed at 3.5 m/km and used to calibrate that deterioration model as well as the 2019 measures for IRI, so that, the IRI curve matches the value measured in 2019.</td>
</tr>
<tr>
<td></td>
<td><strong>IMC to provide costs</strong></td>
<td>Traffic data needed: vehicle types, traffic volume per vehicle type, ESAL per vehicle type and traffic growth. The evaluation team will assess traffic volume with traffic counts performed in 2019, loading composition from weight stations to be obtained in 2019, traffic growth to be deduced from the evolution in traffic between 2009 and 2019, and seasonality factors to be assessed in 2019.</td>
</tr>
<tr>
<td></td>
<td><strong>Discussion Point I:</strong> the evaluator notes that deflections are not recommended yet provides a $25k estimate. The evaluator also notes that both pavements are structurally sound. Why does the evaluator propose performing the deflections? Please clarify this point and the deflection costs.</td>
<td>The cost of Deflections was added to show the actual cost of deflection testing if it was requested by MCC. Only the deflections before the intervention are required, by our recommendation, as input in the HDM-4 simulation. A measurement in 2019 (after the intervention) would not warrant the expense (except to determine if the pavement is structurally sound) as the accuracy of the ERR calculation will not be increased by conducting additional deflection testing.</td>
</tr>
<tr>
<td>Page Number (please reference the number at the bottom of the page)</td>
<td>Comment</td>
<td>IMC Responses</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Discussion Point J: what does the evaluator recommend given their statement that the data is unreliable?</td>
<td>Perform bores on Namialo - Rio Lurio and bores on Rio Lurio – Metoro road section. Perform comparison with the Rio Lurio to Metoro road section <em>(refer to QA 6)</em></td>
<td></td>
</tr>
<tr>
<td>Discussion Point K: the use of google earth is appropriate and cost effective as is the video data collection. Why does the evaluator not want to use the video data that collects the same information as noted in 5.3.3?</td>
<td>Our experience in Côte d’Ivoire, Nepal, Sri Lanka, indicates that assessing geometric parameters and altitude is more reliable and much more practical with Google Earth.</td>
<td></td>
</tr>
<tr>
<td>5.3.4 correct deflection to coring in safety procedures section.</td>
<td>Thank you</td>
<td></td>
</tr>
<tr>
<td>3.4.3 10 core samples per road costs $35K? Is this a typo? Please revisit this estimate. Also note in the Annex that only three cores are recommended per road.</td>
<td>The $35K was a stand-alone estimate assumes that MCC might request the core sampling by itself. Therefore, this cost includes a portion of other cost such as travel, lodging, car rentals, DBA, etc…We will reduce the estimated cost to $10K. Once the final sampling approach is approved, IMC will negotiate with its local subcontractor and will charge MCC the final negotiated cost and stay below our award budgeted price.</td>
<td></td>
</tr>
<tr>
<td>IRI costs $30k? Is this a typo? What are the costs behind this estimate?</td>
<td>The estimated amount was a stand-alone estimate assuming that MCC might request the IRI testing by itself. Therefore, this cost includes a portion of other cost such as travel, lodging, car rentals, DBA, etc…We will reduce the estimated cost to $10K. Also note, that IMC will most likely use in-house Roughometer III (if allowed by the Government in Mozambique to bring it into the country) to measure the IRI hence reducing this cost even further. If we are not allowed to bring the Roughometer into Mozambique, IMC will negotiate with its local subcontractor and will</td>
<td></td>
</tr>
<tr>
<td>Page Number</td>
<td>Comment</td>
<td>IMC Responses</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>55</td>
<td>what is driving the labor rates? At an average hourly rate of $150/hr, this implies over 2,200 hours of work in addition to the data collection costs? The data collection costs appear very high. Please detail and justify.</td>
<td>Please find below the requested details for the estimated level of effort by each individual to cover Task 3 and Task 4 of the Option Period I.</td>
</tr>
<tr>
<td>EDR pg. 55</td>
<td>In the CBA budget, please break out labor and ODCs.</td>
<td>Labor and ODCs have been separated by Research Area.</td>
</tr>
<tr>
<td>EDR pg. 56</td>
<td>Discussion point A: 2009 should be base year. As the compact starts in 2009, all projects should start in the same year for comparability. (if one project is built in the first year and the second project is built in the 4th year, the ERR should reflect more benefits for the project that can be delivered more swiftly)</td>
<td>We will use 2009 as base year.</td>
</tr>
<tr>
<td>EDR pg. 57</td>
<td>Discussion point B: Estimated costs as listed should be used.</td>
<td>Thank you.</td>
</tr>
<tr>
<td>EDR pg. 57</td>
<td>Discussion point C: The HDM-4 done by MCC, in retrospect, can be faulted for not researching actual maintenance expenditures. However, very little maintenance has been done on the network historically. Assume the same maintenance practices with and without project as MCC did not have a notable impact on maintenance practices. Estimate costs of vegetation removal on an annual basis if possible.</td>
<td>Thank you.</td>
</tr>
<tr>
<td>EDR pg. 58</td>
<td>Calibration method, as described, is great for this analysis.</td>
<td>Thank you.</td>
</tr>
<tr>
<td>EDR pg. 58</td>
<td>Discussion point E: The hourly wage rate originally used is being sought, but not found yet. OD surveys can be used to verify the hourly wage of vehicle users.</td>
<td>Thank you, we will adopt this strategy.</td>
</tr>
<tr>
<td>EDR pg. 58</td>
<td>Discussion point F: Original data for accident costs unavailable. Suggest using DALY costs for injuries and life loss. Given the accident rate, the impact on vehicle damage will not shift the ERR significantly.</td>
<td>Thank you. We will use DALY costs.</td>
</tr>
<tr>
<td>Page Number</td>
<td>Comment</td>
<td>IMC Responses</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
<td>---------------</td>
</tr>
<tr>
<td>EDR pg. 59</td>
<td>Discussion point G: IRI values for 2009 should be used for without project IRI, as no other source is available. With project IRI is provided in as built and design documents.</td>
<td>Agreed. The 2009 IRI value from SMEC, is an HDM-4 input before works. IMC will also use the 2009 IRI values to calibrate the counterfactual on the Rio Ligonha-Nampula. Note: The IRI after work will be assumed at 3,5 m/km and used to calibrate that deterioration model as well as the 2019 measures for IRI, so that, the IRI curve matches the value measured in 2019.</td>
</tr>
<tr>
<td>EDR pg. 59</td>
<td>Discussion point K: the use of google earth gets the necessary data and is fine.</td>
<td>Thank you.</td>
</tr>
</tbody>
</table>
**Annex D: Data Collection Options Removed from EDR**

### Geotechnical Conditions Assessment

1. **Sample unit(s)** – The sample unit is a small section of the road, removed and subject to unconfined compressive strength (UCS) and California Bearing Ratio (CBR) tests in a laboratory.

2. **Sample size** – The evaluation team will take three samples from both roads to determine the full composition of the roads.

3. **Sample frame** – N/A

4. **Sampling strategy** – At least three test boring and core sampling will be performed on both roads to determine the composition of the existing roads. The test will identify surface, base and subbase layer thicknesses. Tests will also qualify the materials in terms of unconfined compressive strength and thickness used for each section of each road.

5. **Instruments** – N/A

6. **Rounds, locations and timing** – Samples will be taken in mid-July or August along with other data collection activities.

7. **Respondent(s) within the sample unit** – N/A

8. **Staff** – Evaluation team staff will guide the collection of samples and oversee analysis.

9. **Data processing** – The evaluation team will identify a local lab to conduct UCS and CBR tests.

10. **Data quality** – Unconfined Compressive Strength (UCS) and California Bearing Ratio (CBR) tests in a laboratory

11. **Safety Procedures/Precautions** - Technicians will divert traffic from the lane in which borings are carried out. Technicians and other staff will wear high visibility vests and other gear whenever they are near the road, both on and off duty. Traffic cones will be used to provide a buffer between work and traffic areas. Survey supervisors will ensure safety protocols are followed. Proper signage will guide traffic around work areas.

<table>
<thead>
<tr>
<th>Data collection</th>
<th>Timing MM/YYYY (include multiple rounds)</th>
<th>Sample Unit/Respondent</th>
<th>Sample Size</th>
<th>Relevant instruments/modules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geotechnical Conditions</td>
<td>Next data collection mission</td>
<td>3 per road</td>
<td>6 (3 per road)</td>
<td></td>
</tr>
</tbody>
</table>

**Travel time surveys**

1. **Sample unit(s)** – The sample unit for travel time surveys is the travel route
2. Sample size and associated assumptions – The evaluation team will time each key travel route identified through O-D surveys.

3. Sample frame – N/A

4. Sampling strategy –
   The evaluation team will assess actual times to travel key routes identified through the O-D surveys. To the extent possible, the evaluation team will use different types of vehicles, or engage with operators of various types, to track the time of travel, areas requiring slow down and stoppage, and other data along each route using handheld, GPS devices.

5. Instruments – Handheld devices with GPS recording capability.

6. Rounds, locations and timing – The evaluation team will measure travel time in late July/early August. Key routes will be measured at different times of day to track traffic volume differences, depending on the results of the O-D and traffic count surveys.

7. Respondent(s) within the sample unit – N/A

8. Staff – The evaluation team will subcontract the implementation of the time travel survey to a local data collection firm.

9. Data processing – Data collected on enumerators devices is uploaded to a central server managed on the Google Cloud Platform. Data will be analyzed using the R statistical environment to provide summary statistics on the data collected through the survey. Routes with key data, including areas where vehicles slowed or stopped, and other geographical data will be presented on maps of each route.

10. Data quality – Quality control will be provided through comparison of travel times and routes to other data sources, such as the O-D and traffic count surveys. Data will be cleaned and double checked prior to analysis.

11. Safety Procedures/Precautions – Drivers will operate vehicles following local laws and consistent operating procedures.

Roadside Interviews

1. Sample unit(s) – The sample unit for roadside interview is a vehicle traveling on the road. Drivers of vehicles will serve as the survey’s respondents.

2. Sample size and associated assumptions – To determine the sample size in a qualitative data collection approach, the Evaluator will combine the notions of saturation (when adding new data no longer improves the explanations of the themes, the categories or add any new ones) with the quality of responses received in real time. Thus, the evaluator intends to conduct interviews until data saturation is reached, with a guiding (but not pre-defined) figure estimated at 20 interviews per relevant category (one category will be freight drivers, for example) per road.

3. Relevant assessments of data adequacy will be put in place to ensure the transparency of decisions taken on data sufficiency and adequate sample size.

4. Sample frame – vehicles traveling on the road during the times of data collection.

5. Sampling strategy –
The evaluation team will conduct interviews over three 24-hour time periods comprising two weekdays and one weekend day. Interviews will be completed on each of the main road sections. For suggested locations of interviews, please see the maps included as Annex A. The aim of intercept locations is to ensure that diversions are unavailable and that a high proportion of travelers are engaged. Interviewers will be trained prior to data collection. Each enumerator will use a handheld electronic device to record respondents’ answers to specific questions. Enumerators will explain the purpose of each question to respondents and the potential use of the data to maximize the chance of complete and thorough responses to questions. The purpose of the interviews is to collect qualitative information that will add context and depth around O-D surveys and other traffic related data collection. The interviews take longer, ask open ended questions, and require more time and thought then the O-D surveys. They also do not require as large a sample size as the O-D surveys, which is why they are conducted separately.

6. Instruments – The evaluation team will create an interview guide for each vehicle type. Questions in the interview guide will be pre-coded according to the types of data that they are intended to collect to ensure that that each question contributes to main research questions and analysis tools.

7. Rounds, locations and timing – The evaluation team will conduct the survey over three 24-hour time periods comprising two weekdays and one weekend day in mid-July or August.

8. Respondent(s) within the sample unit – Vehicle operator and passengers if appropriate.

9. Staff – The evaluation team will subcontract the implementation of the roadside interviews to a local data collection firm. Each data collection site will have two enumerators working together and two supervisors will travel among sites to ensure security and quality control.

10. Data processing – The interviews will be guided by the interview guide. The interviewee will conduct the interview as a semi-structured discussion, following useful tangents and divergences as they occur. The interviewer will take notes in a notebook or computer according to the interviewer’s preference. Interviewers will write up interview notes at the end of each workday to ensure that notes are accurate, of high quality, and main points are fresh in the interviewer’s mind. An evaluation team member will read through the interview notes when they are completed, identifying key themes and patterns, that the team member will name and use to code the interviews. The team member will create an excel spreadsheet with individual interviews as rows and codes as columns. The team member will enter specific responses from each interview under each code. This qualitative data will be used to add explanation and narrative depth to traffic data that is collected.

11. Data quality – Data will be recorded promptly after interviews are conducted. Interviewers will be trained on asking non-leading questions, and identifying information critical to the evaluation.

12. Safety Procedures/Precautions – Each location includes a safe survey area where the survey can be conducted. At each location, enumerators will intercept vehicles with the assistance
of police officers. Enumerators will wear safety clothing and follow safety standards established for roadside data collection. Police officers will also ensure that laws and regulations are observed. Site supervisors will travel among the sites to ensure that safety procedures are followed.

**Roadside interviews** add depth and narrative to the data collected through OD surveys and other quantitative instruments. Whereas the O-D survey describes traffic characteristics in categories, roadside interviews describe the “why” behind those characteristics. Interviewers will ask selected motorist and passengers about their experience traveling on the roads, reasons for using the roads, why they travel on the road instead of alternatives, how travel on the road has changed in terms of cost and ease, why the road does or does not create benefits for them, and other questions identified as important through secondary research. Roadside interviews are composed of 5 – 7 open ended question and take 15 – 20 minutes to complete. Information collected will also serve RA 1;

**Travel time surveys** involve measuring the time it takes to travel the key routes identified in the O-D survey. While O-D surveys ask travelers the time of their journey, these estimations rely on travelers’ memories and expectations, which may result in inaccurate time travel estimates. Time travel surveys record the actual time it takes to traverse the crucial routes identified through the O-D survey. Travel time surveys are carried out by the evaluation team using vehicles similar to those identified in the O-D survey as most common and using GPS devices to time travel and mark slowdowns and stops along important routes. While time travel surveys have their own biases due to the limited number of trips, types of vehicles, and times of the day or year that the survey may be conducted, the triangulation of data collected through travel time surveys, O-D surveys, and roadside interviews results in strong estimates of travel time along key routes. Information collected will also serve RA 1;

The **travel time survey** will provide an actual time travel check on vehicle operator’s estimation of travel time. Discrepancies between actual travel and estimated time will be explained through differences in travel conditions or identification of bias. Information gathered through the O-D survey, roadside interviews, and key informant interviews will be compared to identify different estimations of cost of transport, and to draw conclusions based on different respondents’ estimations and a limited number of actual cost checks. Roadside interviews and key informant interviews will also be used to add context and to explain the reasons behind the conclusions drawn from summary statistics.

<table>
<thead>
<tr>
<th>Data collection</th>
<th>Timing MM/YYYY (include multiple rounds)</th>
<th>Sample Unit/Respondent</th>
<th>Sample Size</th>
<th>Relevant instruments/modules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadside interviews</td>
<td>July/August 2019</td>
<td>Drivers and passengers in passing vehicles</td>
<td>20 per category (e.g. freight driver)</td>
<td>Roadside Interview Guide</td>
</tr>
<tr>
<td>Travel time surveys</td>
<td>Late July/August 2019</td>
<td>Vehicle Route</td>
<td>N/A</td>
<td>Travel time survey guide</td>
</tr>
</tbody>
</table>