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Lot 3: Transport

Road Safety Investment Program in Romania - AA-010269

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Acronyms and abbreviations

AADT	Annual Average of Daily Traffic Data
ANAP	National Agency for Public Procurements
ARR	Romanian Road Authority
AToR	Assignment Terms of Reference
BCR	Benefit Cost Ratio
BV	Brasov
BUC	Bucharest
CBA	Cost Benefit Analysis
CD	Concept Design
CJ	Cluj
CNAIR	National Company for Roads Infrastructure Administration
CT	Constanta
CV	Craiova
DAP	CNAIR Procurement Directorate
D&B	Design and build
DJ	District road
DN	National road
DRDP	Regional Roads and Bridges Unit
DSCMT/SST	Department of Road Safety and Traffic Monitoring / Traffic Safety Unit
DUAE	Single European Procurement Document
EC	European Commission
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EIRR	Economic Internal Rate of Return
ENPV	Economic Net Present Value
ESAP	Environmental and Social Action Plan
EU	European Union
FS	Feasibility Study
GDP	Gross Domestic Product
GPS	Global Positioning System
iRap	International Road Assessment Programme
IŞ	Iasi
MCA	Multi-criteria Analysis
MTIC	Ministry of Transport, Infrastructure and Communications
OJEU	Official Journal of the European Union
PIARC	World Road Association
RSIP	Road Safety Investment Program
SICAP	Collaborative IT system for a high-performance environment for public procurement
TM	Timisoara
UN	United Nations
VAT	Value Added Tax

1 Introduction

1.1. Rationale

The annual average number of road fatalities in Romania in the last years is about 1,850[1]. The fatality rate in the crashes of approximately 96 fatalities per million inhabitants is one of the highest rates in the EU and almost twice higher than the EU average. Whilst the number of personal injury accidents and fatalities has fallen over a 15-year period, much is still to be done to reach similar levels of road safety performance as in the other EU countries and to achieve a safer road system.

The road infrastructure of a country not only serves the basic need for mobility and safe transport of people and goods but is also considered vital for its growth and development. Decisions for public and private investments, related to these infrastructures must take into consideration the overall level of their safety capacity in a measurable way.

The key stakeholders in road safety sector include:

- The Ministry of Transport, Infrastructure and Communications (MTIC) which is the national public authority with overall responsibility for policy, strategy and administration of transport in Romania,
- CNAIR - the authority responsible for motorways and national roads in Romania is responsible for planning, design, construction, operation, maintenance and management of approximately 750 km of motorway and over 17,000 km of national (primary) roads,
- The Romanian Road Authority (hereafter - ARR) within the Ministry of Transport and Infrastructure is responsible for road infrastructure safety management, according to the EU Directive 2008/96/EC and the Traffic Police Directorate deals with road traffic safety and crash data collection, registration and evidence.

According to the terms of Reference of this assignment (AToR), the main objective is to contribute to the improvement of road safety in Romania, and hence to contribute to the reduction in fatalities and serious injuries on Romanian motorways and national road network. Accordingly, the purpose of the Assignment is as follows:

- to support the development of a Road Safety Investment Programme (hereafter - RSIP) in Romania.
- to undertake a pilot road safety rating assessment in Romania.

The purposes of this contract, defined in line with the United Nations (UN) Global Framework Plan of Action for Road Safety[2], and in line with “Safe system” principles, which underpin the UN Global Plan for the Decade of Action[3], refers to five pillars and five areas as necessary for achieving safer roads. The Plan encourages countries and stakeholders to implement actions that contribute to the reduction of the forecasted road fatalities rate. Section III of the report titled “Towards Improving Road Safety” explains that, the comprehensive and efficient national road safety system building on

[1] https://ec.europa.eu/transport/road_safety/road-safety-facts-figures-1_en

[2] Global Framework Plan of Action for Road Safety (United Nations Road Safety Trust Fund, 2018

[3] Global Plan for the Decade of Action for Road Safety 2011-2020 (United Nations Road Safety Collaboration)

the international regulatory framework, good practice and experience consists of five pillars, which are:

1. Road safety management (or the bridging pillar)
2. Safe user
3. Safe vehicle
4. Safe road
5. Effective post-crash response

In the road safety management pillar, action needs to focus on target setting, vertical and horizontal management as well as monitoring. Further action under this pillar should focus on coordination with other efforts linked to ensuring high-quality living conditions and mobility of the population covered through land use planning policies and mobility policies.

Romania is part and has approved a series of the policy documents related to the International (EU/UN) and Romanian national strategies / programmes and action plans, including the relevant documents delivered for Romania:

- European Commission (2014) Guide to Cost-Benefit Analysis of Investment Projects,
- European Investment Bank (EIB) (2013) The Economic Appraisal of Investment Projects at EIB,
- World Bank (WB) (2017) Global Road Safety Facility: Road Safety Management Capacity Review – Improving safety of road infrastructure,
- Joint Assistance to Support Projects in European Regions JASPERS (2016) General Action Plan for Road Safety Improvement Measures,
- General Master Plan of Romania (2015),
- National Road Safety Strategy, 2016 – 2020.

National Company for Roads Infrastructure Administration (CNAIR), which is the beneficiary of this assignment, has pre-identified road safety countermeasures, with an implementation cost estimated at EUR 550 million, including roundabouts, intersections (signalised and / or priority), and third / slow lanes, which were considered in the assignment. It is important to note that choosing suitable countermeasures is critical and should be uniquely recommended for each site depending the road safety issues associated with it.

Under Directive 2019/1936, EU Member States shall ensure that a network-wide road safety assessment is carried out on the entire road network covered by this Directive by 2024 and subsequently every five years. The pilot road safety rating assessment undertaken as part of this assignment, along with workshops and drafting of a ToR for future assessments, have prepared CNAIR for carrying out further road safety rating assessments in the future.

This also links to the UN Road Safety Targets 3 and 4 which defines targets for new and existing roads based on their level of in-built safety.

This Consolidated Report is prepared in accordance with the AToR and in line with the reporting requirements of the Consultancy Contract signed between the European Investment Bank and SUEZ Consulting in consortium with SPEA Engineering and TRACTEBEL on the 9th of May 2020. It summarises the results of the tasks carried out in the Assignment.

2.2. Structure of the Report

The overall objective of this Assignment is to contribute to the improvement of road safety in Romania.

The Consolidated Report is organized as follows, in 8 chapters:

- Summary, that presents main assignment results in a concise way,
- The third chapter presents the process of reviewing the proposals received from CNAIR and identification of other suitable locations for safety improvement measures,
- The fourth and the fifth chapters presents in brief the methodologies for and results from Cost Benefit Analyses (CBA) and Multi-criteria Analyses (MCA) that were carried out in order to select the most beneficial and suitable locations to form the scope of the first phase of Romania Safety Improvement Programme to be implemented with the financial support of the EIB; the scope of the RSIP is presented in chapter six.
- In the chapter 7 presents technical requirements for safety measures and
- Chapter 8 deals with the procurement strategy for RSIP implementation.

Information presented in the Report is further detailed in 9 Annexes.

2 Executive Summary

The main objective of this assignment was to contribute to the improvement of road safety in Romania, and hence to contribute to the reduction in fatalities and serious injuries on Romanian roads.

A list of potential road safety investments with an estimated total value of EUR 677 million was prepared by CNAIR in 2019 and was presented to the EIB. After some refinements, the scope of the potential safety investments was reduced to a total value of EUR 550 million.

Hence, the main objective of this assignment was to check the relevance of the proposed safety measures, to determine any gaps in work undertaken so far, and to scope a Phase 1 project (of a road safety investment program) to the value of some EUR 100 million – covering the most suitable and mature investments from the identified categories of road safety investments, which were confirmed together with CNAIR and EIB during Task 1).

As is stated in the International Road Assessment Programme (iRAP) Star Rating and Investment Plan Implementation Support Guide[4], a RSIP shows a list of affordable and economically sound road safety treatments, specifically tailored to reduce risk on the surveyed network.

In line with this, 526 locations of safety measures were considered, as follows:

- 109 locations initially suggested by CNAIR,
- 389 blackspots[5] locations and,
- 28 locations additionally proposed by CNAIR for interchanges.

For the so proposed locations CNAIR provided information about:

- GPS coordinates
- Road accidents' data for 2017-2019
- The Annual Average Daily Traffic (AADT) data for 2015 (total number of vehicles only) in MS Excel format and traffic growth coefficients, provided by CNAIR for five-years intervals up to 2040.

As part of Task 1 activities, the proposed 526 locations were reviewed from a technical and engineering perspective by analysing the crash data provided and the geometry of the intersections. The Beneficiary analysis showed and suggested two type of safety measures (roundabouts and under/overpasses). The Service Provider proposed also to consider implementation of channelisation [6] and/or signalling improvements in intersections – instead mentioned safety improvements.

[4] https://www.irap.org/2017/03/implementation-support-guide-2/

[5] Blackspot is defined as a section of the public road that has a higher rate of road accidents than the average rate of accidents recorded on the distance unit of that road and over a historical period of time

[6] Channelization is a technique serve to separate points of conflict in a junction such as development of turning lanes, design of islands and control of access points all. This enables the drivers to perceive and react to conflicts in an orderly manner

Following the engineering analysis, the list of potential locations was reduced to **229 locations,** presented in the next map, with an estimated investment value of EUR 229.02 million, which were further subject of CBA. The list of the 229 locations is presented in Annex 1.

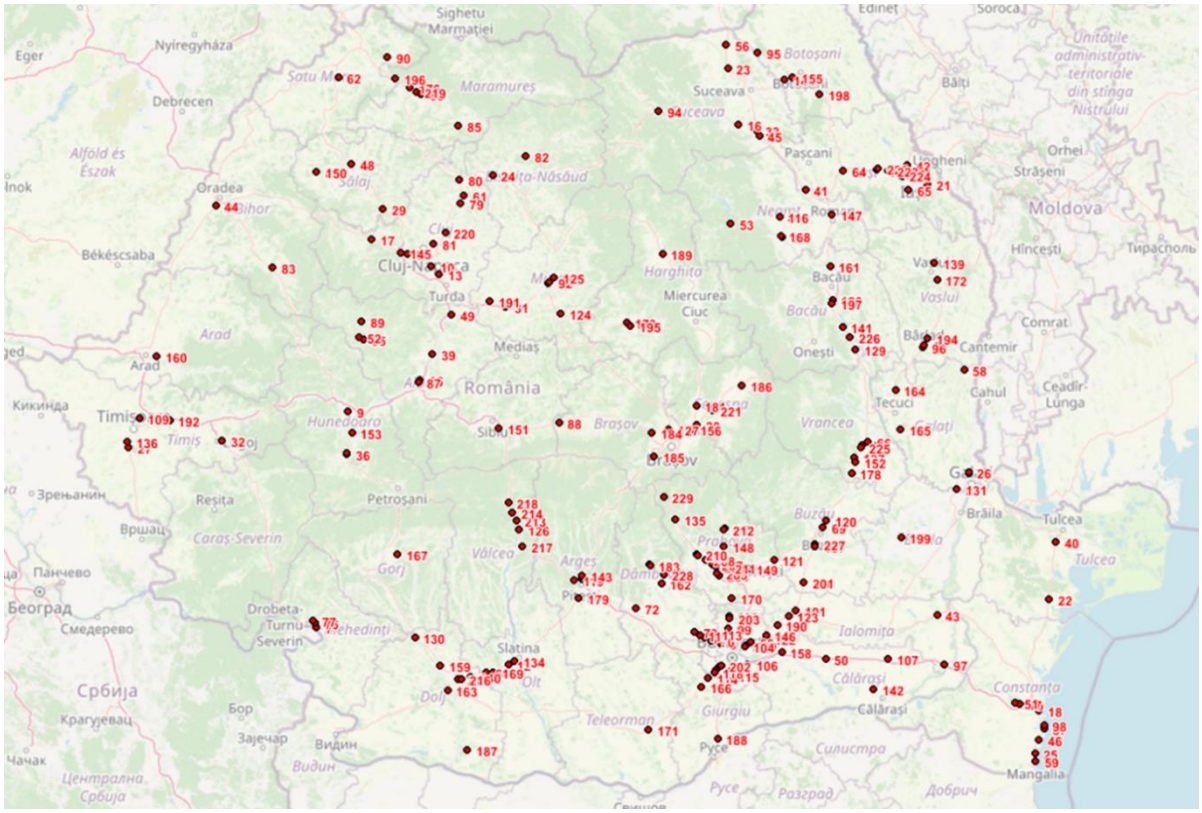


Figure 1 – Map with the 229 locations with approved suitable measures

Based on the CBA and MCA results, recommendations were given on the scope of the first phase of RSIP that included the first 103 locations with highest MCA ranking; the investment costs for these summed up to approximately EUR 100 million (excluding VAT). The scope, as well as the respective technical requirements, timing and costs were discussed in detail with the project stakeholders. The final RSIP Phase 1 scope approved by CNAIR consists of 89 locations with total investment costs estimated at EUR 100.02[7] million in 2020 prices, excluding VAT.

The scope of the Phase 1 Program consists of:

- 43 locations where channelization / signalling measures are recommended with a total investment value of 6.82 million, VAT excl.,
- 40 locations where it is recommended roundabouts to be built with a total investment value of EUR 18.2 million, VAT excl. and

[7] This includes preparation, feasibility study, technical design and tender documentation for works'/services' procurement and the works themselves

- Six locations suitable for over/underpasses with total investment value of EUR 75 million, VAT excl.

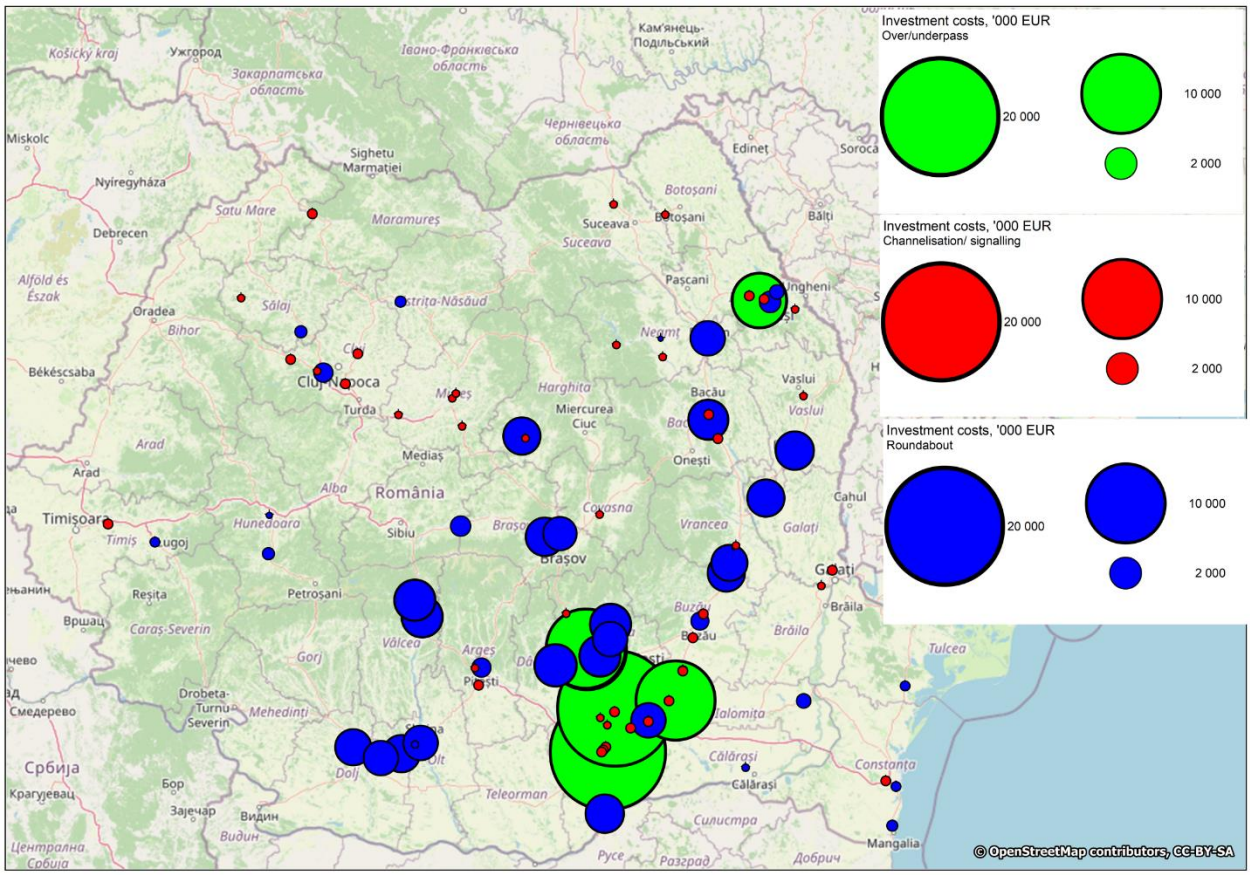


Figure 2 - Map of RSIP Phase 1 scope, 89 locations

The implementation of the RSIP with the proposed scope is expected to save 38 fatalities, 114 serious injuries and 400 light injuries a year, which for the 28 years reference period amounts to EUR 1.306 billion saved economic costs discounted to 2020 prices.

Considering the relevant project's planning and permitting procedures in Romania i.e., feasibility study, technical design and tender documentation for works'/services' procurement and taking into account the geographical position of the approved locations per regional CNAIR units, a procurement strategy for RSIP implementation was prepared.

In accordance with priorities defined for RSIP Phase 1, the procurement strategy was developed in order to provide the most effective focus and access to Contractors that are able to provide the works' and services' contracts within quality and time restraints.

Considering the provisions of the national procurement legislation, as well as the comments of the Beneficiary and EIB representatives, the procurement strategy was developed in such a way as to effectively combine both the CNAIR experience and the recommendations from the EIB.

The proposed procurement strategy consists of a total number of 27 contracts to be procured under a Single Stage Open Tender Procedure, with the publication of the Tender Notices in the official Journal of the European Union (OJEU). The procurement of all the proposed RSIP measures, will be done by the CNAIR headquarters, while the implementation of the contracts for the Signalling & Channelization and Roundabouts will be executed through the regional offices, under direct

supervision of the Bucharest office. The implementation of the Over / Underpasses measure will be overseen by CNAIR headquarters.

In order to develop a procurement strategy that incorporates both EIB recommendations and national procurement provisions, the contracts were divided as shown in the table below.

Table 1 - Total number of contracts and estimated value

Channelisation / signalling					
	FS+EIA+D[8]	***Build***	***Supervision***	***Total***	***No, of contracts***
Total	***440,400***	***5,608,810***	***306,790***	***6,356,000***	***3***
Roundabouts					
	FS+EIA+D[8]	***Build***	***Supervision***	***Total***	***No, of contracts***
Lot 1 BUC+IS+CT	696,000	8,422,400	461,600	9,580,000	3
Lot 2 CV+TM+CJ+BV	498,000	5,993,450	328,550	6,820,000	3
Total	***1,194,000***	***14,415,850***	***790,150***	***16,400,000***	***6***
Over/underpasses					
	FS+EIA[8]	***D&B***	***Supervision***	***Total***	***No, of contracts***
Lot 1 BUC	600,000	8,930,000	470,000	10,000,000	3
Lot 2 BUC	600,000	8,930,000	470,000	10,000,000	3
Lot 3 BUC	600,000	8,930,000	470,000	10,000,000	3
Lot 4 BUC	1,200,000	17,860,000	940,000	20,000,000	3
Lot 5 BUC	1,200,000	14,060,000	740,000	20,000,000	3
Lot 6 BUC	300,000	3,515,000	185,000	5,000,000	3
Total	***4,500,000***	***62,225,000***	***3,275,000***	***75,000,000***	***18***
Grand Total	***6,134,400***	***82,249,660***	***4,371,940***	***97,756,000***	***27***

[8] FS+EIA+D+B – Feasibility studies; Environmental Impact Assessments; Design; Built

3 Review of technical/engineering proposals. Determine gaps in work undertaken

Within Task 1, the proposed three lists of 526 measures in total were reviewed and analysed from technical and engineering perspective and other categories of investments were also investigated by analysing the crash data provided. At that early stage of analysis, it was realised that neither separation of opposite traffic flows by the means of median barriers had been considered, nor the building of third (and climbing) lanes. No sites for such measures were provided by the Beneficiary.

Due to the COVID19 pandemic, the Consultant was not able to carry out site visits and prepare more comprehensive road safety engineering (inspection) of the locations identified by CNAIR. Hence, the technical/engineering review was prepared through:

- Crash data analysis and Google Street view surveys,
- Technical discussions with the Beneficiary to clarify the details which have not been possible to check remotely such as:
- AADT data,
- Geometric design and configuration of locations,
- Types of junctions, etc.

3.1. Types of measures

A junction is always a potential high-risk location within a road network and safety measures at junctions are often more cost effective than measures on road links[9]. A junction has to fulfil a number of general design requirements, but the most important is to be recognisable, understandable, visible, comprehensive, and complete.

The Consultant analysed the locations pre-identified by CNAIR and the black spots[5] clustering them into four basic types (forms) of junctions to be evaluated as potential road safety measures:

- At grade – roundabout,
- At grade – priority junction with traffic control system,
- At grade – priority junction without traffic control system (channelization),
- Over / underpasses.

Roundabouts are considered the safest at grade junctions and are very suitable both - inside and outside the built-up areas as these assure the fluid flow of traffic, speed reduction and finally, contribute to road safety, due to their capacity, clarity and uniformity.

A great deal of research has been conducted into the safety of roundabouts in Europe. In the Netherlands, where traditional junctions have been converted into roundabouts, the total number of recorded accidents has dropped by almost 50% over the life of the measure [9]. The number of victims

[9] DHV Environment and Transportation (2005). Sustainable Safe Road Design. A Practical Manual. A Manual produced by the WB and Dutch Ministry of Transport, Public Works and Water Management

outside urban areas has decreased by as much as 85% over the life of the measure. These outcomes are also confirmed by the World Road Association (PIARC) in their Catalogue of Design Safety Problems and Potential Countermeasures[10].

The great advantage of the two-lane roundabout is its larger capacity (see Table 2)[11], but there are also disadvantages compared with single-lane roundabouts: the higher speeds because of the wider traffic lanes, the more complex traffic situation caused by lane changing and weaving on the roundabout, cutting-in conflicts on exit roads, and longer crossing distances for mopeds, cyclists, and pedestrians. This last problem can be solved by using single instead of double access ramps, this, however, does indeed diminish the roundabout's capacity. In addition, a single exit ramp ensures a lower speed and, therefore, a lower collision speed. It also prevents the danger of vehicles being obscured by other vehicles. For long vehicles such as lorries and buses, roundabouts can be an awkward obstacle. This must be allowed for in the design of the roundabout, particularly on roads with a lot of freight traffic.

Table 2 - Rules of thumb for roundabout capacity[9]

Roundabout type	AADT (veh/day)	Conflicts (pve/h)[12]
Single lane	20,000 – 25,000	1,500
Two-lane with single-lane entrance and exit ramps	22,000 – 30,000	1,500
Two-lane with two-lane entrance and exit ramps	35,000 – 40,000	2,100 – 2,400

For all the proposed locations the injury risk reduction in case of implementation of the proposed measures was estimated, according to the PIARC Catalogue of design safety problems and potential countermeasures[10]. Risk reduction factors estimated this way were further applied in the (CBAs) developed for each location.

This way, the countermeasures proposed in the RSIP are being supported by strong evidence that, if implemented, these will prevent fatalities and serious injuries in a cost-effective way. The results of the CBAs carried out for the 229 locations showed that in 85% of the cases, i.e., 195 locations, the suggested measures will be viable from economic point of view as the economic internal rate of return (EIRR) is higher than the threshold of 5%[13]. The EIRRs of the remaining 34 locations were below 5%. The economic profitability of 60% of the considered location was very high – exceeding 100%.

The total investment costs for the 195 measures with positive economic return were estimated at EUR 181.04 million in current prices. In order to select the most suitable and mature ones, a MCA methodology was developed, which takes into account six main criteria, namely: type of road, traffic level, road safety risk, economic viability, risk and maturity, and other (dis)benefits. By applying the

[10] PIARC Technical Committee 3.1 Road Safety (2009). PIARC Catalogue of Design Safety Problems and Potential Countermeasures. www.piarc.org

[11] https://www.swov.nl/en/facts-figures/fact/roundabouts-what-types-roundabout-are-there

[12] Pve – passenger vehicle equivalent

[13] The Guide for Cost Benefit Analyses for Investment Projects, Economic Appraisal Tool for Cohesion Policy 2014-2020, the economic discount rate is set at 5%

methodology, the locations were compared and ranked, establishing this way a priority list of the analysed locations.

3.2. Reviewed locations

As it is stated in Table 3, the Beneficiary first provided a list of 109[14] suggested measures to be financed by EIB within a Phase 1 of the RSIP for Romania. This included 67 possible new roundabout solutions, 31 temporary roundabout solutions to be redesigned as permanent roundabouts and 11 locations for over/underpass solutions. In the frame of the first consultations with the Beneficiary, from the list of over/underpasses two locations were rejected because they are part of other projects to be improved, leaving a remainder of 9 locations.

Table 3 – The list of measures pre-identified by CNAIR

Investment project type	Unit	No	Cost per unit (EUR million)	Total Cost (EUR million)
Roundabouts (feasibility stage)	no	67	0.4	26.8
Roundabouts (technical stage)	no	31	0.4	12.4
Under- and overpasses	no	11	5.0	55.0
Total		**109**		**94.2**

Analysis of junctions per type and proposed measures is presented in the Table 4.

Table 4- Analysis of junctions per type and proposed measures

New roundabouts solutions		
"T"[15] type junction	channelized with marking - in built-up area	4
	channelized with marking - outside built-up area	7
	in built-up area	10
	outside built-up area	4
	physical channelization - in built-up area	2
	staggered - channelized with marking - in built-up area	1
"Y" type junction	channelized with marking - in built-up area	8
	channelized with marking - outside built-up area	3
	in built-up area	2
	outside built-up area	1
	physical channelization - in built-up area	4
	temporary roundabout solution	1
"X" type junction	channelized with marking - in built-up area	3
	channelized with marking - outside built-up area	1
	in built-up area	10
	outside built-up area	2
	staggered - channelized with marking - in built-up area	1
	staggered - channelized with marking - in built-up area	2
	staggered - outside built-up area	1

[14] See the Sheet Tabs "CNAIR list-R", "Temporary solutions" and "Overpasses" of the Excel file " Annex6_Technical-Engineering-analysis.xlsx", which is the part of this Report

[15] T, Y and X type of junctions are three four leg intersections with different angle of junction

New roundabouts solutions		
Total		**67**
Temporary roundabouts – in permanent solutions		
"T" type junction	All locations currently are temporary roundabouts	13
"Y" type junction		6
"X" type junction		12
Total		**31**
Overpasses		
"T" type junction	signalized intersection- pedestrians crossing	1
"Y" type junction	Entrance in built-up area – unchannelized	1
	2+2 cross section - physical channelization on the main road for the left direction	1
"X" type junction	in built-up area	1
	2+2 cross section - in built-up area – temporary roundabout	1
	Bypass road – existent turbo-roundabout solution	1
Overpass	Existent overpasses (2 addresses were excluded)	1
Bridge	Bridges across Dimbovita river (Bucharest bypass)	2
Total		**9**
Full Total		**107**

Based on engineering judgement measures that can be viewed in the description columns[16] that would be deliverable and would effectively treat the prevalent crash types at those locations were recommended.

3.3. Data analysis and findings[17]. Gaps in work undertaken

For the engineering/ technical review, CBA, and MCA activities, input data were collected, which referred to GPS coordinates of the intersections, crash data for the 2017 – 2019 and AADT for 2015 together with traffic growth coefficients for 2020, 2025, 2030, 2035 and 2040 for five road categories: European roads, national main roads, national secondary roads, regional/county roads and local roads.

The analyses used the basic data on road accidents, such as the number of accidents, the number of fatalities, serious and slight injuries and the number of vehicles involved. AADT data was collected at road sections close to the locations analysed.

As it is stated before, COVID-19 pandemic prevented the Consultant to visit the sites and to perform in situ analysis. Instead, the Beneficiary provided the GIS coordinated of the locations, which allowed the Consultant to understand and analyse the junctions in terms of their geometry and configuration of each location.

For the first phase of the analysis, the junction configurations, the junction type and how it is currently managed for traffic movement was established. For the locations referred to in sub-chapter 2.1, an

[16] See the Sheet Tabs "Overpasses" of the Excel file " Annex6_Technical-Engineering-analysis.xlsx", which is the part of this Report,

[17] The results of the engineering / technical review could be seen in the Sheet Tab "CNAIR list" of the Excel file " Annex3_CBA-MCA-calculations.xlsx", which is the part of this Report

analysis of the causes of road accidents was also attempted, based on available data provided by the Beneficiary.

As a result of this analysis, recommendations were made with reference to the suitability of the design as a roundabout intersection or the efficiency of another junction option. At the same time, based on the PIARC Manual of design safety problems and potential countermeasures[10] possible percentage reductions in road accidents were evaluated in case of implementation of the related engineering measures. This data formed the basis of the subsequent CBA and MCA.

The findings of the performed review of the technical/engineering proposals pre-identified by CNAIR, are the following:

1. **List of proposed new roundabouts solutions (67 proposed locations):**
   - 11 locations with a number of crashes with injuries in the last 3 years more than or equal to 10,
   - 8 locations with no crashes and 8 locations with one crash with injuries in the last 3 years,
   - 36 locations with no deaths in the last 3 years
   - 32 locations are considered appropriate to be redesigned as roundabout solutions; the expected reduction in road accidents could be from 25 to 81% (average of 53%) over the life of the measure,
   - Other 35 locations could be improved with traffic signals and channelization measures and improvement of pedestrian safety; the expected reduction in road accidents could be from 25-40%. In addition, a 10-25% reduction in junction crashes with better channelization.
2. **List of proposed new roundabouts from the existent temporary solutions (31 proposed locations):**
   - 9 locations with several crashes with injuries in the last 3 years more or equal than 10,
   - 10 locations with no crashes and 4 locations with one crash with injuries in the last 3 years,
   - 22 locations with no deaths in the last 3 years.
   - 23 locations are considered appropriate to be redesigned as roundabout solutions; the expected reduction in road accidents could be from 25 to 81% (average of 53%) over the life of the measure,
   - the other 8 locations could be improved with traffic signals and channelization measures and improvement of pedestrian's safety; the expected reduction in road accidents could be from 25-40%. About 10-25% reduction in junction crashes with better channelization.
3. **List of proposed over/underpasses from at-level type solutions (9 proposed locations):**
   - The Beneficiary withdrew 2 locations on Bucharest Bypass (DNCB, km 12+358 and km 12+444) and completed the list with a new investment on Timisoara Bypass (roundabout at intersection with DJ 591) because they were part of other projects to be improved,
   - All locations contain more than 10 crashes with injuries in the last three years (apart from Timisoara Bypass),
   - There are two locations with no deaths in the last 3 years.

Considering the proposed locations for overpasses[18] first, it was needed to have a thorough understanding about the correctitude and feasibility of the proposed overpasses on all nine locations selected:

Table 5 - Analysis of the proposed locations for overpasses

Road	Current stage	Proposal
DN 1: km 20+750	Intersection of DN1 (km 20+750, 2+2 divided cross section) with DJ101 in Balotești village (Ilfov country). Occurred 10 turning and 10 rear-end, 6 pedestrian crashes (3 died). The dangerous manoeuvres seem to be U-turns and left turning on DJ101	Traffic Signals with improved channelization. Difficult to grade separate due to land needed. It is understood that further investigatory work will be needed into a solution as the AADT is extremely high.
DN 2: km 12+600	Intersection of DN2 (km 12+600, 2+2 cross section) with DC 27 in the industrial area of Voluntari city. 8 pedestrians (2 died), 2 crashes with vehicles parked in the Bus station, 2 turning crashes occurred	Opportunity to improve traffic signals will better channelization. Pedestrian safety could be improved with signalised crossings. Difficult to grade separate here due to available land
DN 2: km 55+800	Intersection of DN 2 (km 55+800) with DN 2A at the entrance of the Urziceni city. 8 turning, 4 hitting of the obstacles outside the road and rollover, 4 pedestrians (one died), 3 head-on crashes occurred.	Roundabout would be a good solution at this location but would require some land acquisition. An overpass solution would require more investigation.
DN 6: km 11+220	Interchange of DN 6 (km 11+220) with DNCB (Bucharest Bypass). 9 turning, 8 pedestrians (2 died), 5 rear-end crashes occurred. The problem is the accesses from DNCB to DN6, especially to move in the Bucharest direction. Should be performed much more detailed analysis of the crashes occurred, especially to find the locations	Opportunity to build a new junction to the east which would require a new link road to be constructed. Option to improve exiting junction with traffic signals and channelization.
DNCB: km 25+200	Alignment on DNCB (km 25+200 - 25+400 - across the Dimbovita river). The biggest number of crashes occurred in 2017 (7) and 2018 (5). In 2019 occurred only one crash. 6 persons died (one pedestrian, 3 in rollover crash, 2 in turning and one - obstacle outside the road. There is not a factual typology of crashes occurred	Site requires further investigation by CNAIR
DNCB: km 25+400		
DN 21: km 105+500	Intersection of DN 21 (km 105+500) with DN 3A (Drajna village). Also, a railway passage is on the way. 6 rear-end, 3 turning, 2 head-on and 2 pedestrians crashes occurred.	Site requires further investigation by CNAIR with traffic signals and improved channelization
DN 6: km 13+400	DN6 road in alignment into the Bragadiru settlement at the km 13+400. 19 pedestrians (5 died), 10 turning, 8 rear-end.	Traffic Signals with pedestrian crossings a good solution here. Overpass solution requires further investigation.

[18] See the Sheet Tabs "Overpasses" of the Excel file " Annex6_Technical-Engineering-analysis.xlsx", which is the part of this Report

Road	Current stage	Proposal
Timisoara Bypass (VOTM) intersection with DJ 591	DNCT cu DJ 691 Timisoara Bypass located at the intersection with DJ 591, which is a new investment, due to the increase in traffic road on local roads.	Site requires further investigation by CNAIR.

These proposals were taken forward in the next step for CBA and MCA[19] .

3.4. Rank and shortlist the proposed safety measures

Following a review of the crashes and an engineering appraisal of each location, the following findings have been made:

- For the New Roundabout Solutions, 32 of the initially proposed 67 locations were considered suitable for a new roundabout; the remaining 35 locations could be improved by other countermeasures such as traffic signals, improved channelization and pedestrian facilities.

  Pedestrian crashes were dominant at many locations and therefore there is an opportunity to improve the operational safety of the junction and also pedestrian and other vulnerable road user safety.

- For the 31 suggested locations for upgrading the existing temporary roundabouts to New Roundabout Solutions, 23 were considered suitable to be constructed into permanent roundabouts (with modifications to improve entry deflection for example); the remaining eight locations could be improved by other countermeasures such as traffic signals, improved channelization and pedestrian facilities.

  Again, pedestrian crashes featured at many locations.

- Nine locations were proposed for Over/Underpasses (grade separation), at this stage of investigation; it was proposed CNAIR to perform a more detailed analysis to assess the feasibility of constructing over/underpasses at these locations.

  The sites are complex and have high AADT, and it is clear that in the majority of cases considerable land acquisition and/or demolition would be required.

[19] The Sheet Tab ”CNAIR list” of the Excel file ”Annex3_CBA-MCA-calculations.xlsx”, which is the part of this Report

4 Consider other categories/types of investments[20]

A list of supplementary 389 blackspots locations on the main road network in Romania was reviewed in relation to road safety countermeasures. This list contained:

- GPS coordinates and Google Map links with kilometre position (address) and intersected road,
- Number of crashes with injuries, died, serious and slight injuries, number of the vehicles involved,

It was considered other locations and the suggested measures were the same - channelisation / signalling, roundabout and over/underpasses.

The definition of the blackspot in Romania is established by the ARR within the Law no. 265/2008 on management of the road infrastructure safety. According to the art. 3, n) of the Law, the blackspot represents a section of the public road that has a higher rate of road accidents than the average rate of accidents recorded on the distance unit of that road and over a historical period of time. For the purposes of this definition, according to the ARR, the historical time period is 3 years, the unit distance outside built-up area is 1 km and the unit distance in built-up area is 50 m.

However, the information requested was focused on junctions, in which occurred between one (the lowest) to 36 (the highest) number of crashes.

According to the adopted definition and based on RiPCORD-iSEREST[21], it is statistical one based on the critical value of accident number and critical value of accident rate, but these two values are not calculated. A statistical definition of an accident blackspot relies on the comparison of the recorded number of accidents to a normal number for a similar type of location. Depending on how the normal number of accidents is estimated, a statistical definition may come close to a model-based definition of a blackspot.

It was recommended to develop the necessary normative basis (guidance) for identifying, analysing, treating and monitoring blackspots based on the existing definition or to adopting a new concept, more convenient with the available data collected in Romania.

It was decided to use the simplified numerical values and chose to analyse only the sections (locations) where no less than 3 road accidents with injuries occurred per year, without taking into consideration the type of accidents and other elements indispensable for a numerical definition of identification. Thus, according to the Annex 6 information, 92 blackspots locations out of initial 389 were selected and analysed from the safety engineering point of view. At this stage, CNAIR also proposed an additional list of 28 locations for over / underpasses. Analysis of junctions per type and proposed measures is presented in the Table 6.

[20] The results of the engineering / technical review could be seen in the Sheet Tabs ”Blackspot list”, ” CNAIR Sup.list over1” and ” CNAIR Sup.list2” of the Excel file ” Annex 6_Technical-Engineering-analysis-draft2.xlsx”, which is the part of this Report

[21] RiPCORD-iSEREST (2008). Black Spot Management and Safety Analysis of Road Networks - Best Practice Guidelines and Implementation Steps.

Table 6 - Analysis of junctions per type and proposed measures

Black Spots (supplementary list)		
"Y" type junction	In Built-up area	9
	Outside bult-up area	9
"T" type junction	In buit-up area	25
	Outside built-up area	13
	In industrial area	3
"X" type junction	In built-up area	24
	Outside built-up area	6
Multi-leg junction	In built-up area	3
Total		**92**
Overpasses (supplementary list)		
"T" type junction	Channelised intersection - pedestrians crossing	7
	Channelised intersection – without pedestrians crossing	3
	Roundabout, 2+2 approaching	1
"Y" type junction	physical channelization on the main road for the left direction	4
	Roundabout, 2+2 approaching	1
"X" type junction	2+2 cross section - in built-up area – temporary roundabout	3
	Roundabout	2
Railways	At grade junction with railway	4
Total		**25**
Roundabouts (supplementary list)		
"Y" type junction	Channelised intersection	2
"X" type junction	Channelised intersection	1
Total		**3**
Full Total		**120**

As in respect to the first pre-identified list of CNAIR, the blackspot locations were reviewed and analysed from satellite images, and based on the available crash data, number of vehicles involved and injuries.

The intersection's configuration and possible engineering problems for road user' safety were the main issues for analysis, respectively, the conclusions on the possibility to improve the mode of junction, including a very important element - pedestrian safety, if location is in a built-up area.

It was estimated the injury risk reduction in case of implementation of the proposed measures, according to the PIARC Catalogue of design safety problems and potential countermeasures[10]. The risk reduction factor was further taken in consideration in the CBAs.

Based on the above, a final list of 229 locations with respective safety measures to be implemented and estimated reduction of crashes and casualties was established. Each location from this list was further analysed from socio-economic point of view.

5 Cost-benefit analyses

5.1. Methodology

For each of the 229 finally selected locations, a simplified CBA was undertaken in line with the "Guide to Cost-Benefit Analysis of Investment projects", issued by the EU in December 2014. The main elements of the CBAs are as follows:

- 25 years reference period, starting from 2020 till 2045,
- done on incremental basis by comparing the "With project scenario" with a "Without Project/ Do nothing/ counterfactual scenario" and
- applying discounted cash flow method, meaning that when aggregating cash flows occurring in different years, the time value of money is considered by discounting the cash flows back to the present using a time-declining discount rate; the discount rate used is 5%, as recommended for the economic analyses for 2014 – 2020 planning period.

For each of the locations under investigation the following costs and benefits were considered:

- ***Investment/Capital costs***: the unit costs were estimated in cooperation with CNAIR based on expert assessment and data for similar measures implemented by the Beneficiary. These are summarised in the next table.

Table 7 - Estimated investment costs per measure and cost type, 2020 price VAT excl.

Technical solution to be applied	Total capital costs, EUR	Design costs, EUR	Land acquisition costs, EUR	Works costs, EUR
Channelisation and/or traffic signals				
Outside built-up area, 1 + 1 lanes cross section, no land acquisition	100,000	3,000	0	97,000
Outside built-up area, 2 + 2 lanes cross section, no land acquisition	180,000	5,400	0	174,600
In built-up area with pedestrian facilities, 1+1 lanes cross section, no land acquisition	120,000	3,600	0	116,400
In built-up area with pedestrian facilities, 2+2 lanes cross section, no land acquisition	200,000	6,000	0	194,000
Roundabout				
Outside built-up area, no land acquisition, 1+1 lanes cross section	300,00	9,000	0	291,000
Outside built-up area, no land acquisition, 2+2 lanes cross section	600,000	18,000	0	582,000
In built-up area, no land acquisition, 1+1 lanes cross section	400,000	12,000	0	388,000
In built-up area, no land acquisition, 2+2 lanes cross section	500,000	15,000	0	485,000
Outside built-up area, with land acquisition, 1+1 lanes cross section	400,000	12,000	80,000	308,000
Outside built-up area, with land acquisition, 2+2 lanes cross section	600,000	18,000	120,000	462,000
In built-up area, with land acquisition, 1+1 lanes cross section	500,000	15,000	100,000	385,000
In built-up area, with land acquisition, 2+2 lanes cross section	700,000	21,000	140,000	539,000

Technical solution to be applied	Total capital costs, EUR	Design costs, EUR	Land acquisition costs, EUR	Works costs, EUR
Under/overpass				
Outside built-up area, with small land acquisition, 1+1 lanes cross section	5,000,000	150,000	1,000,000	3,850,000
Outside built-up area, with small land acquisition, 2+2 lanes cross section	10,000,000	300,000	2,000,000	7,700,000
In built-up area, with small land acquisition, 1+1 lanes cross section	7,500,000	225,000	1,500,000	5,775,000
In built-up area, with small land acquisition, 2+2 lanes cross section	12,500,000	375,000	2,500,000	9,625,000
Outside built-up area, with land acquisition issues, 1+1 lanes cross section	7,500,000	225,000	1,500,000	5,775,000
Outside built-up area, with land acquisition issues, 2+2 lanes cross section	15,000,000	450,000	3,000,000	11,550,000
In built-up area, with land acquisition issues, 1+1 lanes cross section	10,000,000	300,000	2,000,000	7,700,000
In built-up area, with land acquisition issues, 2+2 lanes cross section	20,000,000	600,000	4,000,000	15,400,000

As per the Romanian CBA Guide[22], the design costs were assumed at the level of 3% of the total capital costs; based on past experience, CNAIR estimated the land acquisition costs, where relevant, to be some 20% of the total capital costs;

For each of the locations it was assumed the design, feasibility study and land acquisition (where relevant), will be carried out in 2021 and the actual works are scheduled for 2022, so the With project situation should be operational starting from 2023;

- ***Operation and maintenance* (O&M) *costs*** for the periods after implementation of the proposed measures were assumed at the level of 1.5% of the works' costs
- No residual value after 23 years of operation and no financial revenues are considered
- For the need of the economic analyses, financial costs were recalculated into ***economic costs*** by applying standard conversion factor of 0.858, estimated as presented in the next table 6; for all tradable components conversion factor of 1 was assumed; in respect to the labour costs the conversion factor applied is 0.65 that is calculated based on 5% unemployment rate and 32% share of unemployment and other charges and taxes imposed.

Table 8- Estimation of standard conversion factor

Components	Cost share	Conversion factor	Standard Conversion factor
Equipment	20%	1	0.200
Materials	30%	1	0.300
Labour	40%	0.65	0.258
Other	10%	1	0.100
	100%		**0.858**

[22] AECOM (2014) Ghidul Național de Evaluare a Proiectelor în Sectorul de Transport și Metodologia de Prioritizare a Proiectelor din cadrul Master Planului Volumul 2, Partea C: Ghid privind Elaborarea Analizei Cost- Beneficiu Economice şi Financiare şi a Analizei de Risc

Source: National CBA Guide for the cost shares; EU CBA Guide and national data on unemployment and taxation for the conversion factors

- ***Benefits of saved road accidents*** were estimated for the rest of the reference period until 2045 as a difference between the costs in "Without project scenario" and "With project scenario"; the number of the future accidents and casualties in "Without Project scenario" was estimated based on the road safety statistics for the last three years and traffic growth with elasticity of 0.05;

  By the legislation in force, the ARR sets every year unit average costs for serious accidents and for serious accidents with fatalities; it was received the unit costs for 2016 and 2017[23]; the lack of unit costs set for 2020 was not a problem because the ARR sets value per accident (with or without fatalities), which could not be applied because the statistics provided for the locations did not distinguish accidents with fatalities and without fatalities; the information that was made available did not allow to estimate the number of accidents with fatalities as in some accidents more than one fatality might had been occurred; due to this, the Consultant used the unit costs and methodology for their future years update as set in the Romanian CBA Guide; these unit costs refer to 2010 and in line with the EC and Romanian CBA guides, they were updated to 2020 values with elasticity of 1 to the gross domestic product (GDP) per capita increase; for the period 2011 to 2019 the Consultant used statistical data for the GDP per capita growth and for the future years till 2045 the annual growth rates as prescribed in the Romanian CBA Guide[24] were applied; the results of these calculations per time horizons are summarised in the next table.

  No other potential benefits such as time savings, vehicle operation costs' savings and/ or environmental impact were taken into account due to the principal objective of determining measures on road safety grounds.

Table 9- Fatality and casualty economic values per time horizon

Year	Cumulative GDP per capita growth	Fatality costs, EUR	Serious injury costs, EUR	Light injury costs, EUR
2010	1.00	635 972	87 963	7 114
2020	1.5325	974 611	134 801	10 902
2025	1.8573	1 181 210	163 376	13 213
2030	2.2510	1 431 604	198 009	16 014
2035	2.6963	1 714 795	237 178	19 182
2040	3.1593	2 009 231	277 902	22 475
2045	3.6696	2 333 776	322 791	26 106

Source: National CBA Guide for 2010 values and national statistics and forecasts for the GDP/ capita growth

[23] For 2016: EUR 169,270.16 for severe accident and EUR 1,087,468.38 for accident with fatalities; for 2017: EUR 168,560.09 and EUR 1,082,964.44 respectively

[24] AECOM (2014) Ghidul Național de Evaluare a Proiectelor în Sectorul de Transport și Metodologia de Prioritizare a Proiectelor din cadrul Master Planului Volumul 2, Partea C: Ghid privind Elaborarea Analizei Cost- Beneficiu Economice şi Financiare şi a Analizei de Risc ; Tabelul A3.6 – Scenariul de creștere pentru PIB per capita

The road accidents' costs in "Without project scenario" were calculated by multiplying the estimated number of casualties per type and year to the respective unit cost; the share of the casualties to be avoided in "With project scenario" were estimated separately for each of the locations depending on the type of recommended safety measures; the road accidents' costs in "With project scenario" were estimated based on the costs in "Without project scenario" and respective percentage of avoided casualties; no other benefits other than saved road accidents' costs were included in the CBA;

For each of the considered locations, Economic Net Present Value (ENPV), Economic Internal Rate of Return (EIRR) and Benefit Cost Ratio (B/C) were calculated.

5.2. CBA results

Cost estimation for all 229 locations was estimated at EUR 229.02 million, VAT excl., allocated per type of safety measure as follows:

- Roundabouts – 111 locations with estimated costs of EUR 52.4 million, VAT excl.
- Channelisation and/or improving signalling – 101 locations with estimated costs of EUR 16.620 million, VAT excl. and
- Interchanges – 13 locations with estimated costs of EUR 160.0 million, VAT excl. and
- 4 locations for which no safety improvement measures were identified.

No CBA results could be calculated for all the locations because of the following reasons:

1. Current solution is good and cannot be further improved,
2. Unclear solution proposed or solution is withdrawn from the list by the Beneficiary,
3. New investment for which no input data (AADT and/ or accidents data).

For 19 of the locations proposed by CNAIR no accidents and casualties were reported for 2017-2019, which made impossible estimation of future accidents' costs and benefits. This way, for these locations only capital and O&M costs were calculated without any benefits.

Out of the remaining 208 locations, the CBA for 13 locations showed negative ENPV, EIRR below the threshold of 5% and benefit cost ratio (BCR) - below 1. In most of the cases these are locations with low number of accidents and no fatalities recorded, but in one case the estimated investment costs of EUR 20 million for proposed interchange exceeds the potential safety benefits. The remaining 195 locations are assessed to be beneficial for the society. As presented in the next figure, the EIRR of more than half of the locations exceeds 100% and the BCR is above 20, which shows an extremely high economic profitability.

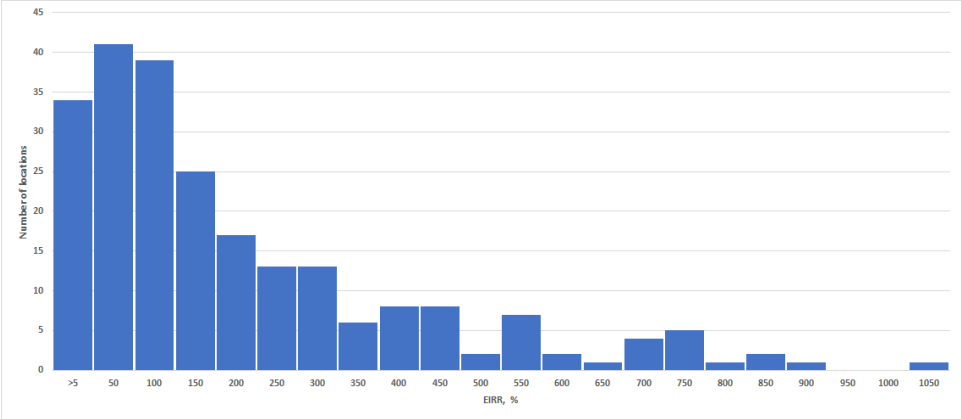


Figure 3 - EIRRs of 229 considered locations

The results of the CBA for the 229 locations considered are presented in Annex 2. Total investment costs for the 195 locations that proved to be viable from economic point of view is EUR 181.04 million. Detailed CBA calculations are presented in Annex 4 CBA and MCA calculations.

6 Multi-criteria analysis

6.1. MCA methodology

In order to select the most mature and beneficial locations, which to be implemented with higher priority, the 195 locations were ranked by applying a multi-criteria analysis. The MCA methodology developed in purpose consists of the following steps:

1. Definition of suitable evaluation criteria (main criteria; criteria)
2. Definition of the aim of each criterion
3. Definition of suitable indicators for evaluation of the criteria
4. Evaluation of the level of achievement of the objective for each criterion against the defined indicator
5. Synthesis of evaluation for each main criterion (synthesis of the results of the evaluation of the criteria to an evaluation of a main criterion) and
6. Calculation of results.

The following set of main criteria was adopted:

- **Main criterion 1**

  Location; this criterion considers:

  - ***Type of the road*** on which the junction is located, highest priority being given to European roads, followed by national trunk roads and national secondary road and,
  - whether this is in a ***built-up area or not.***

- **Main criterion 2**

  Traffic level; this main criterion considers the probability for crashes, which is higher at junctions with higher AADT in comparison to locations with lower AADT

- **Main criterion 3**

  Road safety risk; this is the most important main criterion, which considers the relative crash rate and the severity rate of the accidents that occurred at the location; crash and severity rates were calculated based on 2017-2019 period with the following formulas:

$$C = \frac{\text{A x 1,000,000}}{\text{T x AADT x l}}$$, where:

C - the ***relative crash rate*** in number of accidents per million vehicle-km

A - the number of accidents recorded in the analysed period, i.e., one year

T - the number of days, for annual rate, T = 365

AADT - the AATD registered in the analysed period and

L - the length in km of the analysed road section; since subject of analysis are junctions and not road sections, it was assumed L = 0.1 km

$$S = \frac{\text{F+I}}{\text{A}}$$, where:

S - accidents' severity rate in number of casualties per accident

F - the number of fatalities registered in the analysed period

I - the sum of severe and light injuries and

A - the total number of accidents registered.

- **Main criterion 4**

  Economic viability; this main criterion prioritizes locations, which based on the CBA results, which proved to be the most beneficial for the society; the EIRR is the indicator used to compare and prioritise locations with different capital and maintenance and operation costs

- **Main criterion 5**

  Risk & maturity; this criterion takes into account the possible risks associated with the implementation of the proposed safety measures, such as:

  - land acquisition issues and
  - need of relocation of facilities.

- **Main criterion 6**

  Other benefits; benefits other than saved road accidents' costs that could arise out of the suggested safety measures are reduction of travel time (in case of overpasses) and/or environmental impact.

The above man criteria and criteria, scores and weights are summarised in the following MCA performance matrix.

Table 10 - MCA matrix

Main criteria	Criteria	Value	Weight	Sub-weight
Location	Road class	1 to 3 scale	10%	5%
	Area type	1/ 2		5%
Traffic level	AADT	High – Low (1 to 5 scale)	10%	10%
Road safety risk	Relative crash rate	High – Low (1 to 5 scale)	40%	16%
	Accidents' severity rate	High – Low (1 to 5 scale)		24%
Economic	EIRR	Low – Hight (1 to 5 scale)	25%	25%
Risk/ maturity	Land acquisition issues	Yes /n.a. - No (0 / 1)	10%	0%/ 5%
	Utility relocation	n.a. – No/ Yes (0 / 1)		0%/ 5%
Other benefits	Travel time reduction and/or environmental	No/ Yes (0 / 1)	5%	0%/ 5%

6.2. MCA results

The results of the MCA for all the 229 locations considered are presented in Annex 3. The final MCA score per location varies from 80.5 to 31.5 out of 100. The first batch of highest ranked locations with total estimated total costs (preparation of feasibility studies and environmental impact assessment, if needed, land acquisition, design and build and supervision) of approximately EUR 100.020 million, VAT excl. were recommended to be included in the Phase 1 of the RSIP.

7 Proposed locations and safety measures

The locations selected based on an MCA were discussed with CNAIR and small adjustments (replacements sites) to the list were made at the Beneficiary's request due to the presence of some ranked locations in the other procurement programmes. The so set scope of the Program consists of 89 locations in total, split per type of safety measure as follows (see in Table 11):

- 43 locations where channelization/ signalling measures are recommended with a total investment value of 6.82 million,
- 40 locations where it is recommended roundabouts to be built with a total investment value of EUR 18.2 million and
- Six locations suitable for over/underpasses with total investment value of EUR 75 million.

Table 11 – Final list with 89 locations and proposed safety measures with their GIS localization

No	DRDP	Location	Current type of junction	Cross section on main road	Number of lanes on approach		Urban / Rural areas	AADT on main road	Proposed measure for improvement	Google cords
					Main road	Second. road				
1	BUC	DN 1A km 13+255	T	B2S	2	1	urban	12376	Chan. / sign.	44.522706, 26.006926
2		DN 2- km 117+350	T	2+2	2	1	urban	12491	Roundabout	45.190545, 26.840839
3		DN 73 km 3+250	Y	2+2	2	1	urban	25739	Roundabout	44.895608, 24.874269
4		DN 1 – km 20+750	X	2+2	2	1	urban	28279	Chan. / sign.	44.609244, 26.072277
5		DN 2 – km 12+600	T	2+2	2	1	urban	22938	Chan. / sign.	44.505448, 26.217078
6		DN 2 – km 55+800	Y	B2S	2	1	urban	20387	Over/under.	44.708851, 26.621668
7		DN 6 – km 11+220	Overpass	2+2	3	1	urban	24377	Chan. / sign.	44.383092, 25.993539
8		DN 6 – km 13+400	X-TRbt	2+2	2	1	urban	24377	Chan. / sign.	44.364919, 25.971279
9		DN1A km 20+800	T	1+1	1	1	urban	9855	Chan. / sign.	44.570308, 25.944089
10		DN 6 km 15+500	X	2+2	2	1	urban	24377	Chan. / sign.	44.351284, 25.955296
11		DN 7 km 119+750	Y	1+1	1	1	urban	15533	Chan. / sign.	44.88872, 24.81483
12		DN 2 km 122+700	X	1+1L	2	1	urban	29122	Chan. / sign.	45.23301, 26.87048
13		DN 2 km 27+600	T	B2S	2	1	urban	17513	Chan. / sign.	44.547832, 26.376749
14		DN 2 km 49+500	X	B2S	2	1	urban	20387	Chan. / sign.	44.680048, 26.562104
15		DN1 km 106+885	X	1+1	1	1	urban	23437	Chan. / sign.	45.234832, 25.636606
16		DN 2 km 29+700	T	B2S	1	1	rural	17513	Roundabout	44.564401, 26.377650
17		DN1A km 100+400	T	1+1	1	1	rural	13992	Roundabout	45.082808, 26.033454

No	DRDP	Location	Current type of junction	Cross section on main road	Number of lanes on approach		Urban / Rural areas	AADT on main road	Proposed measure for improvement	Google cords
					Main road	Second. road				
18		DN 2 km 99+700	X	B2S	2	1	urban	25461	Chan. / sign.	45.08210, 26.77672
19		DN 65 km 110+300	X	1+1	1	1	urban	17894	Chan. / sign.	44.78056, 24.84814
20		DN 5 km 55+300	T	2+2	3	1	rural	13783	Roundabout	43.963895, 25.984183
21		DN 2 km 74+900	Y	B2S	2	1	rural	16363	Chan. / sign.	44.87317, 26.68711
22		DN 2 km 74+800	T	B2S	2	1	rural	16363	Chan. / sign.	44.87149, 26.68714
23		DN 6 km 9+200	T	2+2	2	1	urban	24377	Over/under.	44.388433, 26.011558
24		DN 1 km 27+500	T	2+2	3	1	urban	28279	Over/under.	44.667894, 26.076737
25		DN 1 km 68+450	T	2+2	3	1	rural	28677	Roundabout	44.977916, 25.940505
26		DN 1 km 79+580	T	2+2	3	1	rural	28677	Over/under.	45.030399, 25.822863
27		DN 1 km 80+700	T	2+2	3	1	rural	26793	Over/under.	45.039118, 25.813285
28		DN 1A km 111+300	X	1+1	1	1	urban	13992	Roundabout	45.179290, 26.035847
29		DN 72 km 41+900	X	1+1R	2	1	rural	7976	Roundabout	44.919382, 25.541661
30	BV	DN 1 - km 388+889	T	1+1L	2	1	rural	19124	Roundabout	45.790371, 24.687835
31		DN 15 - km 81+315	T	2+2	2	1	urban	16107	Chan. / sign.	46.582787, 24.611135
32		DN 13 km 146+200	X	1+1L	2	1	urban	7938	Chan. / sign.	46.408932, 24.700412
33		DN 15 km 85+750	T	1+1	1	1	urban	16107	Chan. / sign.	46.613062, 24.644129
34		DN 13 km 9+600	Y	1+1L	2	1	rural	14502	Roundabout	45.748722, 25.581729
35		DN 13A km 70+400	X	1+1	1	1	urban	4886	Roundabout	46.359898, 25.238049
36		DN 1 km 186+400	Y	1+1L	2	1	rural	8646	Roundabout	45.730269, 25.445061
37		DN 15 km 35+300	Y	1+1	1	1	rural	13141	Chan. / sign.	46.480117, 24.126345
38		DN 13A km 75+200	T	1+1	1	1	rural	4886	Chan. / sign.	46.341007, 25.270259
39		DN 11, km 35+050	X-R	1+1	1	1	rural	8031	Chan. / sign.	45.858560, 25.937450
40	CJ	DN 1 - km 462+980	T	2+2	2	1	rural	16952	Chan. / sign.	46.674066, 23.648146
41		DN 1 - km 514+063	Y	2+2	3	1	rural	9865	Chan. / sign.	46.824867, 23.156625
42		DN 17 - km 22+550	T	1+1	1	1	rural	6403	Roundabout	47.178283, 24.147104
43		DN 1F - km 48+395	T	1+1L	2	1	rural	5162	Roundabout	46.995131, 23.249905

No	DRDP	Location	Current type of junction	Cross section on main road	Number of lanes on approach		Urban / Rural areas	AADT on main road	Proposed measure for improvement	Google cords
					Main road	Second. road				
44		DN 1 - km 488+378	O	1+1	1	1	rural	16592	Roundabout	46.745364, 23.451747
45		DN 1 km 491+900	T	1+1L	2	1	urban	13100	Chan. / sign.	46.751591, 23.396201
46		DN1H km 42+320	X	1+1	1	1	urban	5201	Chan. / sign.	47.199640, 22.709913
47		DN 1C km 170+500	X	1+1L	2	1	urban	13498	Chan. / sign.	47.713866, 23.351420
48		DN1C km 20+550	T	1+1	1	1	urban	15777	Chan. / sign.	46.859342, 23.761119
49	CR	DN 65 - km 42+452	X	1+1L	2	1	urban	10694	Roundabout	44.398673, 24.276132
50		DN65 km 47+450	T	1+1LR	2	1	rural	10694	Roundabout	44.417998, 24.327305
51		DN 65 km 14+100	T	1+1	1	1	rural	13299	Roundabout	44.32139, 23.96836
52		DN 6 km 238+200	T	2+2	2	1	urban	17189	Roundabout	44.39276, 23.72018
53		DN65 km 30+480	X	1+1LR	2	1	rural	11669	Roundabout	44.351942, 24.153784
54		DN 7 - km 190+900	Y	1+1	1	1	urban	15013	Roundabout	45.227333, 24.340462
55		DN 7, km 207+500	Y	1+1L	2	1	urban	13270	Roundabout	45.332716, 24.275162
56	CT	DN 3 km 251+020	T	2+2	2	1	urban	17420	Chan. / sign.	44.165467, 28.513738
57		DN 3 km 110+000	X	1+1	1	1	rural	8364	Roundabout	44.24896, 27.25268
58		DN 39E - km 1+250	T	1+1	1	1	rural	7124	Roundabout	44.12895, 28.60542
59		DN 22 - km 226+625	X	1+1L	2	1	urban	3734 / 4169	Roundabout	44.775247, 28.688714
60		DN 39 - km 36+150	T	2+2	3	1	rural	6857	Roundabout	43.874801, 28.574061
61		DN 2A - km 100+700	X	1+1	1	1	rural	4057	Roundabout	44.681239, 27.775052
62	IS	DN 2 - km 179+096	T	B2S	2	1	urban	8969	Chan. / sign.	45.664035, 27.165325
63		DN 2 - km 174+825	X	B2S	2	1	rural	8969	Roundabout	45.647916, 27.149169
64		DN 15D - km 8+910	X	1+1	1	1	urban	7341	Roundabout	46.949718, 26.488793
65		DN 15 - km 327+790	T	1+1	1	1	urban	11784	Chan. / sign.	46.838137, 26.506865
66		DN 28 - km 83+170	Y	1+1	1	1	urban	8041	Chan. / sign.	47.130953, 27.697463
67		DN 2 - km 457+100	Y	1+1	1	1	rural	9267	Chan. / sign.	47.769357, 26.065012
68		DN 26 - km 8+000	T	1+1R	2	1	rural	5832	Chan. / sign.	45.509987, 28.031939
69		DN 25 - km 68+197	Y	1+1	1	1	urban	9194	Chan. / sign.	45.409796, 27.934600

No	DRDP	Location	Current type of junction	Cross section on main road	Number of lanes on approach		Urban / Rural areas	AADT on main road	Proposed measure for improvement	Google cords
					Main road	Second. road				
70		DN 24 - km 206+525	O-multi-leg	1+1	1	1	Rural	6481	Roundabout	47.239507, 27.532479
71		DN 15 - km 286+850	T	2+2	2	1	urban	1175	Chan. / sign.	46.911536, 26.088429
72		DN 28 - km 63+290	O-t	2+2	2	2	rural	16032	Roundabout	47.180942, 27.472405
73		DN 28 km 59+300	T	B2S	2	1	urban	16032	Chan. / sign.	47.194426, 27.418175
74		DN 2 km 278+100	T	B2S	2	1	urban	11693	Chan. / sign.	46.48367, 26.92039
75		DN 2 km 259+500	T	B2S	2	1	urban	11693	Chan. / sign.	46.33453, 27.00322
76		DN 29 km 28+100	Y	1+1	1	1	rural	6085	Chan. / sign.	47.70788, 26.52938
77		DN 2 km 334+300	T	B2S	1	1	rural	11858	Chan. / sign.	46.962471, 26.912410
78		DN2 km 166+500	X	B2S	2	1	rural	8969	Roundabout	45.566145, 27.105688
79		DN 24 km 33+500	X	1+1	1	1	urban	7274	Roundabout	45.97333, 27.43502
80		DN 24 km 115+900	T	1+1	1	1	urban	6293	Chan. / sign.	46.596871, 27.773513
81		DN 28 km 48+800	T	1+1	1	1	urban	17865	Chan. / sign.	47.214532, 27.285121
82		DN2 km 158+675	X	B2S	3	1	urban	13175	Roundabout	45.503770, 27.077356
83		DN24 km 74+500	X	1+1LR	2	1	rural	5535	Roundabout	46.269137, 27.694829
84		DN 2 km 275+900	T	B2S	2	1	rural	11693	Roundabout	46.46336, 26.91616
85		DN 28 km 56+136	X-R	B2S	2	1	rural	16032	Over/under.	47.204263, 27.377283
86	TM	DN 7 - km 383+825	X	2+2	2	1	urban	21426	Roundabout	45.853568, 22.965059
87		DN 6 - km 495+000	X	1+1LR	2	1	urban	9944	Roundabout	45.68667, 21.93522
88		DN 66 - km 181+053	Y	2+1	2	1	urban	6993	Roundabout	45.615378, 22.956810
89		DN 6 km 532+900	Y	1+1	1	1	urban	14288	Chan. / sign.	45.800563, 21.512425

Note: TRbt – temporary roundabout; R – roundabout; LR –dedicated left or right lanes; B2S - 1+1 cross section with wide shoulder; Chan. / sign. – channelization / signalling; Over/under. - Over/underpasses

The summary costs of CBA inputs for each location (land acquisition, FS & EIA, work costs and supervision) can be viewed in Annex 8. The safety measures included in this first RSIP phase include (Figure 4**Eroare! Fără sursă de referință.**) and their regional distribution (Figure 5**Eroare! Fără sursă de referință.**) are presented below.

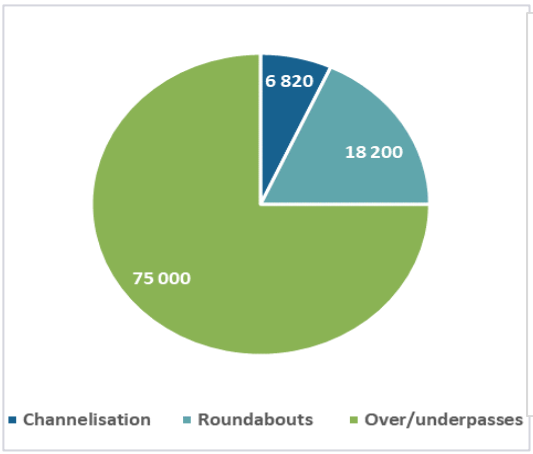


Figure 4 - Allocation of RSIP investment costs per type of safety measures, 000 EUR

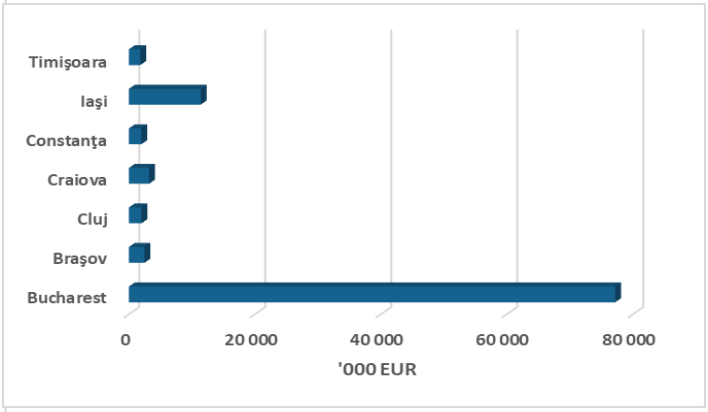


Figure 5 - Allocation of investment costs per regional unit, '000 EUR

Territorial distribution of the RSIP Phase 1 budget is presented in the next figure.

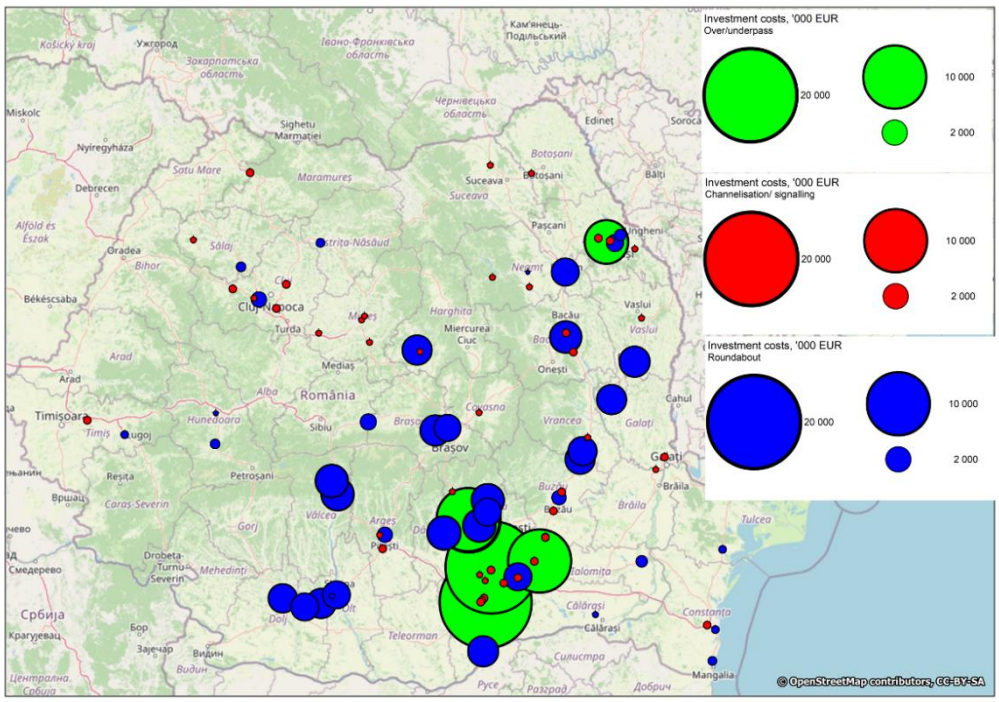


Figure 6 - Territorial distribution of investment costs per type of safety measure

The implementation of the RSIP with the proposed scope is expected to result in average avoided 38 fatalities, 114 serious injuries and 400 light injuries a year, which for the 28 years referent period amounts to EUR 1.306 billion saved economic costs discounted to 2020 prices.

7.1. Technical requirements per safety measure

The policy framework for efficient road safety refers to a variety of measures which, together, form the basis for implementation of safety measures in all fields of road safety. The practices in this area provide a support framework for all remaining road safety work. The best practices relate to road safety visions, targets and strategies, political leadership and to tools and strategies for the selection and implementation of cost-effective road safety measures.

According to the World Health Organization[25], the following interventions have to be provided for the safe infrastructure design and improvement:

- Provide safe infrastructure for all road users including sidewalks, safe crossings, refuges, overpasses and underpasses,
- Put in place bicycle and motorcycle lanes,
- Make the sides of roads safer by using clear zones, collapsible structures or barriers,
- Design safer intersections,
- Separate access roads from through-roads,
- Prioritize people by putting in place vehicle-free zones,
- Restrict traffic and speed in residential, commercial and school zones,
- Provide better, safer routes for public transport.

In the same way, building or modify roads which calm traffic, e.g., roundabouts, road narrowing, speed bumps, chicanes and rumble strips can help road authorities to manage safely the speed.

Channelisation and signalling

Improving channelisation at intersections involves providing additional road space for drivers waiting to undertake turning manoeuvres at the junction. This is typically a ghost left turn island arrangement with the safety benefits of providing some protection to left turning drivers as well as allowing free flow traffic on the mainline which improves capacity. This type of interchange is suitable for locations where the major road AADT are approx.10,000 vehicles per day and minor road AADT 5,000 vehicles per day.

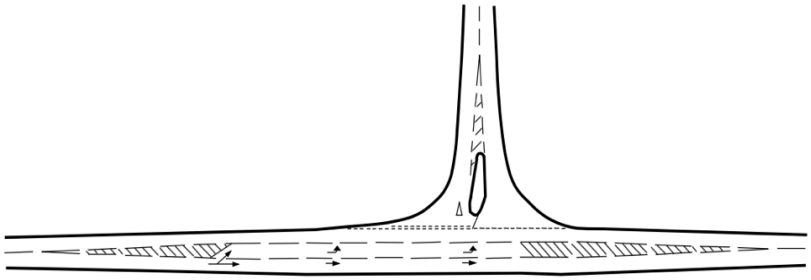


Figure 7 - Extract from UK DMRB CD123
Geometric design of at-grade priority and signal-controlled junctions

[25] https://apps.who.int/iris/rest/bitstreams/1083500/retrieve

Channelisation improvements can require local widening at intersections but generally are easy to implement. Basic junction modelling can be useful at locations requiring channelisation to get a full understanding of junction capacity and turning movements. Land acquisition may also be required in order to provide appropriate lane widths. Appropriate lane width for the left turn lane is 3m with through lanes of 3m. If larger vehicles are using the junction the left turn lane can be widened to 3.5m.

Traffic signals can also be incorporated with channelisation improvements with the added benefit of providing green time for turning movements and also improving capacity. Local widening will be required for traffic signals and additional widening may require land acquisition. Traffic signals also have the added benefit of allowing pedestrian crossing improvements to be incorporated into any signals design and pedestrian only phases to be included if capacity allows.

Traffic modelling is beneficial when implementing signals so that the signal timings can be optimised for traffic flows and also taking into account any clearances required between phases and if pedestrian phases are required.

Where considerable pedestrian movements are expected, traffic signals are preferable over roundabouts as they are far more pedestrian friendly. They do have however higher operation and maintenance costs.

Roundabout

Roundabouts are statistically a very safe form of intersection treatment but they do often require additional land in order to deliver an appropriate roundabout solution. There are some design critical elements such as entry deflection, number of circulatory lanes and size of the central island which can directly affect traffic safety. A poorly designed roundabout can often lead to collisions particularly if entry speeds are high. A normal roundabout as shown in the example below is considered a good solution where the AADT is 8,000 to 12,000 two way on any approach but are also effective are higher flows than 12,000.

Roundabouts offer considerable capacity improvements and also offer safe u turn opportunities, but they are not considered pedestrian or cycle friendly.

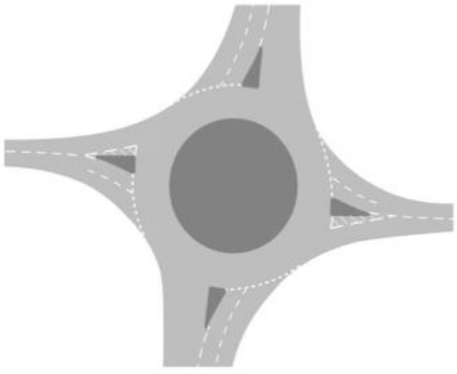


Figure 8 - Extract from UK DMRB CD1116

Due to the amount of land required particularly if multiple lanes are involved. They can also be difficult to implement in urban areas and in this instance traffic signals may well be more appropriate as well as more pedestrian friendly as already stated.

Due to additional land requirements, an EIA and/or ESAP (Environmental and Social Action Plan) and full consultation will be often required as they could impact on the environment and landscape.

Over/underpasses

Grade separation of junctions is required when junction capacity requires a more complex interchange solution. Grade separation, if well designed, offers considerable crash savings but they are expensive to implement, may require large amounts of land acquisition and higher potential for adverse environmental and social impacts. Full consultation, EIA and ESAP processes is normally required for grade separation.

There are several options available for grade separation and traffic modelling will be required to inform on the most appropriate solution. The options available will also depend on available land and some options may be cheaper to implement than others.

Diamond interchanges

A diamond layout includes slip roads leading to/from two staggered priority junctions. The advantages of this layout are minimised land from certain quadrants of the junction, conventional slip roads (rather than loops which are necessary with half-cloverleaf layouts) and the requirement for only one bridge.

The disadvantage is that there are a number of conflict points on the minor road resulting from the staggered junctions. It is also necessary to evaluate the risk of road users turning into an off-slip from the minor road when considering a diamond layout. These are suitable for roads with a two-way AADT of 30,000 vehicles per day.

Figure 9 - Extract from UK DMRB CD122.
Geometric Design of Grade Separated Junctions – Diamond Junction

Dumbbell Interchanges

A dumbbell roundabout layout includes slip roads leading to/from two roundabouts. The dumb-bell roundabout has the advantage of requiring less land than the diamond and two bridge and also requires only one bridge.

It is important to ensure that the link road between the two roundabouts can provide queuing storage capacity otherwise queuing could extend back onto the roundabouts.

Figure 10 - Extract from UK DMRB CD122.
Geometric Design of Grade Separated Junctions – Dumbbell Junction

Two Bridge Interchanges

Two bridge interchanges provide greater traffic flow capacity than the dumbbell roundabout layout and are less complex from a road user perspective. They do however require two bridges and have a greater footprint and therefore the most expensive.

Cloverleaf style interchanges are also a widely used option in the USA and Middle East but require large amounts of land and are expensive to implement.

Figure 11 - Extract from UK DMRB CD122.
Geometric Design of Grade Separated Junctions – Two Bridge Junction

3-way 2 level 'Trumpet' interchange

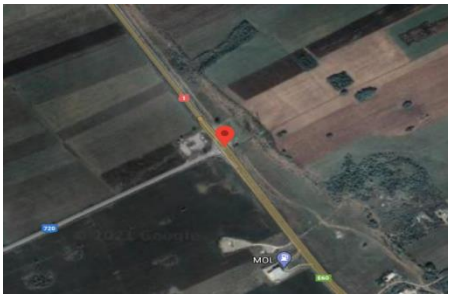
The trumpet interchange requires less land and allows good traffic flow to be maintained.

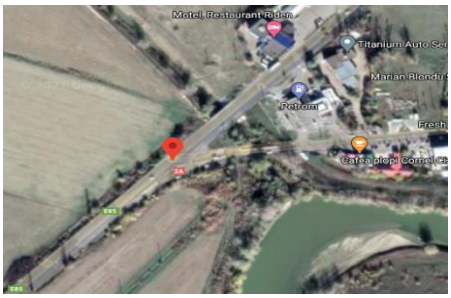
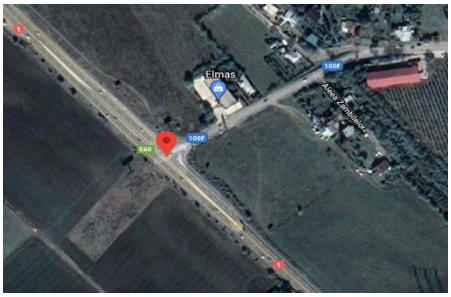
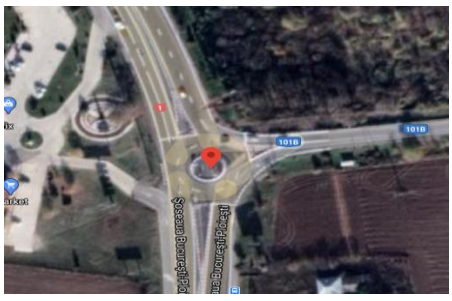
Figure 12 - Extract from UK DMRB CD122. Geometric Design of Grade Separated Junctions
a) Three-way two Level 'Trumpet' **b) Three- way two level free flow 'T' layout**

7.2. Technical Specifications for Sites recommended for over/underpasses

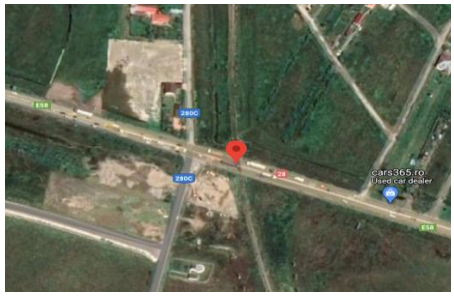
For the six locations identified for over/underpasses, it has provided additional information on the site location and what could be an appropriate method of grade separation at each location. This information is provided in Table 12.

Table 12 - Additional information on the site location for over/underpasses

Site location and description and Google Street view Image	Aerial Photograph	Suggested Grade Separation Solution
DN1 Km 80+700: AADT on main road = 26793 veh/day Rural "T" junction of DN1 and DJ720 (Floresti village access), DN1 with 2+2 cross section with no central median / DJ720 with 1+1 cross section 		Three-way, two level Trumpet would be a good solution at this location.

Site location and description and Google Street view Image	Aerial Photograph	Suggested Grade Separation Solution
DN 2 Km 55+800: AADT on main road = 20387 veh/day. Rural/Urban "Y" junction of DN2 and DN2A (Urziceni bypass). DN2 with B2S cross section with wide shoulder / DN2B with 1+1 cross section 		Three-way, two level Trumpet would be a good solution at this location.
DN 1 Km 79+580: AADT on main road = 28677 veh/day Rural/Urban "T" junction of DN1 and DJ100F (access to Baicoi settlement). DN1 with 2+2 cross section with median barrier / DJ100F with 1+1 cross section 		Three-way, two level Trumpet would be a good solution at this location.
DN1 Km 27+500: AADT on main road = 28279 veh/day Urban "T" Temporary Rbt[26] of DN1 and DJ101B (access to Snagov settlement). DN1 with 2+2 cross section with median barrier DJ100F with 1+1 cross section 		Three-way, two level Trumpet would be a good solution at this location. *Note: Temporary Roundabout shown on aerial imagery*

[26] Rbt - Roundabout

Site location and description and Google Street view Image	Aerial Photograph	Suggested Grade Separation Solution
DN28 Km 56+136: AADT on main road = 16032 veh/day Rural "X" junction of DN28 and railway near the junction with DC280C DN28 with 1+1 cross section with wide shoulder / one line railway / DC280C with 1+1 cross section DJ280C 1+1 		Diamond or Dumbbell interchange options would both be options at this location. *Note: Proximity of DC280C could mean overpass has to cover both junctions*
DN6 Km 9+200 AADT on main road = 24377 veh/day Urban "T" junction of DN6 and Smardan st. in Brigadiru village. DN6 with 2+2 cross section with median barrier / 1+1 – Smardan st.  *Note: Major land acquisition challenges at this location – junction may need to be relocated or combine with the nearest one. In this regard, in the next stage (the feasibility / options study) it is recommend to analyse in detail all technical, environmental and social issues – supplementary to road safety, before decisions will be ultimately taken on junction and intervention type.*		Three-way, two level free flow 'T' close designed layout would be a good solution at this location.

7.3. Land acquisition and Environmental Impact Assessment

It has been estimated that for 32 locations - land acquisition and for 16 – environmental impact assessment would most probably be needed. The budget allocated for this was estimated at EUR 7.264 million – for land acquisition and other EUR 2.352,6 – for environmental impact assessment, as presented in the next table.

Table 13 - Estimated costs for land acquisition

№	Location	Measure type	Land acquisition costs, '000 EUR	Environmental Impact Assessment, '000 EUR
DRDP Bucharest				
1	DN 73 km 3+250	Roundabout	140	

№	Location	Measure type	Land acquisition costs, '000 EUR	Environmental Impact Assessment, '000 EUR
2	DN 2 – km 55+800	Over/underpass		300
3	DN 2 km 122+700	Channelisation/ signalling	40	
4	DN 2 km 29+700	Roundabout	100	
5	DN 2 km 99+700	Channelisation/ signalling	40	
6	DN 65 km 110+300	Channelisation/ signalling	40	
7	DN 2 km 74+900	Channelisation/ signalling	40	6
8	DN 2 km 74+800	Channelisation/ signalling	40	6
9	DN 6 km 9+200	Over/underpass	4 000	600
10	DN 1 km 27+500	Over/underpass		600
11	DN 1 km 79+580	Over/underpass		300
12	DN 1 km 80+700	Over/underpass		300
13	DN 1A km 111+300/streets	Roundabout	100	15
14	DN 72 km 41+900/ DJ 720B km 3+400	Roundabout	100	
Bucharest total			**4 640**	**2 127**
DRDP Craiova				
1	DN65 km 47+450	Roundabout	100	
2	DN65 km 30+480	Roundabout	80	12
3	DN 7 - km 190+900 entry to Călimănești	Roundabout	100	
4	DN 7, km 207+500 cu DN 7A	Roundabout	100	
Craiova total			**380**	**12**
DRDP Timisoara				
1	DN 7 - km 383+825	Roundabout	140	
2	DN 6km 532+900	Channelisation/ signalling	40	
Timisoara total			**180**	**0**
DRDP Cluj				
1	DN 1 - km 488+378	Roundabout	80	12
2	DN 1C km 170+500	Channelisation/ signalling	40	
3	Intersection DN1C km 20+550 cu DJ 109D	Channelisation/ signalling	40	
Cluj total			**160**	**12**
DRDP Brasov				
1	DN 1 - km 388+889	Roundabout	80	12
2	DN 13A km 70+400	Roundabout	100	
Brasov total			**180**	
DRDP Iasi				**12**
1	DN 15D - km 8+910	Roundabout	100	
2	DN 28 km 59+300	Channelisation/ signalling	40	
3	DN 2 km 278+100	Channelisation/ signalling	40	
4	DN 2 km 334+300	Roundabout	40	6
5	Dn2 km 166+500	Roundabout	120	18
6	DN 24 km 33+500	Roundabout	100	
7	DN 24 km 115+900	Channelisation/ signalling	24	3.6
8	DN 28 km 48+800	Channelisation/ signalling	40	

№	Location	Measure type	Land acquisition costs, '000 EUR	Environmental Impact Assessment, '000 EUR
9	DN2 km 158+675	Roundabout	140	
10	DN 2 km 275+900	Roundabout	80	12
11	DN 28 km 56+136 rail level crossing	Over/underpass	1 000	150
Iasi total			**1 724**	**189.6**

Following consultations with CNAIR, the time allocated to complete the land acquisition procedures is assumed at 12 months per contract.

8 Procurement approach

Within task 3, ***Support a procurement and implementation strategy for Phase 1 to examine available options and optimisation of works' procurement packages/plan***, a review of the regulatory legal framework in Romania concerning investment works and supply tenders was done.

Applicable legal provisions at EU and national level

Transposition of the European Directives with an impact on public procurement has generated an extensive process of improving the national legal framework in the field of public procurement, which ended with the emergence of a new legislative package with an impact on both primary and secondary/tertiary legislation.

Since 2016, all Public Bodies at local, regional, and national level had to concede to the new and updated Romanian Procurement Legislation, that consists of the following 4 major laws and Government Decisions:

- Law no. 98/2016 on public procurement with its later approved amendments, that transposes the Directive 2014/24/EU of the European Parliament and of the Council of the European Union.
- Government Decision no. 395/2016 for the approval of the Methodological Norms for the application of the provisions regarding the award of the public procurement contract / framework agreement from Law no. 98/2016 on public procurement.
- Law no. 101/2016 on remedies and remedies in the matter of awarding public procurement contracts, sectoral contracts and works concession and service concession contracts, as well as for the organization and functioning of the National Council for Solving Complaints.
- Decision no. 1/2018 of January 10, 2018 for the approval of the general and specific conditions for certain categories of procurement contracts related to investment objectives financed from public funds.

During the development of this procurement strategy, brief overviews were performed on the human resources capacity within CNAIR, and on the consulting and construction sectors in order to strengthen the proposed procurement strategy.

8.1. Human Resource capacity within CNAIR related to the procurement flow

In order to highlight the decision of putting forward a Single Stage Procurement Strategy a brief overview of the Beneficiary HR capacity and procedures was developed.

In the procurement process the following two departments will be involved:

1. Traffic Safety and Traffic Monitoring Department (DSCMT) which is currently served by a number of 28 people, 12 of whom are part of Traffic Safety Service (SST) with technical background and vast experience in developing Technical Terms of Reference.
2. Procurement Directorate (DAP) which is currently served by a number of 65 people, which are implementing all the procurement procedures within CNAIR.

The workflow within the company, regarding the development of procurement procedures is presented below:

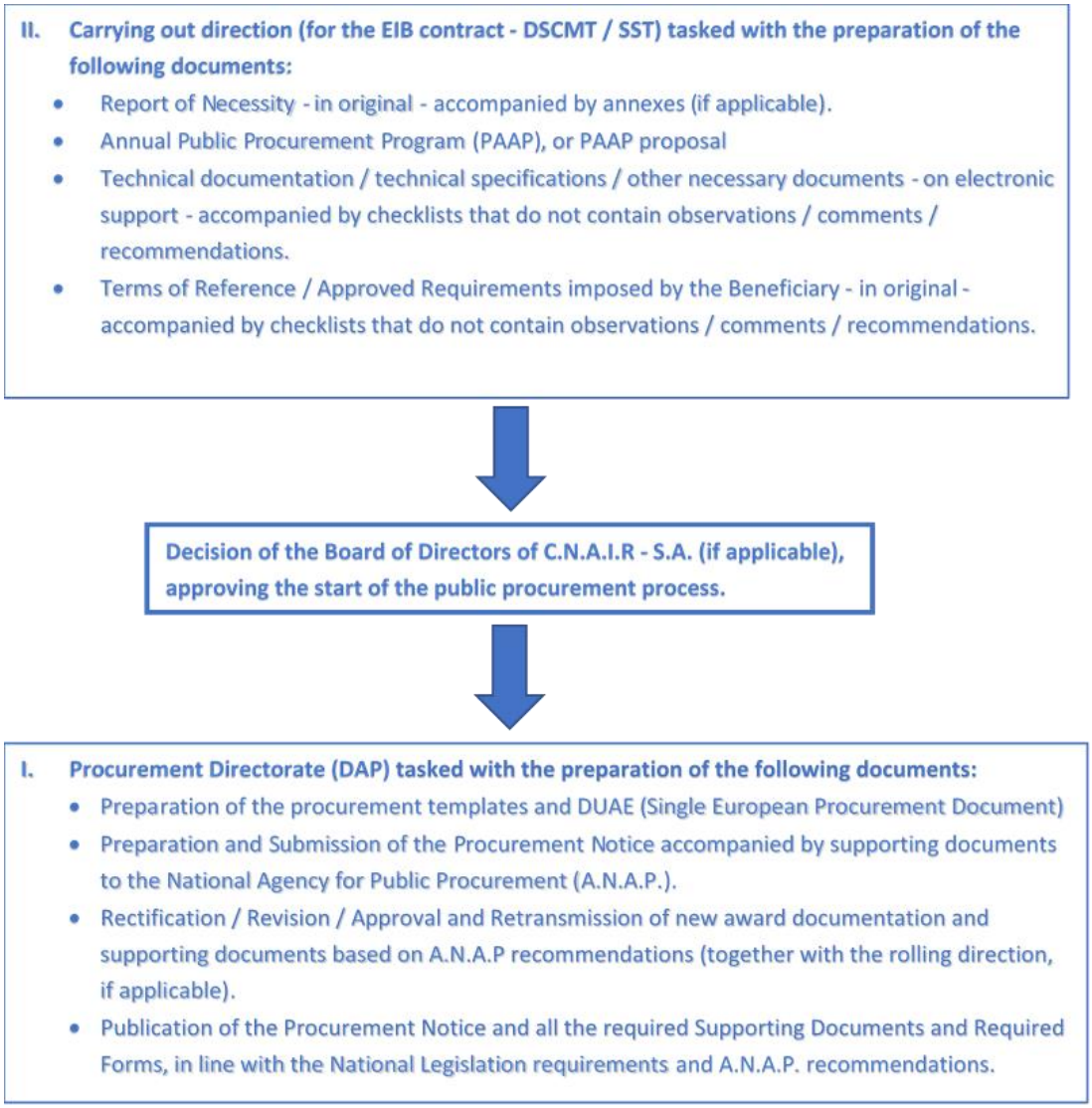


Figure 13 - The workflow within the company

From the moment the Procurement Notice is officially released and up until the deadline for submission of the proposal the two departments work together in order to prepare and release the responses to possible requests for clarifications submitted by economic operators interested in participating in the public procurement procedure.

8.2. Brief Overview of the Romanian Consultancy and Construction market

The market of engineering companies in Romania, specialized in design, consulting and management services in the field of transport infrastructure is currently divided into two categories, as follows:

1. ***Large companies***, which have an annual turnover that is above the threshold of RON 5,000,000, and in this category are included both companies with fully Romanian capital as well as representatives or branches of international companies, which carry out projects at national level, and here we can mention: Search Corporation, Consitrans, EGIS, Eptisa, etc.

2. ***Small and medium companies***, with a turnover of up to RON 5,000,000 that operate mainly in the local market, and that offer their consulting and design services at county level.

The information presented above confirms that in the tender procedure for the preparation of Feasibility Studies and Environmental Impact Studies (where applicable) and Supervision of Works, that companies in the first category will be able to easily cover the Qualification Criteria for submission of tenders for several lots.

In comparison to the market of consulting companies, the companies that have in the field of activity construction of transport infrastructure is a very well developed one. Following an analysis performed by "Ziarul Financiar" based on data provided by companies and those published on the website of the Ministry of Finance, the top 25 builders in Romania, after turnover in 2019, together achieved revenues of RON 7.8 billion, and cumulatively have over 11,000 employees.

In fact, compared to other markets, where foreign players are dominant, the construction field is dominated by companies with shareholders in Romania, which is especially evident in the second part of the ranking, which includes companies with turnovers between 100 and 200 million lei.

Out of the top 25 largest builders in Romania the first 10 of them mainly activate in the construction, development, and improvement of the road infrastructure. Lately due to the extensive investments in the roads development sector many construction companies that reside outside of Romania have taken an interest in participating in bids organized by CNAIR or the Ministry of Transport.

Due to the experience gained in recent years by CNAIR, as well as the trends of the Romanian market, that of participating in consortium for the launched tenders, a number between 5 and 10 bidders for each of the 3 procedures launched under RSIP can be estimated, where the consortia will submit bids for all related lots.

8.3. Proposed Procurement Schedule

Following the discussions with the beneficiary's representatives and the EIB representatives, several procurement strategies were identified, and in the end only one was agreed between all parties. All the RSIP measures will be procured through the Single Stage Open Tender Procedure, with the publication of the Procurement Notice in the OJEU, that will insure maximum visibility, publicity and transparency in relation to the procedures.

The current strategy proposes a merger of the number of contracts to be put up for auction, especially for the Channelization /Signalling and Roundabout measures identified in Phase 1 of the RSIP.

The main advantages of such a solution are the following:

- shorter time in view of preparing technical documents and obtaining approval for launching the tender
- opening the market for large consulting and construction companies that can bring added value and improvements throughout the implementation of the already identified solutions
- shortening the duration of evaluation process and signing of the services and works contracts
- an easier management from the point of view of the implementation of the measures

The main shortcoming in implementing such a strategy is the restriction of small companies to participate in the tender procedure. In addition, the duration of safety measures' preparation will take longer time because of the higher number of locations put together in a contract.

Investment costs per type of measures and procurement tenders are presented in the next table. The tentative allocation of the investment costs over the RSIP implementation period is presented in the following chart and is summarised per quarters in the next table.

Table 14 - RSIP costs per safety tender and lot

	FS+EIA+D	Land acquisition	B	Supervision	Total
Channelisation / signalling					
Total	***440.400***	***464.000***	***5.608.810***	***306.790***	***6.820.000***
	FS+EIA+D	**Land acquisition**	**B**	**Supervision**	**Total**
Roundabouts					
Lot BUC+IS+CT	696.000	1.020.000	8.422.400	461.600	10.600.000
Lot CV+TM+CJ+BV	498.000	780.000	5.993.450	328.550	7.600.000
Total	***1.194.000***	***1.800.000***	***14.415.850***	***790.150***	***18.200.000***
	FS+EIA	**Land acquisition**	**D&B**	**Supervision**	**Total**
Over/underpasses					
Lot BUC 1	600.000	0	8.930.000	470.000	10.000.000
Lot BUC 2	600.000	0	8.930.000	470.000	10.000.000
Lot BUC 3	600.000	0	8.930.000	470.000	10.000.000
Lot BUC 4	1.200.000	0	17.860.000	940.000	20.000.000
Lot BUC 5	1.200.000	4.000.000	14.060.000	740.000	20.000.000
Lot BUC 6	300.000	1.000.000	3.515.000	185.000	5.000.000
Toral	***4.500.000***	***5.000.000***	***62.225.000***	***3.275.000***	***75.000.000***
Grand total	**6.134.400**	**7.264.000**	**82.249.660**	**4.371.940**	**100.020.000**

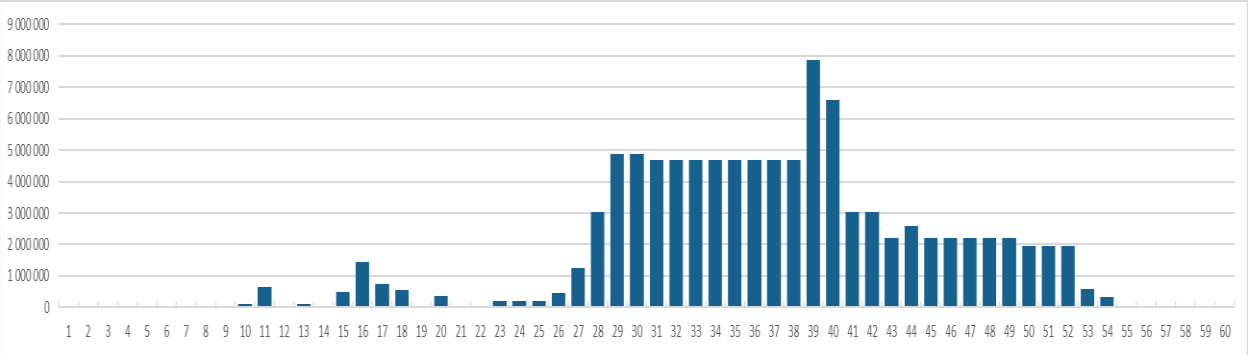


Figure 14 - RSIP costs' allocation over the implementation period

Table 15 - RSIP costs' allocation over the implementation period per quarter

	Q1	Q2	Q3	Q4	Total
Year 1	0	0	0	776,880	**776,880**
Year 2	572,800	2,725,200	352,320	381,033	**4,031,353**
Year 3	1,894,005	12,793,514	14,015,116	14,015,116	**42,717,751**
Year 4	17,215,116	12,650,162	7,006,138	6,634,938	**43,506,354**
Year 5	6,122,342	2,849,403	15,917	0	**8,987,662**
Total					**100 020 000**

Due to the rigors imposed by the procurement legislation in Romania, this procurement strategy will be divided into two parts, the common point being that the procurement procedure will be identical for both, namely Single Stage Open Tender.

Part 1 - Feasibility Studies, EIAs (where relevant) and Design

The feasibility study represents an incipient analysis in the design phase of a construction that establishes the potential of the project to efficiently meet all the desired technical requirements and to be economically profitable. In order for CNAIR to receive the best advice possible in regard to the future investments it is of up most importance to develop a procurement strategy that is currently in line with their current resources and experience, hence the current strategy is developed in three stages.

Stage 1 – Planning Stage

As described in the „Human Resource capacity within CNAIR related to the procurement flow" Chapter this stage will be covered by the Carrying out Direction within CNAIR, and for this particular contract this will be covered by DSCMT / SST Departments.

In order to comply with the principles underlying the award of public procurement contracts mentioned in Art. 2 of the Romania Public Procurement Law the best approach is to divide the Feasibility Studies and EIAs into three major tenders, as follows:

- Open tender for preparation of feasibility studies (FS), EIA (were relevant) and Design for channelization and/or signalling.
- Open tender for preparation of FS and EIA (where relevant) and Design for roundabouts that will include two lots for the identified locations.
- Open tender for preparation of FS and EIA – over/underpasses that will include 6 lots for the identified locations.

In Stage 1, the DSCMT / SST Departments will be responsible for the development of the following documents that are required under Romanian Legislation:

1. **Contracting strategy** – documents the decisions from the planning / preparation stage of the purchase in connection with:
    a. the relationship between the object, the associated constraints, and the complexity of the contract, on the one hand, and the resources available at the level of the contracting authority for carrying out the activities from the stages of the procurement process publishes, on the other hand.
    b. the chosen award procedure, as well as the special modalities for awarding the public procurement contract associated, if applicable;

c. the type of contract proposed and the manner of its implementation;
d. the payment mechanisms within the contract, the allocation of risks within it, management measures and establishing the penalties for non-fulfilment or defective fulfilment of the contractual obligations;
e. the justifications regarding the determination of the estimated value of the contract / framework agreement, as well as any other elements related to obtaining benefits for the contracting authority and / or fulfilling the objectives communicated to the level of the public administration sector in which the contracting authority operates;
f. the justifications regarding the choice of the awarding procedure in the situations provided in art. 69 para. (2) - (5) of the Law and, where appropriate, the decision to reduce the time limits in accordance with the law, the decision not to use the division into lots, the qualification regarding the capacity and, as the case may be, the selection criteria, the award criterion and the evaluation factors to be used;
g. the objective of the local / regional / national development strategy to which it contributes the respective contract / framework agreement, if applicable;

2. **Terms of References for the Assignment** – that will include the mandatory technical specifications representing requirements, prescriptions, technical characteristics that allow each product, service or work to be described, objectively, in order to meet the needs of the contracting authority.

   It is important to note that the Contracting Strategy must include selection criteria related to:

- Legal Capacity - Appropriate status to perform the services required;
- Financial Capacity – a certain minimum level of annual turnover, in the field of the object of the public procurement contract; the minimum annual turnover imposed on economic operators must not exceed twice the estimated value of the public procurement contract.
- Technical and Professional Capacity - Technical and professional capacity requirements established by the contracting authority may whether an appropriate level of experience, in relation to contracts executed in the past.

The purpose of requesting Financial Capacity and Required Similar Experience from the bidders is to give the Contracting Authority the confidence that a company has the financial capability to manage a project of such importance and has the technical expertise to deliver the required solution.

It is important to state in the Procurement Notice the fact that, if a company intends to submit a bid for more than one lot it must demonstrate cumulative experience for technical and financial capacity for all the lots they intend to bid.

The evaluation criteria selected for this Single Stage Open Tender is “The best quality-price ratio”, where the ratio taken into consideration is 60/40, 60% represented by technical part of the proposal, while 40% is represented by the price. The price calculation rule is as follows: a) For the lowest of the prices, the maximum allocated score is granted; b) For the other prices offered, the score P (n) is calculated proportionally, as follows: $P_{(n)}$ = (Minimum price offered / $Price_n$) x maximum assigned score.

When preparing the evaluation of the technical part of the proposal, the following factors can be taken into account:

- Adequate planning of technical and human resources in correlation with the specificity and complexity of the activities carried out within the contract;

- Demonstrating an appropriate service delivery methodology;
- Similar experience of the Key Experts proposed to implement the contract.

Time allocation for Stage 1 follows the standard practice and it's presented in the table below:

Table 16 - Time allocation for Stage 1

No.	Activities	Estimated timeline	Expected number of days (calendar days or working days)
1	Preparation of the Contracting Strategy and the Terms of reference	To be determined	60 working days
2	Approval of the Contracting Strategy and the Terms of reference	To be determined	15 days

Stage 2 – Publishing the Contract Notice

This second stage will be developed and implemented by the Procurement Directorate (DAP) within CNAIR and before the actual publishing the Contract Notice they must undertake the development of the following specific tender documents:

1. Specific forms related to the procurement procedure such as: performance guarantee letter; Statement regarding the inconsistency with the provisions of art. 60, paragraph (1) of Law 98/2016; Power of attorney; Consortium Agreement; Presentation of the Technical Proposal; Presentation of the Financial; etc.
2. Draft contract – based on the recommendations issued by the Government Decision no. 1/2018 of January 2018,
3. DUAE (Single European Procurement Document).

Once all the above have been determined, agreed, and approved all the documents will be uploaded into SICAP (Collaborative IT system for a high-performance environment for public procurement) and an initial request for Ex-Ante control will be sent to ANAP in order to receive the formal approval for releasing the Procurement Notice.

Upon the notice of conformity is received the Procurement Notice will be officially published on SICAP and OJEU (Official Journal of the European Union)

All the tender notices must follow the aspects detailed herewith:

- The tender notice must be published on SICAP and OJEU,
- The tender will be prepared in Romanian Language,
- The process will be in only one stage and all the proposals must comply with requirements in terms of Personal Situation of the Bidder/Consortium, Financial Capacity and Required Similar Experience,
- Tenders will be priced in and paid in RON.

Time allocation for Stage 2 follows the standard practice and it's presented in the table below:

Table 17 – Time allocation for Stage 2

No.	Activities	Estimated timeline	Expected number of days (calendar days or working days)
1	Preparation of the Tender Forms and Type of Contract	To be determined	10-20 working days

No.	Activities	Estimated timeline	Expected number of days (calendar days or working days)
2	Uploading the documents into SICAP platform and request Ex-Ante control from ANAP	To be determined	1 day
3	Receive the "Notice of Conformity" form ANAP	To be determined	Between 10 and 15 days
4	Publication of the Procurement Notice on the on SICAP and OJEU platforms	To be determined	1 day

Stage 3 - Assessment of the bids

The purpose of the tender evaluation is to identify the most economically advantageous tender (lowest compliant offer), compliant with imposed qualification criteria and CNAIR Requirements, in accordance with the Romanian National Procurement Law.

For this stage is recommended that the tender evaluation committee shall comprises of at least:

- Chairperson – responsible for managing the Evaluation committee and making award recommendation for the consideration of the Bank.
- Evaluation committee formed of 2-3 experienced members with procurement expertise and at least one member with technical expertise such Transport Engineer, etc.
- For accountancy / legal issues the Evaluation Committee could request assistance from the Economic / Legal Department within CNAIR.

An administrative assessment of the tenders received will take place immediately after tender opening. The aim is to identify and reject tenders that are incomplete, invalid or materially deviate from the requirements with pass-or-fail criteria. This will help save the time and costs during the tender evaluation process at detailed examination stage.

The administrative assessment will look for completeness of the tender and other compliance checks such as: document formality of commercial and legal status.

The evaluation of each of the responses received will follow a standard process which will be made up of the following steps:

Table 18 – Evaluation steps

Step	Evaluation stage	Notes
1	Administrative assessment	An administrative assessment that includes, presence of the tender guarantee, Tender Form dully completed, Power of attorney for the signature of the Tender Form, JV agreement (if needed), and compliance checks, ensuring that all information requested has been submitted in compliance to the tender instructions. It is proposed that a bidder will not progress to the subsequent evaluation phase if the bidder has not submitted the requested documents
2	Evaluation of the DUAE - CNAIR requirements in terms of Financial and technical Capacity	The mandatory DUAE form will be evaluated particularly regarding the Financial and Technical and Professional Capacity. The bidder will not progress to the subsequent evaluation phase if has not demonstrate that it fulfils the minimum requirements.

Step	Evaluation stage	Notes
3	Evaluation of the Technical Proposal Employer's requirements	To be evaluated in accordance with the Related Employer's Requirements, both quantitative (all objectives are covered) and qualitative (passing minimum performance requirements) Prepare the initial ranking of the bidders based on the evaluation criteria defined in the procurement notice
4	Evaluation of the Financial Proposal	Financial proposals will be evaluated, and the second ranking will be issued
5	Defining the final ranking	Based on Step 3 and Step 4 above the final ranking will be determined
6	Evaluation of the proof documents	The selected winner will need to submit proof of fulfilling all the required qualification criteria as described in the DUAE.

Time allocation for Stage 3 follows the standard practice and it's presented in the table below:

Table 19 – Time allocation for Stage 3

No.	Activities	Estimated timeline	Expected number of days (calendar days or working days)
1	Administrative and DUAE verification	To be determined	5 days
2	Technical evaluation of tenders, including compliance with Employer Requirements on all 6 lots	To be determined	90 days (including clarifications)
3	Financial ranking	To be determined	1 day (in case the price is unusually low, the financial ranking will require 10 days – for the evaluation of the justifying documents, in accordance with the law requirements)
4	Administrative verification of the winning bidder documents	To be determined	2 days
5	Finalization of the Evaluation Report and award recommendation for all 6 lots	To be determined	10 days
6	Issue of letters to successful and unsuccessful participants	To be determined	3 days
7	Clearance of any Complaints		10 days
8	Preparation of Contracts in accordance with Draft included in the Tender Dossier		10 Days (included in the period of complaints)
9	Contracts Signature		1 day
10	Award Notice on SICAP site and OJEU		As required (no longer than 30 days from the contract signature)

Part 2 – Procurement for Works Contract and Supervision of the Works Contracts

In order to ensure a proper time management and compliance with the principles underlying the award of public procurement contracts mentioned in Art. 2 of the Romania Public Procurement Law

the best approach is to launch the two procurement procedures simultaneously and divide them into 6 major tenders, each of them with several lots, as follows:

- Works Contract for:
  - Signalling & Channelization measures open tender
  - Roundabout measures open tender with 2 lots
  - Design and Works Contract for Over / Underpasses open tender with 6 lots (BUC – 5 locations and IS – 1 location)
- Supervision of the Works Contracts for:
  - Signalling & Channelization measures open tender
  - Roundabout measures open tender with 2 lots
  - Over / Underpasses open tender with 6 lots (BUC – 5 locations and IS – 1 location)

As in the case of the Feasibility Studies and EIA's the procurement plan must be divided into 3 stages:

Stage 1 – Planning Stage

As described above the Planning Stage will fall into the responsibility of the DSCMT / SST departments in charge with the development of the following documents:

1. **Contracting strategy** – that documents the decisions from the planning / preparation stage of the purchase.

For both the Detailed Design and Works Contract, as well as for the Supervision of the Works Contracts, the Contracting Strategy must include selection criteria related to:

- Legal Capacity - Appropriate status to perform the services required;
- Financial Capacity – a certain minimum level of annual turnover, in the field of the object of the public procurement contract; the minimum annual turnover imposed on economic operators must not exceed twice the estimated value of the public procurement contract.
- Technical and Professional Capacity - Technical and professional capacity requirements established by the contracting authority may whether an appropriate level of experience, in relation to contracts executed in the past.

For the Signalling & Channelization and Roundabout measures where the Design was prepared in the first phase the qualification criteria for the works contracts can be selected form the following:

- The experience of key experts - materialized in the number of similar projects in which the respective experts performed the same type of activities as those to be performed in the future contract;
- Adequate planning and management of activities and their correlation with the resources mobilized within the contract.
- Guarantee – The higher the warranty time the bidder proposes, the higher number of points he receives;

In case of the Over / Underpasses, the selection criteria that complement the qualification criteria for the Detailed Design and Works Contract must include some of the following components

- The experience of key experts - materialized in the number of similar projects in which the respective experts performed the same type of activities as those to be performed in the future contract;
- Technical component - Demonstration of an adequate methodology for implementing the contract, of an adequate planning of activities and of the adequate allocation of resources;

- Presentation of responsibilities and the interactions within the project implementation team.
- Guarantee – The higher the warranty time the bidder proposes, the higher number of points he receives;

For the Supervision Contracts the following qualification criteria can be taken into consideration during the preparation of the Strategy:

- The experience of key experts - materialized in the number of similar projects in which the respective experts performed the same type of activities as those to be performed in the future contract;
- The proposed approach for the implementation of the contract
- Allocation of Resources (human and material) and achievements corresponding to each activity,
- The number of working days allocated for each category of experts in each month during the contract execution period,

2. **Terms of Reference for the Assignment** – that will include the mandatory technical specifications representing requirements, prescriptions, technical characteristics that allow each product, service or work to be described, objectively, in order to meet the needs of the contracting authority.

Time allocation for Stage 1 follows the standard practice and it's presented in the table below:

Table 20 – Time allocation for Stage 1

No.	Activities	Estimated timeline	Expected number of days (calendar days or working days)
1	Preparation of the Contracting Strategy and the Terms of reference	To be determined	60 working days
2	Approval of the Contracting Strategy and the Terms of reference	To be determined	15 days

Stage 2 – Publishing the Contract Notice

This second stage will be developed and implemented by the DAP within CNAIR and will be mirroring the documents and steps already developed for the FSs and EIAs. Initially the following documents need to be developed:

1. Specific forms related to the procurement procedure such as: performance guarantee letter; Statement regarding the inconsistency with the provisions of art. 60, paragraph (1) of Law 98/2016; Power of attorney; Consortium Agreement; Presentation of the Technical Proposal; Presentation of the Financial; etc.
2. Draft contract – based on the recommendations issued by the Government Decision no. 1/2018 of January 2018
3. DUAE

Once all the above have been determined, agreed, and approved all the documents will be uploaded into SICAP (Collaborative IT system for a high-performance environment for public procurement) and an initial request for Ex-Ante control will be sent to ANAP in order to receive the formal approval for releasing the Procurement Notice.

Upon the notice of conformity is received the Procurement Notice will be officially published on SICAP and OJEU

Time allocation for Stage 2 follows the standard practice and it's presented in the table below:

Table 21 – Time allocation for Stage 2

No.	Activities	Estimated timeline	Expected number of days (calendar days or working days)
1	Preparation of the Tender Forms and Type of Contract	To be determined	10 working days
2	Uploading the documents into SICAP platform and request Ex-Ante control from ANAP	To be determined	1 day
3	Receive the "Notice of Conformity" form ANAP	To be determined	Between 10 and 15 days
4	Publication of the Procurement Notice on the on SICAP and OJEU platforms	To be determined	1 day

Stage 3 - Assessment of the bids

The purpose of the tender evaluation is to identify the most economically advantageous tender (lowest compliant offer), compliant with imposed qualification criteria and CNAIR Requirements, in accordance with the Romanian National Procurement Law.

For this stage is recommended that the tender evaluation committee shall comprises of at least:

- Chairperson – responsible for managing the Evaluation committee and making award recommendation for the consideration of the Bank.
- Evaluation committee formed of 3-4 experienced members with procurement expertise and at least one member with technical expertise such Transport Engineer, Construction Engineer, etc.
- For accountancy / legal issues the Evaluation Committee could request assistance from the Economic / Legal Department within CNAIR.

An administrative assessment of the tenders received will take place immediately after tender opening. The aim is to identify and reject tenders that are incomplete, invalid or materially deviate from the requirements with pass-or-fail criteria. This will help save the time and costs during the tender evaluation process at detailed examination stage.

The administrative assessment will look for completeness of the tender and other compliance checks such as: document formality of commercial and legal status.

The evaluation of each of the responses received will follow a standard process which will be made up of the following steps:

Table 22 – The evaluation steps

Step	Evaluation stage	Notes
1	Administrative assessment	An administrative assessment that includes, presence of the tender guarantee, Tender Form dully completed, Power of attorney for the signature of the Tender Form, JV agreement (if needed), and compliance checks, ensuring that all information requested has been submitted in compliance to the tender instructions.

Step	Evaluation stage	Notes
		It is proposed that a bidder will not progress to the subsequent evaluation phase if the bidder has not submitted the requested documents
2	Evaluation of the DUAE - CNAIR requirements in terms of Financial and technical Capacity	The mandatory DUAE form will be evaluated particularly regarding the Financial and Technical and Professional Capacity. The bidder will not progress to the subsequent evaluation phase if has not demonstrate that it fulfils the minimum requirements.
3	Evaluation of the Technical Proposal – Employer's requirements	To be evaluated in accordance with the Related Employer's Requirements, both quantitative (all objectives are covered) and qualitative (passing minimum performance requirements) Prepare the initial ranking of the bidders based on the evaluation criteria defined in the procurement notice
4	Evaluation of the Financial Proposal	Financial proposals will be evaluated, and the second ranking will be issued
5	Defining the final ranking	Based on Step 3 and Step 4 above the final ranking will be determined
6	Evaluation of the proof documents	The selected winner will need to submit proof of fulfilling all the required qualification criteria as described in the DUAE.

Time allocation for Stage 3 follows the standard practice and it's presented in the table below:

Table 23 – Time allocation for stage 3

No.	Activities	Estimated timeline	Expected number of days (calendar days or working days)
1	Administrative and DUAE verification	To be determined	5 days
2	Technical evaluation of tenders, including compliance with Employer Requirements on all 6 lots	To be determined	90 days (including clarifications)
3	Financial ranking	To be determined	1 day (in case the price is unusually low, the financial ranking will require 10 days – for the evaluation of the justifying documents, in accordance with the law requirements)
4	Administrative verification of the winning bidder documents	To be determined	10 days
5	Finalization of the Evaluation Report and award recommendation for all 6 lots	To be determined	1 day
6	Issue of letters to successful and unsuccessful participants	To be determined	3 days
7	Clearance of any Complaints		10 days
8	Preparation of Contracts in accordance with Draft included in the Tender Dossier		10 Days (included in the period of complaints)
9	Contracts Signature		1 day

No.	Activities	Estimated timeline	Expected number of days (calendar days or working days)
10	Award Notice on SICAP site and JOUE		As required (no longer than 30 days from the contract signature)

The duration of supervision contracts is assumed by a month longer than the duration of the respective Design and Build (D&B) contract.

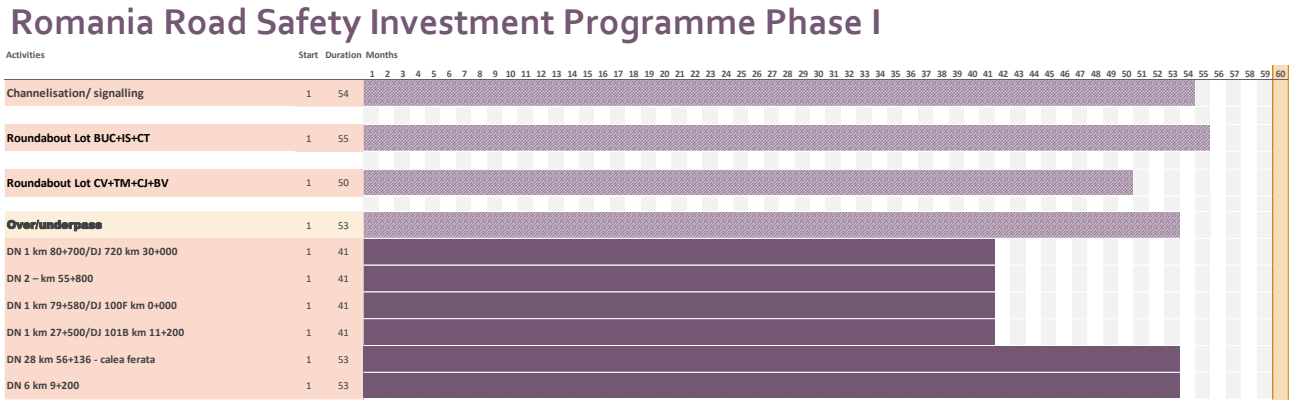
For all the above procurement procedures alternative tenders will not be accepted.

In Annex 9 a more detailed presentation of the locations, including several maps indicating the exact location of the measure can be found.

Based on details of the procurement strategy provided for both parts, CNAIR shall award the contract to the qualified Participant (or Participants) submitting the most economically advantageous tenders, substantially responsive to the requirements of the Tender Document, and because of the rigors of the law.

8.4 Overall RSIP timing

Based on the above presented time schedules per type of safety measures and location, the overall duration of the Phase I RSIP is estimated at 55 months. An indicative timeframe can be found below.



In order to estimate the timing and the allocation of the costs over the time for the Phase 1 RSIP, detailed time schedules were developed at safety measure type and region level in line with the procurement approach presented in above in this chapter 8, and they can be found in Annex 7.

Annex 1. List of 229 locations subject of CBA and MCA

No	Location	Proposed safety improvement measure	Estimated costs
1	DN 2 - km 179+096	Channelisation/ signalling	120
2	DN 2 - km 174+825	Roundabout	600
3	DN 1A km 13+255 stg	Channelisation/ signalling	120
4	DN 15D - km 8+910	Roundabout	500
5	DN 3 km 251 +020	Channelisation/ signalling	180
6	DN 15 - km 327+790	Channelisation/ signalling	120
7	DN 6 - km 332+180	Channelisation/ signalling	200
8	DN 1H - km 42+240	Channelisation/ signalling	120
9	DN 7 - km 383+825	Roundabout	700
10	DN 1 - km 462+980	Channelisation/ signalling	180
11	DN 3 - km 110+000	Roundabout	300
12	DN 65 - km 42+452	Roundabout	400
13	DN 1 - km 455+650	Channelisation/ signalling	200
14	DN 26 - km 6+740	Channelisation/ signalling	100
15	DN 1 - km 374+773	Roundabout	400
16	DN 2E - km 11+970	Roundabout	400
17	DN 1 - km 514+063	Channelisation/ signalling	180
18	DN 39E - km 1+250	Roundabout	300
19	DN 6 - km 495+000	Roundabout	400
20	DN 11 - km 21+000	Roundabout	400
21	DN 28 - km 83+170	Channelisation/ signalling	120
22	DN 22 - km 226+625	Roundabout	300
23	DN 2 - km 457+100	Channelisation/ signalling	100
24	DN 17 - km 22+550	Roundabout	300
25	DN 39 - km 36+150	Roundabout	600
26	DN 26 - km 8+000	Channelisation/ signalling	180
27	DN 59 - km 13+790	Channelisation/ signalling	200
28	DN 25 - km 68+197	Channelisation/ signalling	120
29	DN 1F - km 48+395	Roundabout	300
30	DN 66 - km 180+555	Channelisation/ signalling	200
31	DN 15 cu DN 14A, km 46+742	Roundabout	300
32	DN 6 - km 498+723	Roundabout	400
33	DN 2 - km 407+595	Roundabout	400
34	DN 66 - km 181+053	Roundabout	500
35	DN 74 - km 42+200	Roundabout	400
36	DN 39 - km 30+100	Roundabout	500
37	DN 39 - km 18+500	Channelisation/ signalling	200
38	DN 28 - km 65+400	Roundabout	500
39	DN 1 - km 394+100	Channelisation/ signalling	100
40	DN 22 - km 186+900	Roundabout	300
41	DN 2 - km 358+264	Roundabout	400
42	DN 24 - km 206+525	Roundabout	300
43	DN 2A - km 100+700	Roundabout	300

No	Location	Proposed safety improvement measure	Estimated costs
44	DN 79 - km 108+623	Channelisation/ signalling	100
45	DN 2 - km 403+500	Roundabout	400
46	DN 39 - km 26+900	Channelisation/ signalling	180
47	DN 3, km 245+313	Channelisation/ signalling	200
48	DN 1F - km 93+909	Roundabout	400
49	DN 1 - km 426+079	Roundabout	400
50	DN 3 - km 54+560	Roundabout	300
51	DN 3 - km 242+800	Roundabout	500
52	DN 74 - km 38+450	Roundabout	500
53	DN 15 - km 286+850	Channelisation/ signalling	120
54	DN 24 - km 67+660	Channelisation/ signalling	200
55	DN 24 - km 68+761	Roundabout	500
56	DN 2 - km 471+816	Channelisation/ signalling	120
57	DN 18B - km 43+193	Channelisation/ signalling	120
58	DN 26 - km 78+470	Channelisation/ signalling	120
59	DN 39 - km 41+370	Channelisation/ signalling	200
60	DN 65 - km 25+573	Channelisation/ signalling	120
61	VGH - km 5+047	not identified	#N/A
62	DN 19A - km 43+501	Roundabout	300
63	DN 29A - km 23+660	Channelisation/ signalling	100
64	DN 28 - km 26+350	Channelisation/ signalling	120
65	DN 28D - km 12+020	Roundabout	400
66	DN 23 - km 1+790	Channelisation/ signalling	100
67	DN 24 - km 69+616	Channelisation/ signalling	200
68	DN 2-km 16 +100	Roundabout	500
69	DN 2- km 117+350	Roundabout	600
70	DN 7 km 17+750	Roundabout	700
71	DN 7 km 23+350	Roundabout	600
72	DN7 km 73+185	Channelisation/ signalling	120
73	DN7 km 30+865	Roundabout	600
74	DN 73 (km 3+250)	Roundabout	700
75	DN 2 km 100+700	Roundabout	500
76	DN CDTS - km 1+810	Roundabout	300
77	DN CDTS - km 7+970	Roundabout	300
78	DN 1 - km 488+378	Roundabout	400
79	DN 1C - km 43+100	Roundabout	400
80	DN 1C - km 61+600	Channelisation/ signalling	120
81	DN VOCNE - km 0+450	Roundabout	400
82	DN 17C - km 20+002	Channelisation/ signalling	120
83	DN 76 - km 123+020	Roundabout	400
84	DN 1C - km 155+000	Roundabout	400
85	DN 18B - km 43+630	Roundabout	400
86	DN VOBM - km 5+001	Roundabout	400
87	DN 1 - km 373+201	Roundabout	300
88	DN 1 - km 388+889	Roundabout	400

No	Location	Proposed safety improvement measure	Estimated costs
89	DN 75 - km 78+196	Channelisation/ signalling	100
90	DN 19 - KM 168+635	Roundabout	400
91	DN 15 - km 80+450	Channelisation/ signalling	180
92	DN 15 - km 81+315	Channelisation/ signalling	120
93	DN 28 - km 63+290	Roundabout	400
94	DN 17A - km 0+400	Roundabout	300
95	DN 29A -km 23+652	Roundabout	400
96	DN 24 km 67+660	Roundabout	500
97	DN 3 - km 54+560	Roundabout	300
98	DN 39 - km 16+665	Channelisation/ signalling	200
99	DN 1 – km 20+750	Channelisation/ signalling	200
100	DN 2 – km 12+600	Channelisation/ signalling	200
101	DN 2 – km 55+800	Roundabout	600
102	DN 6 – km 11+220	Channelisation/ signalling	200
103	DN CB – km 12+358	Channelisation/ signalling	120
104	DN CB – km 12+444	Channelisation/ signalling	120
105	DN CB – km 25+200	not identified	#N/A
106	DN CB – km 25+400	not identified	#N/A
107	DN 21 – km 105+500	Channelisation/ signalling	100
108	DN 6 – km 13+400	Channelisation/ signalling	200
109	Intersection of Timisoara Bypass with DJ 591	not identified	#N/A
110	DN 73 km 4+100	Channelisation/ signalling	200
111	DN 7 km 26+700	Channelisation/ signalling	200
112	DN 28 km 59+300	Channelisation/ signalling	200
113	DN1A km 20+800	Channelisation/ signalling	120
114	DN 6 km 23+300	Channelisation/ signalling	200
115	DN 5 km 11+900	Channelisation/ signalling	200
116	DN 15D km 8+900	Roundabout	500
117	DN1A km 112+200	Channelisation/ signalling	200
118	DN 6 km 15+500	Channelisation/ signalling	200
119	DN 7 km 119+750	Channelisation/ signalling	120
120	DN 2 km 122+700	Channelisation/ signalling	200
121	DN1B km 42+905	Channelisation/ signalling	200
122	DN 2 km 27+600	Channelisation/ signalling	200
123	DN 2 km 49+500	Channelisation/ signalling	200
124	DN 13 km 146+200	Channelisation/ signalling	120
125	DN 15 km 85+750	Channelisation/ signalling	120
126	DN7 km 184+500	Roundabout	500
127	DN 13 km 9+600	Roundabout	300
128	DN 2 km 278+100	Channelisation/ signalling	200
129	DN 2 km 242+700	Roundabout	700
130	DN 6 km 263+500	Roundabout	700
131	DN 25 km 68+000	Channelisation/ signalling	200
132	DN 1 km 28+700	Channelisation/ signalling	200
133	DN 15 km 327+000	Roundabout	500

No	Location	Proposed safety improvement measure	Estimated costs
134	DN65 km 47+450	Roundabout	500
135	DN1 km 106+885	Channelisation/ signalling	120
136	DN59 km 10+100	Roundabout	600
137	DN 2 km 169+900	Roundabout	700
138	DN 28 km 60+500	Roundabout	700
139	DN 24 km 128+250	Roundabout	300
140	DN 65 km 14+100	Roundabout	300
141	DN 2 km 259+500	Channelisation/ signalling	200
142	DN 3 km 110+000	Roundabout	300
143	DN 73 km 5+280	Roundabout	700
144	DN 29 km 28+100	Channelisation/ signalling	100
145	DN 1 km 491+900	Channelisation/ signalling	120
146	DN 2 km 29+700	Roundabout	500
147	DN 2 km 334+300	Channelisation/ signalling	200
148	DN1A km 100+400	Roundabout	300
149	DN1B km 25+295	Roundabout	700
150	DN1H km 42+320	Channelisation/ signalling	120
151	DN1 km 303+920	Roundabout	700
152	Dn2 km 166+500	Roundabout	600
153	DN 66 km 197+900	Roundabout	500
154	DN1 km 80+710	Roundabout	600
155	DN 29 km 33+800	Roundabout	500
156	DN 11 km 16+900	Channelisation/ signalling	120
157	DN 2 km 99+700	Channelisation/ signalling	200
158	DN 3 km 33+100	Channelisation/ signalling	200
159	DN 6 km 238+200	Roundabout	600
160	DN 7 km 536+800	Roundabout	500
161	DN 2 km 300+700	Channelisation/ signalling	200
162	DN 71 km 39+250	Roundabout	300
163	DN 56 km 5+500	Channelisation/ signalling	200
164	DN 24 km 33+500	Roundabout	500
165	DN 25 km 11+300	Channelisation/ signalling	200
166	DN 6 km 30+600	Channelisation/ signalling	200
167	DN 67 km 90+850	Roundabout	400
168	DN 15 km 327+033	Roundabout	500
169	DN65 km 30+480	Roundabout	400
170	DN1 km 41+450	Channelisation/ signalling	200
171	DN6 km 79+100	Channelisation/ signalling	200
172	DN 24 km 115+900	Channelisation/ signalling	120
173	DN 13A km 70+400	Roundabout	500
174	DN 28 km 48+800	Channelisation/ signalling	200
175	DN 1 km 27+500	Roundabout	700
176	DN 1C km 159+100	Channelisation/ signalling	200
177	DN1 km 68+500	Roundabout	600
178	DN2 km 158+675	Roundabout	700

No	Location	Proposed safety improvement measure	Estimated costs
179	DN 65 km 110+300	Channelisation/ signalling	200
180	DN 2F km 9+280	Roundabout	500
181	DN 12 km 13+200	Roundabout	500
182	DN 71 km 54+700	Roundabout	500
183	DN 71 km 53+700	Channelisation/ signalling	200
184	DN 1 km 186+400	Roundabout	600
185	DN 73 km 121+300	Channelisation/ signalling	200
186	DN 11 km 61+700	Channelisation/ signalling	200
187	DN 55 km 51+700	Channelisation/ signalling	200
188	DN 5 km 55+300	Roundabout	600
189	DN 12 km 138+400	Channelisation/ signalling	200
190	DN 2 km 40+100	Channelisation/ signalling	200
191	DN 15 km 35+300	Channelisation/ signalling	100
192	DN 6km 532+900	Channelisation/ signalling	200
193	Dn7 km 207+450	Roundabout	300
194	DN24 km 74+500	Roundabout	300
195	DN 13A km 75+200	Channelisation/ signalling	100
196	DN 1C km 170+500	Channelisation/ signalling	200
197	DN 2 km 275+900	Roundabout	400
198	DN 28B km 57+700	Channelisation/ signalling	200
199	DN 2B km 64+500	Channelisation/ signalling	200
200	DN 2 km 74+900	Channelisation/ signalling	200
201	DN 2 km 74+800	Channelisation/ signalling	200
202	DN 6 km 9+200	Over/underpass	20 000
203	DN 1 km 27+500/DJ 101B km 11+200	Over/underpass	20 000
204	DN 1 km 59+700/DN 1A km 64+400	Roundabout	700
205	DN 1 km 61+800/DJ 129 km 4+800	Roundabout	700
206	DN 1 km 66+500/DN 1B bretea	Over/underpass	20 000
207	DN 1 km 68+450/DJ 155 km 0+000	Roundabout	600
208	DN 1 km 73+750/DJ 215 km 0+000	Over/underpass	10 000
209	DN 1 km 79+580/DJ 100F km 0+000	Over/underpass	10 000
210	DN 1 km 80+700/DJ 720 km 30+000	Over/underpass	10 000
211	DN 1A km 84+320/DN 1B km 10+185	Roundabout	700
212	DN 1A km 111+300/strazi	Roundabout	500
213	DN 7 - km 190+900 intrare Călimănești	Roundabout	500
214	DN 7 - km 194+520 ieșire Călimănești	Roundabout	300
215	DN 65 cu DN 65F	Over/underpass	20 000
216	DN 65, km 7+700 cu DJ 652A	Roundabout	700
217	DN 7, km 170+800 cu DN 67	Over/underpass	10 000
218	DN 7, km 207+500 cu DN 7A	Roundabout	500
219	Intersectie DN 1C 147+360 km cu VOBM km 1+450	Channelisation/ signalling	200
220	Intersectie DN1C km 20+550 cu DJ 109D	Channelisation/ signalling	200
221	Trecere la nivel cu calea ferata DN 11, km 35+050	Channelisation/ signalling	100
222	DN 28 km 49+212 - calea ferata	Over/underpass	10 000
223	DN 28 km 56+136 - calea ferata	Over/underpass	5 000

No	Location	Proposed safety improvement measure	Estimated costs
224	DN 28 km 63+930	Over/underpass	10 000
225	DN 2 km 174+825	Over/underpass	5 000
226	DN 2 km 251+ 431	Channelisation/ signalling	100
227	DN 2 km 100+675/DN 2B km 0+000	Roundabout	500
228	DN 72 km 41+900/DJ 720B km 3+400	Roundabout	500
229	DN 1 km 125+900/Bd. Bucurestilor	Over/underpass	10 000
			229 020

Annex 2. CBA results for the 229 considered locations

ID	Location	Proposed safety improvement measure	EIRR, %
1	DN 2 - km 179+096	Channelisation/ signalling	495%
2	DN 2 - km 174+825	Roundabout	147%
3	DN 1A km 13+255 stg	Channelisation/ signalling	507%
4	DN 15D - km 8+910	Roundabout	157%
5	DN 3 km 251 +020	Channelisation/ signalling	778%
6	DN 15 - km 327+790	Channelisation/ signalling	614%
7	DN 6 - km 332+180	Channelisation/ signalling	241%
8	DN 1H - km 42+240	Channelisation/ signalling	863%
9	DN 7 - km 383+825	Roundabout	74%
10	DN 1 - km 462+980	Channelisation/ signalling	293%
11	DN 3 - km 110+000	Roundabout	264%
12	DN 65 - km 42+452	Roundabout	161%
13	DN 1 - km 455+650	Channelisation/ signalling	416%
14	DN 26 - km 6+740	Channelisation/ signalling	717%
15	DN 1 - km 374+773	Roundabout	80%
16	DN 2E - km 11+970	Roundabout	111%
17	DN 1 - km 514+063	Channelisation/ signalling	378%
18	DN 39E - km 1+250	Roundabout	103%
19	DN 6 - km 495+000	Roundabout	81%
20	DN 11 - km 21+000	Roundabout	77%
21	DN 28 - km 83+170	Channelisation/ signalling	294%
22	DN 22 - km 226+625	Roundabout	101%
23	DN 2 - km 457+100	Channelisation/ signalling	445%
24	DN 17 - km 22+550	Roundabout	110%
25	DN 39 - km 36+150	Roundabout	88%
26	DN 26 - km 8+000	Channelisation/ signalling	234%
27	DN 59 - km 13+790	Channelisation/ signalling	42%
28	DN 25 - km 68+197	Channelisation/ signalling	115%
29	DN 1F - km 48+395	Roundabout	106%
30	DN 66 - km 180+555	Channelisation/ signalling	99%
31	DN 15 cu DN 14A, km 46+742	Roundabout	27%
32	DN 6 - km 498+723	Roundabout	66%
33	DN 2 - km 407+595	Roundabout	24%
34	DN 66 - km 181+053	Roundabout	37%
35	DN 74 - km 42+200	Roundabout	72%
36	DN 39 - km 30+100	Roundabout	53%
37	DN 39 - km 18+500	Channelisation/ signalling	171%
38	DN 28 - km 65+400	Roundabout	8%
39	DN 1 - km 394+100	Channelisation/ signalling	9%
40	DN 22 - km 186+900	Roundabout	18%
41	DN 2 - km 358+264	Roundabout	31%
42	DN 24 - km 206+525	Roundabout	49%
43	DN 2A - km 100+700	Roundabout	66%

ID	Location	Proposed safety improvement measure	EIRR, %
44	DN 79 - km 108+623	Channelisation/ signalling	128%
45	DN 2 - km 403+500	Roundabout	17%
46	DN 39 - km 26+900	Channelisation/ signalling	32%
47	DN 3, km 245+313	Channelisation/ signalling	-2%
48	DN 1F - km 93+909	Roundabout	-2%
49	DN 1 - km 426+079	Roundabout	-17%
50	DN 3 - km 54+560	Roundabout	7%
51	DN 3 - km 242+800	Roundabout	n.a.
52	DN 74 - km 38+450	Roundabout	44%
53	DN 15 - km 286+850	Channelisation/ signalling	84%
54	DN 24 - km 67+660	Channelisation/ signalling	4%
55	DN 24 - km 68+761	Roundabout	-8%
56	DN 2 - km 471+816	Channelisation/ signalling	21%
57	DN 18B - km 43+193	Channelisation/ signalling	9%
58	DN 26 - km 78+470	Channelisation/ signalling	48%
59	DN 39 - km 41+370	Channelisation/ signalling	-3%
60	DN 65 - km 25+573	Channelisation/ signalling	n.a.
61	VGH - km 5+047	not identified	n.a.
62	DN 19A - km 43+501	Roundabout	n.a.
63	DN 29A - km 23+660	Channelisation/ signalling	n.a.
64	DN 28 - km 26+350	Channelisation/ signalling	n.a.
65	DN 28D - km 12+020	Roundabout	n.a.
66	DN 23 - km 1+790	Channelisation/ signalling	n.a.
67	DN 24 - km 69+616	Channelisation/ signalling	n.a.
68	DN 2-km 16 +100	Roundabout	92%
69	DN 2- km 117+350	Roundabout	34%
70	DN 7 km 17+750	Roundabout	6%
71	DN 7 km 23+350	Roundabout	68%
72	DN7 km 73+185	Channelisation/ signalling	11%
73	DN7 km 30+865	Roundabout	127%
74	DN 73 (km 3+250)	Roundabout	148%
75	DN 2 km 100+700	Roundabout	13%
76	DN CDTS - km 1+810	Roundabout	n.a.
77	DN CDTS - km 7+970	Roundabout	n.a.
78	DN 1 - km 488+378	Roundabout	167%
79	DN 1C - km 43+100	Roundabout	-14%
80	DN 1C - km 61+600	Channelisation/ signalling	-1%
81	DN VOCNE - km 0+450	Roundabout	n.a.
82	DN 17C - km 20+002	Channelisation/ signalling	n.a.
83	DN 76 - km 123+020	Roundabout	n.a.
84	DN 1C - km 155+000	Roundabout	17%
85	DN 18B - km 43+630	Roundabout	-3%
86	DN VOBM - km 5+001	Roundabout	n.a.
87	DN 1 - km 373+201	Roundabout	33%
88	DN 1 - km 388+889	Roundabout	168%

ID	Location	Proposed safety improvement measure	EIRR, %
89	DN 75 - km 78+196	Channelisation/ signalling	38%
90	DN 19 - KM 168+635	Roundabout	n.a.
91	DN 15 - km 80+450	Channelisation/ signalling	70%
92	DN 15 - km 81+315	Channelisation/ signalling	340%
93	DN 28 - km 63+290	Roundabout	105%
94	DN 17A - km 0+400	Roundabout	n.a.
95	DN 29A -km 23+652	Roundabout	8%
96	DN 24 km 67+660	Roundabout	n.a.
97	DN 3 - km 54+560	Roundabout	52%
98	DN 39 - km 16+665	Channelisation/ signalling	n.a.
99	DN 1 – km 20+750	Channelisation/ signalling	354%
100	DN 2 – km 12+600	Channelisation/ signalling	284%
101	DN 2 – km 55+800	Roundabout	91%
102	DN 6 – km 11+220	Channelisation/ signalling	281%
103	DN CB – km 12+358	Channelisation/ signalling	150%
104	DN CB – km 12+444	Channelisation/ signalling	150%
105	DN CB – km 25+200	not identified	n.a.
106	DN CB – km 25+400	not identified	n.a.
107	DN 21 – km 105+500	Channelisation/ signalling	324%
108	DN 6 – km 13+400	Channelisation/ signalling	825%
109	Intersection of Timisoara Bypass with DJ 591	not identified	n.a.
110	DN 73 km 4+100	Channelisation/ signalling	192%
111	DN 7 km 26+700	Channelisation/ signalling	662%
112	DN 28 km 59+300	Channelisation/ signalling	701%
113	DN1A km 20+800	Channelisation/ signalling	587%
114	DN 6 km 23+300	Channelisation/ signalling	277%
115	DN 5 km 11+900	Channelisation/ signalling	549%
116	DN 15D km 8+900	Roundabout	256%
117	DN1A km 112+200	Channelisation/ signalling	98%
118	DN 6 km 15+500	Channelisation/ signalling	526%
119	DN 7 km 119+750	Channelisation/ signalling	502%
120	DN 2 km 122+700	Channelisation/ signalling	205%
121	DN1B km 42+905	Channelisation/ signalling	357%
122	DN 2 km 27+600	Channelisation/ signalling	1013%
123	DN 2 km 49+500	Channelisation/ signalling	506%
124	DN 13 km 146+200	Channelisation/ signalling	708%
125	DN 15 km 85+750	Channelisation/ signalling	352%
126	DN7 km 184+500	Roundabout	158%
127	DN 13 km 9+600	Roundabout	211%
128	DN 2 km 278+100	Channelisation/ signalling	585%
129	DN 2 km 242+700	Roundabout	91%
130	DN 6 km 263+500	Roundabout	72%
131	DN 25 km 68+000	Channelisation/ signalling	267%
132	DN 1 km 28+700	Channelisation/ signalling	198%

ID	Location	Proposed safety improvement measure	EIRR, %
133	DN 15 km 327+000	Roundabout	129%
134	DN65 km 47+450	Roundabout	141%
135	DN1 km 106+885	Channelisation/ signalling	438%
136	DN59 km 10+100	Roundabout	121%
137	DN 2 km 169+900	Roundabout	96%
138	DN 28 km 60+500	Roundabout	95%
139	DN 24 km 128+250	Roundabout	139%
140	DN 65 km 14+100	Roundabout	311%
141	DN 2 km 259+500	Channelisation/ signalling	398%
142	DN 3 km 110+000	Roundabout	253%
143	DN 73 km 5+280	Roundabout	48%
144	DN 29 km 28+100	Channelisation/ signalling	821%
145	DN 1 km 491+900	Channelisation/ signalling	329%
146	DN 2 km 29+700	Roundabout	127%
147	DN 2 km 334+300	Channelisation/ signalling	249%
148	DN1A km 100+400	Roundabout	88%
149	DN1B km 25+295	Roundabout	105%
150	DN1H km 42+320	Channelisation/ signalling	445%
151	DN1 km 303+920	Roundabout	59%
152	Dn2 km 166+500	Roundabout	136%
153	DN 66 km 197+900	Roundabout	135%
154	DN1 km 80+710	Roundabout	104%
155	DN 29 km 33+800	Roundabout	97%
156	DN 11 km 16+900	Channelisation/ signalling	549%
157	DN 2 km 99+700	Channelisation/ signalling	218%
158	DN 3 km 33+100	Channelisation/ signalling	406%
159	DN 6 km 238+200	Roundabout	222%
160	DN 7 km 536+800	Roundabout	23%
161	DN 2 km 300+700	Channelisation/ signalling	414%
162	DN 71 km 39+250	Roundabout	80%
163	DN 56 km 5+500	Channelisation/ signalling	140%
164	DN 24 km 33+500	Roundabout	243%
165	DN 25 km 11+300	Channelisation/ signalling	698%
166	DN 6 km 30+600	Channelisation/ signalling	163%
167	DN 67 km 90+850	Roundabout	36%
168	DN 15 km 327+033	Roundabout	50%
169	DN65 km 30+480	Roundabout	94%
170	DN1 km 41+450	Channelisation/ signalling	164%
171	DN6 km 79+100	Channelisation/ signalling	68%
172	DN 24 km 115+900	Channelisation/ signalling	683%
173	DN 13A km 70+400	Roundabout	184%
174	DN 28 km 48+800	Channelisation/ signalling	197%
175	DN 1 km 27+500	Roundabout	47%
176	DN 1C km 159+100	Channelisation/ signalling	415%
177	DN1 km 68+500	Roundabout	23%

ID	Location	Proposed safety improvement measure	EIRR, %
178	DN2 km 158+675	Roundabout	171%
179	DN 65 km 110+300	Channelisation/ signalling	256%
180	DN 2F km 9+280	Roundabout	116%
181	DN 12 km 13+200	Roundabout	132%
182	DN 71 km 54+700	Roundabout	36%
183	DN 71 km 53+700	Channelisation/ signalling	84%
184	DN 1 km 186+400	Roundabout	225%
185	DN 73 km 121+300	Channelisation/ signalling	91%
186	DN 11 km 61+700	Channelisation/ signalling	232%
187	DN 55 km 51+700	Channelisation/ signalling	430%
188	DN 5 km 55+300	Roundabout	66%
189	DN 12 km 138+400	Channelisation/ signalling	505%
190	DN 2 km 40+100	Channelisation/ signalling	73%
191	DN 15 km 35+300	Channelisation/ signalling	255%
192	DN 6km 532+900	Channelisation/ signalling	361%
193	Dn7 km 207+450	Roundabout	242%
194	DN24 km 74+500	Roundabout	156%
195	DN 13A km 75+200	Channelisation/ signalling	733%
196	DN 1C km 170+500	Channelisation/ signalling	314%
197	DN 2 km 275+900	Roundabout	135%
198	DN 28B km 57+700	Channelisation/ signalling	485%
199	DN 2B km 64+500	Channelisation/ signalling	227%
200	DN 2 km 74+900	Channelisation/ signalling	350%
201	DN 2 km 74+800	Channelisation/ signalling	347%
202	DN 6 km 9+200	Over/underpass	9%
203	DN 1 km 27+500/DJ 101B km 11+200	Over/underpass	8%
204	DN 1 km 59+700/DN 1A km 64+400	Roundabout	65%
205	DN 1 km 61+800/DJ 129 km 4+800	Roundabout	64%
206	DN 1 km 66+500/DN 1B bretea	Over/underpass	7%
207	DN 1 km 68+450/DJ 155 km 0+000	Roundabout	88%
208	DN 1 km 73+750/DJ 215 km 0+000	Over/underpass	16%
209	DN 1 km 79+580/DJ 100F km 0+000	Over/underpass	13%
210	DN 1 km 80+700/DJ 720 km 30+000	Over/underpass	24%
211	DN 1A km 84+320/DN 1B km 10+185	Roundabout	78%
212	DN 1A km 111+300/strazi	Roundabout	65%
213	DN 7 - km 190+900 intrare Călimănești	Roundabout	226%
214	DN 7 - km 194+520 ieșire Călimănești	Roundabout	253%
215	DN 65 cu DN 65F	Over/underpass	-2%
216	DN 65, km 7+700 cu DJ 652A	Roundabout	77%
217	DN 7, km 170+800 cu DN 67	Over/underpass	12%
218	DN 7, km 207+500 cu DN 7A	Roundabout	71%
219	Intersectie DN 1C 147+360 km cu VOBM km 1+450	Channelisation/ signalling	101%
220	Intersectie DN1C km 20+550 cu DJ 109D	Channelisation/ signalling	351%

ID	Location	Proposed safety improvement measure	EIRR, %
221	Trecere la nivel cu calea ferata DN 11, km 35+050	Channelisation/ signalling	696%
222	DN 28 km 49+212 - calea ferata	Over/underpass	-6%
223	DN 28 km 56+136 - calea ferata	Over/underpass	40%
224	DN 28 km 63+930	Over/underpass	-1%
225	DN 2 km 174+825	Over/underpass	39%
226	DN 2 km 251+ 431	Channelisation/ signalling	297%
227	DN 2 km 100+675/DN 2B km 0+000	Roundabout	44%
228	DN 72 km 41+900/DJ 720B km 3+400	Roundabout	153%
229	DN 1 km 125+900/Bd. Bucurestilor	Over/underpass	6%

Annex 3. MCA results of all analysed locations

Priority ran-king	List name	ID	Location	Measure type	Investment costs, '000 EUR	MCA score
1	Black spots	27	DN59 km 10+100	Roundabout	600	80.50%
2	Black spots	50	DN 6 km 238+200	Roundabout	600	79.30%
3	New Roundabouts	2	DN 2 - km 174+825	Roundabout	600	78.90%
4	New Roundabouts	17	DN 1 - km 514+063	Channelisation/ Traffic signalling	180	78.90%
5	Black spots	45	DN1 km 80+710	Roundabout	600	78.10%
6	New Roundabouts	11	DN 3 - km 110+000	Roundabout	300	78.00%
7	Overpasses	3	DN 2 – km 55+800	Roundabout	600	77.50%
8	Black spots	31	DN 65 km 14+100	Roundabout	300	77.30%
9	Black spots	82	DN 15 km 35+300	Channelisation/ Traffic signalling	100	77.30%
10	Black spots	33	DN 3 km 110+000	Roundabout	300	76.80%
11	New Roundabouts	22	DN 22 - km 226+625	Roundabout	300	76.50%
12	New Roundabouts	1	DN 2 - km 179+096	Channelisation/ Traffic signalling	120	76.40%
13	Sup. list overpasses	19	Intersectie DN1C km 20+550 cu DJ 109D	Channelisation/ Traffic signalling	200	76.00%
14	Black spots	10	DN 7 km 119+750	Channelisation/ Traffic signalling	120	75.20%
15	Black spots	3	DN 28 km 59+300	Channelisation/ Traffic signalling	200	75.00%
16	New Roundabouts	10	DN 1 - km 462+980	Channelisation/ Traffic signalling	180	74.50%
17	New Roundabouts	23	DN 2 - km 457+100	Channelisation/ Traffic signalling	100	74.10%
18	Black spots	18	DN 13 km 9+600	Roundabout	300	74.00%
19	Overpasses	2	DN 2 – km 12+600	Channelisation/ Traffic signalling	200	74.00%
20	Black spots	38	DN 2 km 334+300	Roundabout	200	73.80%
21	Black spots	86	DN 13A km 75+200	Channelisation/ Traffic signalling	100	73.20%
22	Temporary solutions	21	DN 1 - km 388+889	Roundabout	400	73.10%
23	New Roundabouts	43	DN 2A - km 100+700	Roundabout	300	73.10%
24	New Roundabouts	21	DN 28 - km 83+170	Channelisation/ Traffic signalling	120	72.70%
25	Sup. list overpasses	9	DN 1 km 80+700/DJ 720 km 30+000	Over/underpass	10 000	72.50%

Priority ran-king	List name	ID	Location	Measure type	Investment costs, '000 EUR	MCA score
26	Black spots	84	Dn7 km 207+450	Roundabout	300	72.50%
27	New Roundabouts	4	DN 15D - km 8+910	Roundabout	500	72.50%
28	Overpasses	10	DN 6 – km 13+400	Channelisation/ Traffic signalling	200	72.40%
29	Black spots	26	DN1 km 106+885	Channelisation/ Traffic signalling	120	72.30%
30	Black spots	79	DN 5 km 55+300	Roundabout	600	72.30%
31	New Roundabouts	29	DN 1F - km 48+395	Roundabout	300	72.10%
32	Black spots	35	DN 29 km 28+100	Channelisation/ Traffic signalling	100	72.10%
33	Black spots	13	DN 2 km 27+600	Channelisation/ Traffic signalling	200	72.00%
34	Black spots	14	DN 2 km 49+500	Channelisation/ Traffic signalling	200	72.00%
35	New Roundabouts	12	DN 65 - km 42+452	Roundabout	400	71.60%
36	New Roundabouts	26	DN 26 - km 8+000	Channelisation/ Traffic signalling	180	71.60%
37	New Roundabouts	30	DN 66 - km 180+555	Channelisation/ Traffic signalling	200	71.40%
38	New Roundabouts	7	DN 6 - km 332+180	Channelisation/ Traffic signalling	200	71.20%
39	Sup. list overpasses	12	DN 7 - km 190+900 intrare Călimănești	Roundabout	500	71.20%
40	Black spots	91	DN 2 km 74+900	Channelisation/ Traffic signalling	200	71.10%
41	Black spots	92	DN 2 km 74+800	Channelisation/ Traffic signalling	200	71.10%
42	Sup. list overpasses	17	DN 7, km 207+500 cu DN 7A	Roundabout	500	71.00%
43	Black spots	55	DN 24 km 33+500	Roundabout	500	71.00%
44	Black spots	7	DN 15D km 8+900	Roundabout	500	70.90%
45	Black spots	75	DN 1 km 186+400	Roundabout	600	70.50%
46	Black spots	69	DN2 km 158+675	Roundabout	700	69.80%
47	Black spots	25	DN65 km 47+450	Roundabout	500	69.70%
48	Black spots	15	DN 13 km 146+200	Channelisation/ Traffic signalling	120	69.60%
49	Overpasses	1	DN 1 – km 20+750	Channelisation/ Traffic signalling	200	69.20%
50	Overpasses	4	DN 6 – km 11+220	Channelisation/ Traffic signalling	200	69.20%
51	Black spots	9	DN 6 km 15+500	Channelisation/ Traffic signalling	200	69.20%
52	Black spots	11	DN 2 km 122+700	Channelisation/ Traffic signalling	200	69.00%
53	New Roundabouts	53	DN 15 - km 286+850	Channelisation/ Traffic signalling	120	68.90%

Priority ran-king	List name	ID	Location	Measure type	Investment costs, '000 EUR	MCA score
54	Sup. list overpasses	24	DN 2 km 174+825	Over/underpass	5 000	68.90%
55	Black spots	85	DN24 km 74+500	Roundabout	300	68.90%
56	New Roundabouts	18	DN 39E - km 1+250	Roundabout	300	68.80%
57	Black spots	43	Dn2 km 166+500	Roundabout	600	68.70%
58	Black spots	32	DN 2 km 259+500	Channelisation/ Traffic signalling	200	68.40%
59	Black spots	19	DN 2 km 278+100	Channelisation/ Traffic signalling	200	68.20%
60	New Roundabouts	19	DN 6 - km 495+000	Roundabout	400	68.10%
61	New Roundabouts	5	DN 3 km 251 +020	Channelisation/ Traffic signalling	180	68.00%
62	New Roundabouts	34	DN 66 - km 181+053	Roundabout	500	67.60%
63	Sup. list overpasses	8	DN 1 km 79+580/DJ 100F km 0+000	Over/underpass	10 000	67.50%
64	Black spots	88	DN 2 km 275+900	Roundabout	400	67.50%
65	Sup. list roundabouts	3	DN 72 km 41+900/DJ 720B km 3+400	Roundabout	500	67.40%
66	Temporary solutions	7	DN 73 (km 3+250)	Roundabout	700	67.40%
67	Black spots	60	DN65 km 30+480	Roundabout	400	67.30%
68	Temporary solutions	26	DN 28 - km 63+290	Roundabout	400	67.20%
69	Sup. list overpasses	13	DN 7 - km 194+520 ieșire Călimănești	Roundabout	300	67.10%
70	Black spots	37	DN 2 km 29+700	Roundabout	500	67.00%
71	Black spots	65	DN 28 km 48+800	Channelisation/ Traffic signalling	200	67.00%
72	Black spots	70	DN 65 km 110+300	Channelisation/ Traffic signalling	200	67.00%
73	Black spots	29	DN 28 km 60+500	Roundabout	700	66.80%
74	New Roundabouts	14	DN 26 - km 6+740	Channelisation/ Traffic signalling	100	66.80%
75	New Roundabouts	3	DN 1A km 13+255 stg	Channelisation/ Traffic signalling	120	66.70%
76	New Roundabouts	6	DN 15 - km 327+790	Channelisation/ Traffic signalling	120	66.70%
77	Black spots	4	DN1A km 20+800	Channelisation/ Traffic signalling	120	66.30%
78	Black spots	41	DN1H km 42+320	Channelisation/ Traffic signalling	120	66.30%
79	Black spots	44	DN 66 km 197+900	Roundabout	500	66.20%
80	Black spots	72	DN 12 km 13+200	Roundabout	500	66.20%
81	Black spots	89	DN 28B km 57+700	Channelisation/ Traffic signalling	200	66.20%

Priority ran-king	List name	ID	Location	Measure type	Investment costs, '000 EUR	MCA score
82	Sup. list overpasses	6	DN 1 km 68+450/DJ 155 km 0+000	Roundabout	600	66.10%
83	Black spots	48	DN 2 km 99+700	Channelisation/ Traffic signalling	200	65.80%
84	New Roundabouts	24	DN 17 - km 22+550	Roundabout	300	65.70%
85	Temporary solutions	2	DN 2- km 117+350	Roundabout	600	65.70%
86	Black spots	64	DN 13A km 70+400	Roundabout	500	65.70%
87	New Roundabouts	9	DN 7 - km 383+825	Roundabout	700	65.60%
88	Overpasses	9	DN 21 – km 105+500	Channelisation/ Traffic signalling	100	65.60%
89	Temporary solutions	25	DN 15 - km 81+315	Channelisation/ Traffic signalling	120	65.50%
90	Black spots	16	DN 15 km 85+750	Channelisation/ Traffic signalling	120	65.50%
91	Sup. list overpasses	20	Trecere la nivel cu calea ferata DN 11, km 35+050	Channelisation/ Traffic signalling	100	65.50%
92	Sup. list overpasses	5	DN 1 km 66+500/DN 1B bretea	Over/underpass	20 000	65.40%
93	Black spots	6	DN 5 km 11+900	Channelisation/ Traffic signalling	200	65.40%
94	New Roundabouts	42	DN 24 - km 206+525	Roundabout	300	65.30%
95	New Roundabouts	28	DN 25 - km 68+197	Channelisation/ Traffic signalling	120	65.20%
96	Black spots	36	DN 1 km 491+900	Channelisation/ Traffic signalling	120	65.20%
97	Sup. list overpasses	2	DN 1 km 27+500/DJ 101B km 11+200	Over/underpass	20 000	65.00%
98	Sup. list overpasses	10	DN 1A km 84+320/DN 1B km 10+185	Roundabout	700	65.00%
99	Black spots	83	DN 6km 532+900	Channelisation/ Traffic signalling	200	65.00%
100	Black spots	87	DN 1C km 170+500	Channelisation/ Traffic signalling	200	65.00%
101	Black spots	63	DN 24 km 115+900	Channelisation/ Traffic signalling	120	64.70%
102	Temporary solutions	11	DN 1 - km 488+378	Roundabout	400	64.70%
103	Sup. list overpasses	22	DN 28 km 56+136 - calea ferata	Over/underpass	5 000	64.50%
104	New Roundabouts	8	DN 1H - km 42+240	Channelisation/ Traffic signalling	120	64.30%
105	Temporary solutions	1	DN 2-km 16 +100	Roundabout	500	64.20%
106	Sup. list overpasses	4	DN 1 km 61+800/DJ 129 km 4+800	Roundabout	700	64.20%
107	Black spots	1	DN 73 km 4+100	Channelisation/ Traffic signalling	200	64.20%
108	Black spots	39	DN1A km 100+400	Roundabout	300	64.20%

Priority ran-king	List name	ID	Location	Measure type	Investment costs, '000 EUR	MCA score
109	Black spots	53	DN 71 km 39+250	Roundabout	300	64.20%
110	New Roundabouts	13	DN 1 - km 455+650	Channelisation/ Traffic signalling	200	64.00%
111	Sup. list overpasses	11	DN 1A km 111+300/strazi	Roundabout	500	63.70%
112	Black spots	2	DN 7 km 26+700	Channelisation/ Traffic signalling	200	63.70%
113	Black spots	30	DN 24 km 128+250	Roundabout	300	63.60%
114	Sup. list overpasses	3	DN 1 km 59+700/DN 1A km 64+400	Roundabout	700	63.40%
115	Black spots	67	DN 1C km 159+100	Channelisation/ Traffic signalling	200	63.30%
116	Black spots	68	DN1 km 68+500	Roundabout	600	63.10%
117	New Roundabouts	16	DN 2E - km 11+970	Roundabout	400	63.10%
118	Temporary solutions	24	DN 15 - km 80+450	Channelisation/ Traffic signalling	180	63.00%
119	Black spots	56	DN 25 km 11+300	Channelisation/ Traffic signalling	200	62.90%
120	Black spots	5	DN 6 km 23+300	Channelisation/ Traffic signalling	200	62.50%
121	New Roundabouts	25	DN 39 - km 36+150	Roundabout	600	62.30%
122	Black spots	22	DN 25 km 68+000	Channelisation/ Traffic signalling	200	62.20%
123	Black spots	40	DN1B km 25+295	Roundabout	700	62.20%
124	Black spots	52	DN 2 km 300+700	Channelisation/ Traffic signalling	200	62.20%
125	Black spots	54	DN 56 km 5+500	Channelisation/ Traffic signalling	200	62.20%
126	Sup. list overpasses	18	Intersectie DN 1C 147+360 km cu VOBM km 1+450	Channelisation/ Traffic signalling	200	62.00%
127	Black spots	47	DN 11 km 16+900	Channelisation/ Traffic signalling	120	61.90%
128	Black spots	24	DN 15 km 327+000	Roundabout	500	61.70%
129	New Roundabouts	33	DN 2 - km 407+595	Roundabout	400	61.60%
130	Black spots	12	DN1B km 42+905	Channelisation/ Traffic signalling	200	61.40%
131	Black spots	77	DN 11 km 61+700	Channelisation/ Traffic signalling	200	61.40%
132	New Roundabouts	15	DN 1 - km 374+773	Roundabout	400	61.30%
133	New Roundabouts	44	DN 79 - km 108+623	Channelisation/ Traffic signalling	100	61.30%
134	Temporary solutions	20	DN 1 - km 373+201	Roundabout	300	61.30%
135	Black spots	20	DN 2 km 242+700	Roundabout	700	61.20%

Priority ran-king	List name	ID	Location	Measure type	Investment costs, '000 EUR	MCA score
136	Black spots	46	DN 29 km 33+800	Roundabout	500	61.20%
137	Overpasses	5	DN CB – km 12+358	Channelisation/ Traffic signalling	120	61.10%
138	Overpasses	6	DN CB – km 12+444	Channelisation/ Traffic signalling	120	61.10%
139	Black spots	23	DN 1 km 28+700	Channelisation/ Traffic signalling	200	61.00%
140	Black spots	61	DN1 km 41+450	Channelisation/ Traffic signalling	200	61.00%
141	New Roundabouts	35	DN 74 - km 42+200	Roundabout	400	60.90%
142	New Roundabouts	37	DN 39 - km 18+500	Channelisation/ Traffic signalling	200	60.80%
143	New Roundabouts	36	DN 39 - km 30+100	Roundabout	500	60.60%
144	New Roundabouts	20	DN 11 - km 21+000	Roundabout	400	60.50%
145	Black spots	17	DN7 km 184+500	Roundabout	500	60.20%
146	Black spots	57	DN 6 km 30+600	Channelisation/ Traffic signalling	200	60.20%
147	Black spots	42	DN1 km 303+920	Roundabout	700	60.00%
148	Black spots	49	DN 3 km 33+100	Channelisation/ Traffic signalling	200	59.70%
149	Black spots	90	DN 2B km 64+500	Channelisation/ Traffic signalling	200	59.70%
150	Black spots	80	DN 12 km 138+400	Channelisation/ Traffic signalling	200	59.40%
151	New Roundabouts	31	DN 15 cu DN 14A, km 46+742	Roundabout	300	59.30%
152	Black spots	78	DN 55 km 51+700	Channelisation/ Traffic signalling	200	59.30%
153	Sup. list overpasses	25	DN 2 km 251+ 431	Channelisation/ Traffic signalling	100	59.10%
154	Black spots	58	DN 67 km 90+850	Roundabout	400	59.00%
155	Black spots	81	DN 2 km 40+100	Channelisation/ Traffic signalling	200	58.80%
156	New Roundabouts	32	DN 6 - km 498+723	Roundabout	400	58.60%
157	Temporary solutions	30	DN 3 - km 54+560	Roundabout	300	58.60%
158	Temporary solutions	5	DN7 km 73+185	Channelisation/ Traffic signalling	120	58.50%
159	Black spots	21	DN 6 km 263+500	Roundabout	700	58.40%
160	Sup. list overpasses	15	DN 65, km 7+700 cu DJ 652A	Roundabout	700	58.20%
161	Black spots	71	DN 2F km 9+280	Roundabout	500	58.10%
162	Temporary solutions	4	DN 7 km 23+350	Roundabout	600	58.00%
163	Temporary solutions	6	DN7 km 30+865	Roundabout	600	57.60%

Priority ran-king	List name	ID	Location	Measure type	Investment costs, '000 EUR	MCA score
164	Sup. list overpasses	1	DN 6 km 9+200	Over/underpass	20 000	57.40%
165	Sup. list roundabouts	4	DN 1 km 125+900/Bd. Bucurestilor	Over/underpass	10 000	57.30%
166	Black spots	76	DN 73 km 121+300	Channelisation/ Traffic signalling	200	57.20%
167	Sup. list overpasses	16	DN 7, km 170+800 cu DN 67	Over/underpass	10 000	57.20%
168	Black spots	28	DN 2 km 169+900	Roundabout	700	56.40%
169	Black spots	62	DN6 km 79+100	Channelisation/ Traffic signalling	200	56.40%
170	Black spots	66	DN 1 km 27+500	Roundabout	700	55.80%
171	New Roundabouts	40	DN 22 - km 186+900	Roundabout	300	55.50%
172	New Roundabouts	27	DN 59 - km 13+790	Channelisation/ Traffic signalling	200	55.20%
173	Sup. list roundabouts	1	DN 2 km 100+675/DN 2B km 0+000	Roundabout	500	55.20%
174	Temporary solutions	22	DN 75 - km 78+196	Channelisation/ Traffic signalling	100	55.20%
175	Black spots	8	DN1A km 112+200	Channelisation/ Traffic signalling	200	55.10%
176	New Roundabouts	45	DN 2 - km 403+500	Roundabout	400	54.60%
177	New Roundabouts	56	DN 2 - km 471+816	Channelisation/ Traffic signalling	120	54.40%
178	New Roundabouts	46	DN 39 - km 26+900	Channelisation/ Traffic signalling	180	53.30%
179	New Roundabouts	41	DN 2 - km 358+264	Roundabout	400	53.20%
180	Sup. list overpasses	7	DN 1 km 73+750/DJ 215 km 0+000	Over/underpass	10 000	53.10%
181	New Roundabouts	52	DN 74 - km 38+450	Roundabout	500	52.50%
182	New Roundabouts	38	DN 28 - km 65+400	Roundabout	500	52.40%
183	New Roundabouts	58	DN 26 - km 78+470	Channelisation/ Traffic signalling	120	51.10%
184	Black spots	34	DN 73 km 5+280	Roundabout	700	51.00%
185	Black spots	51	DN 7 km 536+800	Roundabout	500	51.00%
186	Black spots	74	DN 71 km 53+700	Channelisation/ Traffic signalling	200	49.90%
187	Black spots	73	DN 71 km 54+700	Roundabout	500	49.70%
188	Black spots	59	DN 15 km 327+033	Roundabout	500	48.50%
189	Temporary solutions	8	DN 2 km 100+700	Roundabout	500	47.00%
190	Temporary solutions	17	DN 1C - km 155+000	Roundabout	400	45.80%
191	New Roundabouts	39	DN 1 - km 394+100	Channelisation/ Traffic signalling	100	45.30%

Priority ran-king	List name	ID	Location	Measure type	Investment costs, '000 EUR	MCA score
192	New Roundabouts	50	DN 3 - km 54+560	Roundabout	300	42.00%
193	Temporary solutions	28	DN 29A -km 23+652	Roundabout	400	41.80%
194	Temporary solutions	3	DN 7 km 17+750	Roundabout	700	37.30%
195	New Roundabouts	57	DN 18B - km 43+193	Channelisation/ Traffic signalling	120	31.50%
				Total costs	**181 040**	

Annex 4. CBA and MCA calculations

(Excel file ”Annex4_CBA-MCA-calculations.xlsx”) attached

Annex 5. Final results of CBA and MCA calculations

(Excel file ”Annex5_Final-results_CBA-MCA-calculations.xlsx”) attached

Annex 6. Technical/Engineering analysis

(Excel file ”Annex 6_Technical-Engineering-analysis.xlsx”) attached

Annex 7. Implementation time schedule as per approved procurement strategy

(Excel file ”Annex7_Implementation time schedule_2.xlsx”) attached

Annex 8. Scope of RSIP Phase 1

No	ID	DRDP	Location	Measure type	Land acquisition costs, EUR	FS & EIA, EUR	Works costs, EUR	Supervision, EUR	Total costs, EUR
1	3	BUC	DN 1A km 13+255 stg	Channelisation/ signalling	0	3.600	110.580	5.820	120.000
2	69		DN 2- km 117+350	Roundabout	0	18.000	552.900	29.100	600.000
3	74		DN 73 (km 3+250)	Roundabout	140.000	0	532.000	28.000	700.000
4	99		DN 1 – km 20+750	Channelisation/ signalling	0	6.000	184.300	9.700	200.000
5	100		DN 2 – km 12+600	Channelisation/ signalling	0	6.000	184.300	9.700	200.000
6	101		DN 2 – km 55+800	Over/underpass	0	600.000	8.930.000	470.000	10.000.000
7	102		DN 6 – km 11+220	Channelisation/ signalling	0	6.000	184.300	9.700	200.000
8	108		DN 6 – km 13+400	Channelisation/ signalling	0	6.000	184.300	9.700	200.000
9	113		DN1A km 20+800	Channelisation/ signalling	0	3.600	110.580	5.820	120.000
10	118		DN 6 km 15+500	Channelisation/ signalling	0	6.000	184.300	9.700	200.000
11	119		DN 7 km 119+750	Channelisation/ signalling	0	3.600	110.580	5.820	120.000
12	120		DN 2 km 122+700	Channelisation/ signalling	40.000	6.000	146.300	7.700	200.000
13	122		DN 2 km 27+600	Channelisation/ signalling	0	6.000	184.300	9.700	200.000
14	123		DN 2 km 49+500	Channelisation/ signalling	0	6.000	184.300	9.700	200.000
15	135		DN1 km 106+885	Channelisation/ signalling	0	3.600	110.580	5.820	120.000
16	146		DN 2 km 29+700	Roundabout	100.000	15.000	365.750	19.250	500.000
17	148		DN1A km 100+400	Roundabout	0	9.000	276.450	14.550	300.000
18	157		DN 2 km 99+700	Channelisation/ signalling	40.000	6.000	146.300	7.700	200.000
19	179		DN 65 km 110+300	Channelisation/ signalling	40.000	6.000	146.300	7.700	200.000
20	188		DN 5 km 55+300	Roundabout	0	18.000	552.900	29.100	600.000
21	200		DN 2 km 74+900	Channelisation/ signalling	40.000	12.000	140.600	7.400	200.000
22	201		DN 2 km 74+800	Channelisation/ signalling	40.000	12.000	140.600	7.400	200.000
23	202		DN 6 km 9+200	Over/underpass	4.000.000	1.200.000	14.060.000	740.000	20.000.000
24	203		DN 1 km 27+500/DJ 101B km 11+200	Over/underpass	0	1.200.000	17.860.000	940.000	20.000.000
25	207		DN 1 km 68+450/DJ 155 km 0+000	Roundabout	0	18.000	552.900	29.100	600.000
26	209		DN 1 km 79+580/DJ 100F km 0+000	Over/underpass	0	600.000	8.930.000	470.000	10.000.000

No	ID	DRDP	Location	Measure type	Land acquisition costs, EUR	FS & EIA, EUR	Works costs, EUR	Supervision, EUR	Total costs, EUR
27	210		DN 1 km 80+700/DJ 720 km 30+000	Over/underpass	0	600.000	8.930.000	470.000	10.000.000
27	212		DN 1A km 111+300/strazi	Roundabout	100.000	30.000	351.500	18.500	500.000
29	228		DN 72 km 41+900/DJ 720B km 3+400	Roundabout	100.000	15.000	365.750	19.250	500.000
30	88	BV	DN 1 - km 388+889	Roundabout	80.000	24.000	281.200	14.800	400.000
31	92		DN 15 - km 81+315	Channelisation/ signalling	0	3.600	110.580	5.820	120.000
32	124		DN 13 km 146+200	Channelisation/ signalling	0	3.600	110.580	5.820	120.000
33	125		DN 15 km 85+750	Channelisation/ signalling	0	3.600	110.580	5.820	120.000
34	127		DN 13 km 9+600	Roundabout	0	9.000	276.450	14.550	300.000
35	173		DN 13A km 70+400	Roundabout	100.000	0	380.000	20.000	500.000
36	184		DN 1 km 186+400	Roundabout	0	18.000	552.900	29.100	600.000
37	191		DN 15 km 35+300	Channelisation/ signalling	0	3.000	92.150	4.850	100.000
38	195		DN 13A km 75+200	Channelisation/ signalling	0	3.000	92.150	4.850	100.000
39	221		Trecere la nivel cu calea ferata DN 11, km 35+050	Channelisation/ signalling	0	3.000	92.150	4.850	100.000
40	10	CJ	DN 1 - km 462+980	Channelisation/ signalling	0	5.400	165.870	8.730	180.000
41	17		DN 1 - km 514+063	Channelisation/ signalling	0	5.400	165.870	8.730	180.000
42	24		DN 17 - km 22+550	Roundabout	0	9.000	276.450	14.550	300.000
43	29		DN 1F - km 48+395	Roundabout	0	9.000	276.450	14.550	300.000
44	78		DN 1 - km 488+378	Roundabout	80.000	24.000	281.200	14.800	400.000
45	145		DN 1 km 491+900	Channelisation/ signalling	0	3.600	110.580	5.820	120.000
46	150		DN1H km 42+320	Channelisation/ signalling	0	3.600	110.580	5.820	120.000
47	196		DN 1C km 170+500	Channelisation/ signalling	40.000	6.000	146.300	7.700	200.000
48	220		Intersectie DN1C km 20+550 cu DJ 109D	Channelisation/ signalling	40.000	6.000	146.300	7.700	200.000
49	12	CR	DN 65 - km 42+452	Roundabout	0	12.000	368.600	19.400	400.000
50	134		DN65 km 47+450	Roundabout	100.000	15.000	365.750	19.250	500.000
51	140		DN 65 km 14+100	Roundabout	0	9.000	276.450	14.550	300.000
52	159		DN 6 km 238+200	Roundabout	0	18.000	552.900	29.100	600.000
53	169		DN65 km 30+480	Roundabout	80.000	24.000	281.200	14.800	400.000

No	ID	DRDP	Location	Measure type	Land acquisition costs, EUR	FS & EIA, EUR	Works costs, EUR	Supervision, EUR	Total costs, EUR
54	213		DN 7 - km 190+900 intrare Călimănești	Roundabout	100.000	15.000	365.750	19.250	500.000
55	218		DN 7, km 207+500 cu DN 7A	Roundabout	100.000	15.000	365.750	19.250	500.000
56	5	CT	DN 3 km 251 +020	Channelisation/ signalling	0	5.400	165.870	8.730	180.000
57	11		DN 3 - km 110+000	Roundabout	0	9.000	276.450	14.550	300.000
58	18		DN 39E - km 1+250	Roundabout	0	9.000	276.450	14.550	300.000
59	22		DN 22 - km 226+625	Roundabout	0	9.000	276.450	14.550	300.000
60	25		DN 39 - km 36+150	Roundabout	0	18.000	552.900	29.100	600.000
61	43		DN 2A - km 100+700	Roundabout	0	9.000	276.450	14.550	300.000
62	1	IS	DN 2 - km 179+096	Channelisation/ signalling	0	3.600	110.580	5.820	120.000
63	2		DN 2 - km 174+825	Roundabout	0	18.000	552.900	29.100	600.000
64	4		DN 15D - km 8+910	Roundabout	100.000	15.000	365.750	19.250	500.000
65	6		DN 15 - km 327+790	Channelisation/ signalling	0	3.600	110.580	5.820	120.000
66	21		DN 28 - km 83+170	Channelisation/ signalling	0	3.600	110.580	5.820	120.000
67	23		DN 2 - km 457+100	Channelisation/ signalling	0	3.000	92.150	4.850	100.000
68	26		DN 26 - km 8+000	Channelisation/ signalling	0	5.400	165.870	8.730	180.000
69	28		DN 25 - km 68+197	Channelisation/ signalling	0	3.600	110.580	5.820	120.000
70	42		DN 24 - km 206+525	Roundabout	0	9.000	276.450	14.550	300.000
71	53		DN 15 - km 286+850	Channelisation/ signalling	0	3.600	110.580	5.820	120.000
72	93		DN 28 - km 63+290	Roundabout	0	12.000	368.600	19.400	400.000
73	112		DN 28 km 59+300	Channelisation/ signalling	40.000	6.000	146.300	7.700	200.000
74	128		DN 2 km 278+100	Channelisation/ signalling	40.000	6.000	146.300	7.700	200.000
75	141		DN 2 km 259+500	Channelisation/ signalling	0	6.000	184.300	9.700	200.000
76	144		DN 29 km 28+100	Channelisation/ signalling	0	3.000	92.150	4.850	100.000
77	147		DN 2 km 334+300	Roundabout	40.000	12.000	140.600	7.400	200.000
78	152		Dn2 km 166+500	Roundabout	120.000	36.000	421.800	22.200	600.000
79	164		DN 24 km 33+500	Roundabout	100.000	15.000	365.750	19.250	500.000
80	172		DN 24 km 115+900	Channelisation/ signalling	24.000	7.200	84.360	4.440	120.000
81	174		DN 28 km 48+800	Channelisation/ signalling	40.000	6.000	146.300	7.700	200.000

No	ID	DRDP	Location	Measure type	Land acquisition costs, EUR	FS & EIA, EUR	Works costs, EUR	Supervision, EUR	Total costs, EUR
82	178		DN2 km 158+675	Roundabout	140.000	21.000	512.050	26.950	700.000
83	194		DN24 km 74+500	Roundabout	0	9.000	276.450	14.550	300.000
84	197		DN 2 km 275+900	Roundabout	80.000	24.000	281.200	14.800	400.000
85	223		DN 28 km 56+136 - calea ferata	Over/underpass	1.000.000	300.000	3.515.000	185.000	5.000.000
86	9	TM	DN 7 - km 383+825	Roundabout	140.000	21.000	512.050	26.950	700.000
87	19		DN 6 - km 495+000	Roundabout	0	12.000	368.600	19.400	400.000
88	34		DN 66 - km 181+053	Roundabout	0	15.000	460.750	24.250	500.000
89	192		DN 6km 532+900	Channelisation/ signalling	40.000	6.000	146.300	7.700	200.000
TOTAL					**7.264.000**	**5.317.200**	**83.066.860**	**4.371.940**	**100.020.000**

Annex 9. Procurement of RSIP Measures Selected Option

A9.1. Procurement of channelisation/ signalling measures

In line with the selected procurement approach, three separate tenders shall be prepared and launched, as presented schematically in the following chart and their geographical location is visualised in the next map.

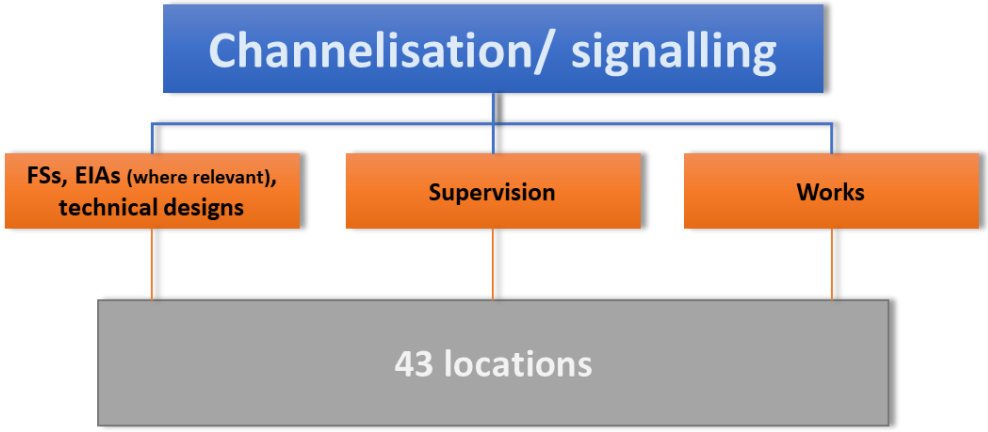


Figure 15 - Procurement strategy for channelisation/ signalling measures

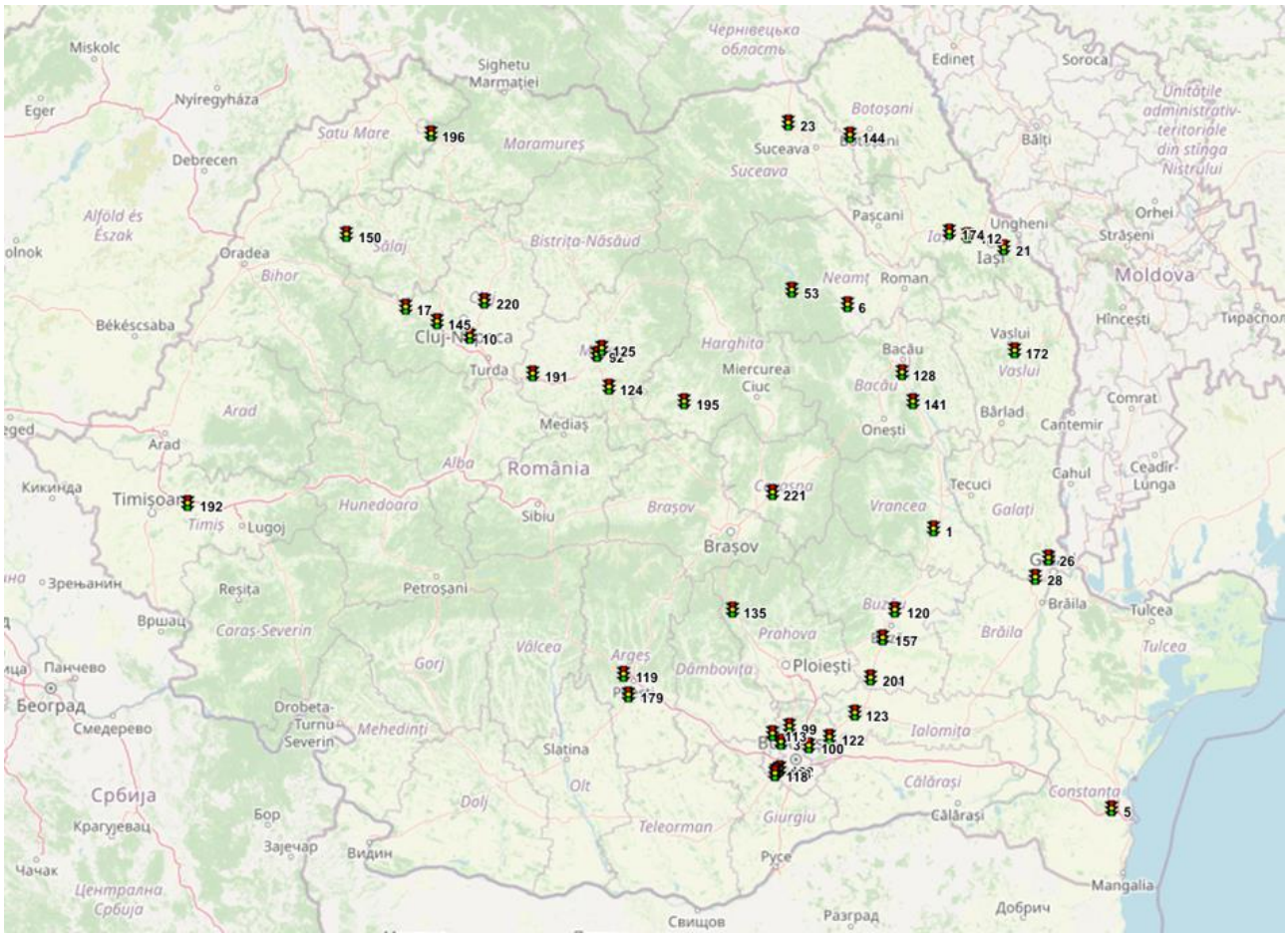


Figure 16 - Geographical location of channelisation/ signalling measures

Table 24 - List of locations for signalling/ channelisation measures

№	ID	DRDP	Location
1	3	BUC	DN 1A km 13+255 stg
2	99	BUC	DN 1 – km 20+750
3	100	BUC	DN 2 – km 12+600
4	102	BUC	DN 6 – km 11+220
5	108	BUC	DN 6 – km 13+400
6	113	BUC	DN1A km 20+800
7	118	BUC	DN 6 km 15+500
8	119	BUC	DN 7 km 119+750
9	120	BUC	DN 2 km 122+700
10	122	BUC	DN 2 km 27+600
11	123	BUC	DN 2 km 49+500
12	135	BUC	DN1 km 106+885
13	157	BUC	DN 2 km 99+700
14	179	BUC	DN 65 km 110+300
15	200	BUC	DN 2 km 74+900
16	201	BUC	DN 2 km 74+800
17	92	BV	DN 15 - km 81+315
18	124	BV	DN 13 km 146+200
19	125	BV	DN 15 km 85+750
20	191	BV	DN 15 km 35+300
21	195	BV	DN 13A km 75+200
22	221	BV	Railway crossing on DN 11, km 35+050
23	10	CJ	DN 1 - km 462+980
24	17	CJ	DN 1 - km 514+063
25	145	CJ	DN 1 km 491+900
26	150	CJ	DN1H km 42+320
27	196	CJ	DN 1C km 170+500
28	220	CJ	DN1C km 20+550 cu DJ 109D
29	5	CT	DN 3 km 251 +020
30	1	IS	DN 2 - km 179+096
31	6	IS	DN 15 - km 327+790
32	21	IS	DN 28 - km 83+170
33	23	IS	DN 2 - km 457+100
34	26	IS	DN 26 - km 8+000
35	28	IS	DN 25 - km 68+197
36	53	IS	DN 15 - km 286+850
37	112	IS	DN 28 km 59+300
38	128	IS	DN 2 km 278+100
39	141	IS	DN 2 km 259+500
40	144	IS	DN 29 km 28+100
41	172	IS	DN 24 km 115+900
42	174	IS	DN 28 km 48+800
43	192	TM	DN 6km 532+900

Total duration for implementation of all the 43 measures for improving channelisation and/or signalling is estimated at 54 months, as presented in the following Gantt chart.

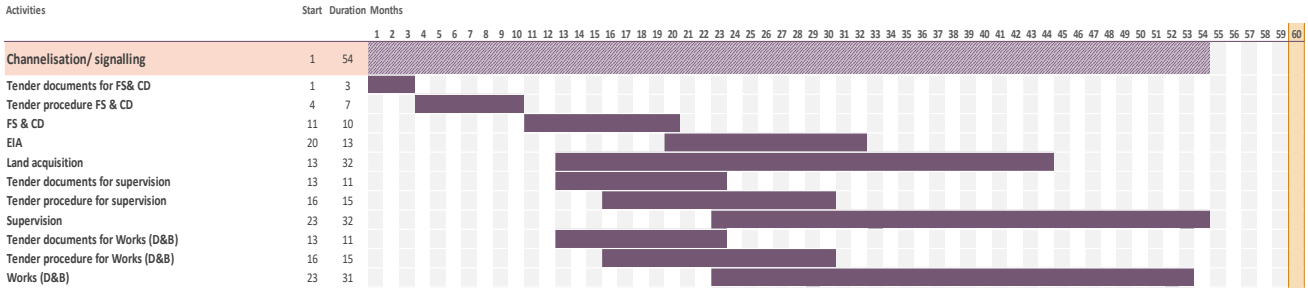


Figure 17 - Gantt chart for implementing channelisation/ signalling measures

A9.2. Procurement of roundabouts

In line with the selected procurement approach, where the contracts are divided into lots, three separate tenders with two lots each shall be prepared and launched, as presented schematically in the following chart.

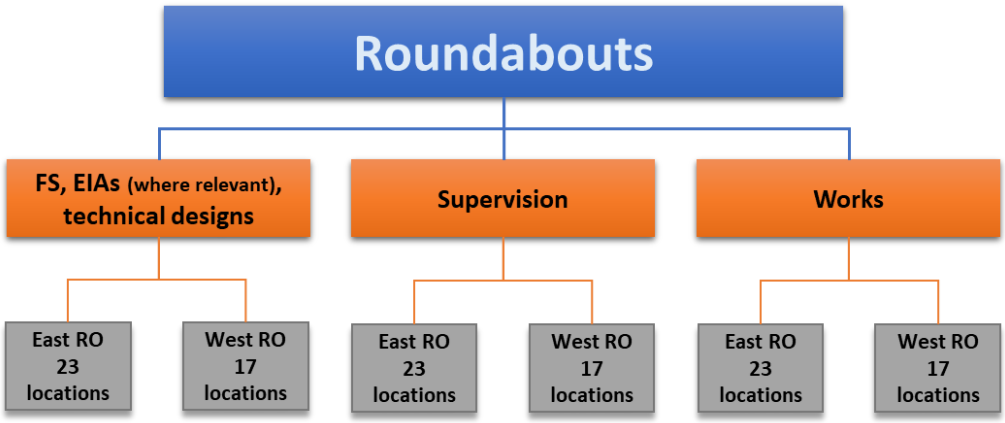


Figure 18 - Procurement strategy for implementing roundabouts

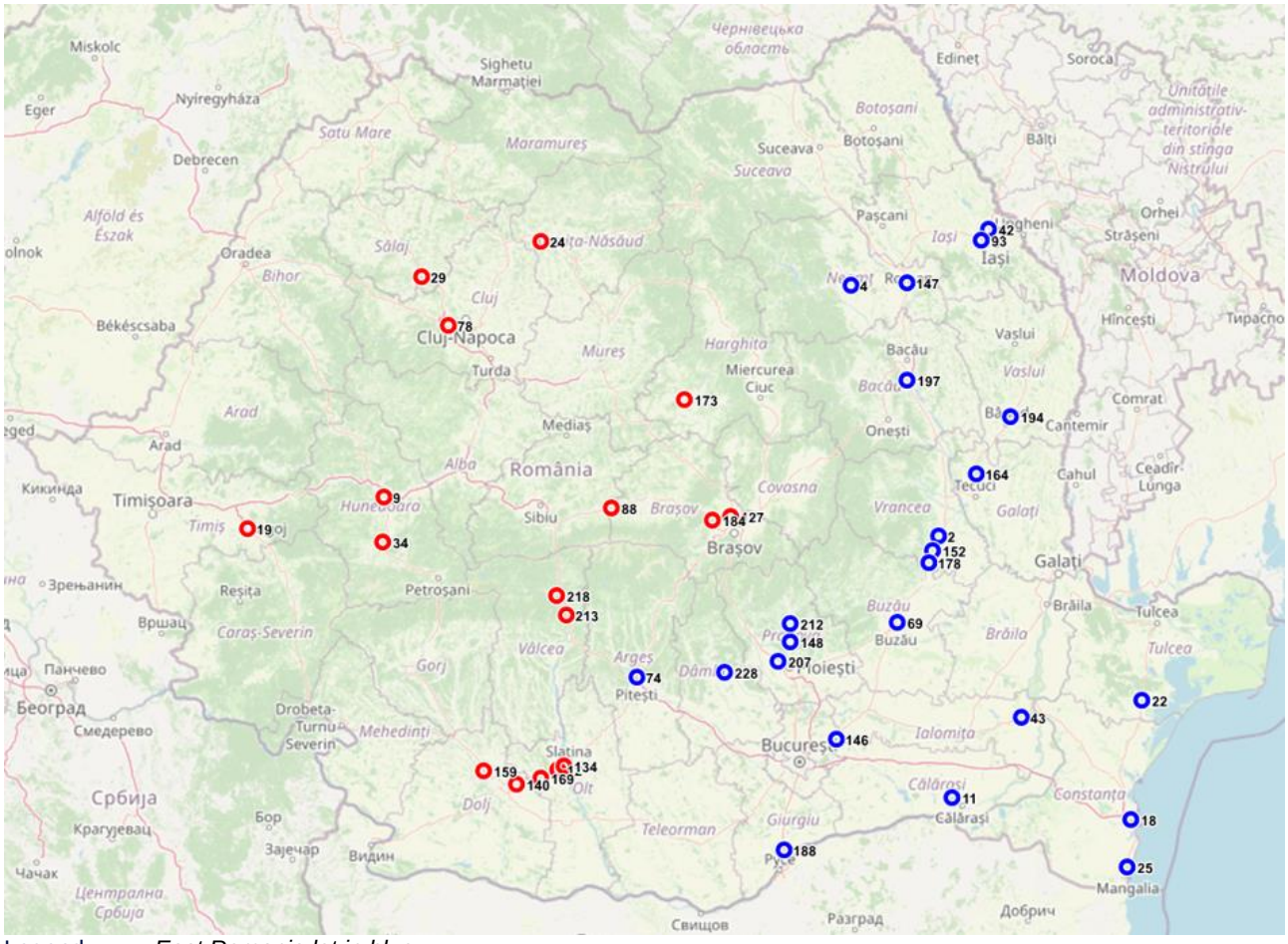
A9.2.1. East Romania lot

The East Romania lot covers the 23 locations on the territories of CNAIR regional directorates Bucharest, Iaşi and Constanţa, visualised in the following map in blue. The list of the locations is summarised in the next table.

Table 25 - List of roundabouts to be implemented within East Romania lot

№	ID	DRDP	Location
1	69	BUC	DN 2- km 117+350
2	74	BUC	DN 73 (km 3+250)
3	146	BUC	DN 2 km 29+700
4	148	BUC	DN1A km 100+400
5	188	BUC	DN 5 km 55+300
6	207	BUC	DN 1 km 68+450/DJ 155 km 0+000
7	212	BUC	DN 1A km 111+300/strazi
8	228	BUC	DN 72 km 41+900/DJ 720B km 3+400

№	ID	DRDP	Location
9	11	CT	DN 3 - km 110+000
10	18	CT	DN 39E - km 1+250
11	22	CT	DN 22 - km 226+625
12	25	CT	DN 39 - km 36+150
13	43	CT	DN 2A - km 100+700
14	2	IS	DN 2 - km 174+825
15	4	IS	DN 15D - km 8+910
16	42	IS	DN 24 - km 206+525
17	93	IS	DN 28 - km 63+290
18	147	IS	DN 2 km 334+300
19	152	IS	Dn2 km 166+500
20	164	IS	DN 24 km 33+500
21	178	IS	DN2 km 158+675
22	194	IS	DN24 km 74+500
23	197	IS	DN 2 km 275+900



Legend: *East Romania lot in blue*
West Romania lot in red

Figure 19 - Geographical locations of roundabouts

Total duration for implementation of all the 23 roundabouts in East Romania lot is estimated at 55 months, as presented in the following Gantt chart.

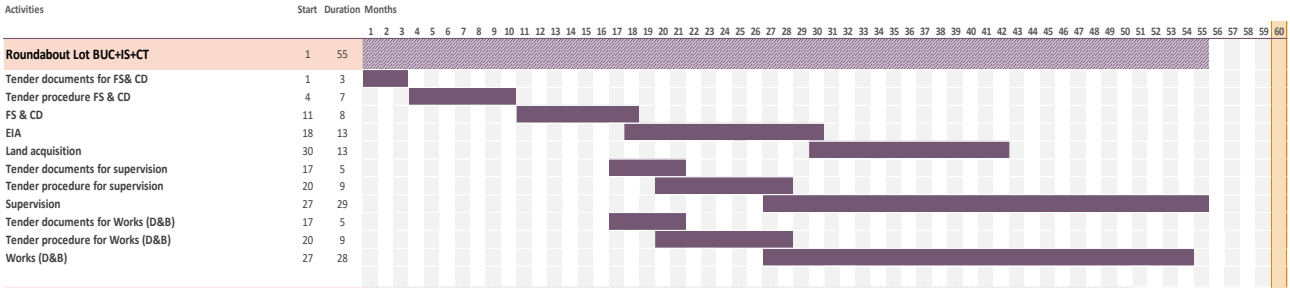


Figure 20 - Gantt chart for implementing roundabouts within East Romania lot

A9.2.2. West Romania lot

The West Romania lot covers the 17 locations on the territories of CNAIR regional directorates Brasov, Craiova, Cluj and Timisoara, visualised in the following map in blue. The list of the roundabouts is summarised in the next table and these are visualised in red in the above map.

Table 26 - List of roundabouts to be implemented within West Romania lot

№	ID	DRDP	Location
1	88	BV	DN 1 - km 388+889
2	127	BV	DN 13 km 9+600
3	173	BV	DN 13A km 70+400
4	184	BV	DN 1 km 186+400
5	24	CJ	DN 17 - km 22+550
6	29	CJ	DN 1F - km 48+395
7	78	CJ	DN 1 - km 488+378
8	12	CR	DN 65 - km 42+452
9	134	CR	DN65 km 47+450
10	140	CR	DN 65 km 14+100
11	159	CR	DN 6 km 238+200
12	169	CR	DN65 km 30+480
13	213	CR	DN 7 - km 190+900
14	218	CR	DN 7, km 207+500 cu DN 7A
15	9	TM	DN 7 - km 383+825
16	19	TM	DN 6 - km 495+000
17	34	TM	DN 66 - km 181+053

Total duration for implementation of all the 23 roundabouts in East Romania lot is estimated at 50 months, as presented in the following Gantt chart.

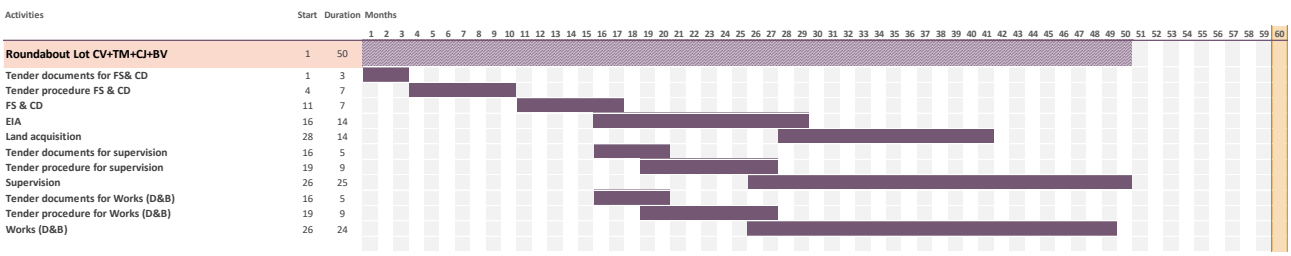


Figure 21 - Gantt chart for implementing roundabouts within West Romania lot

A9.3. Procurement of over/underpasses

The selected procurement approach suggests the tenders for the six over/underpasses to be launched and carry out as separate lots. In line with this, three separate tenders with six lots each shall be prepared and launched, as presented schematically in the following chart.

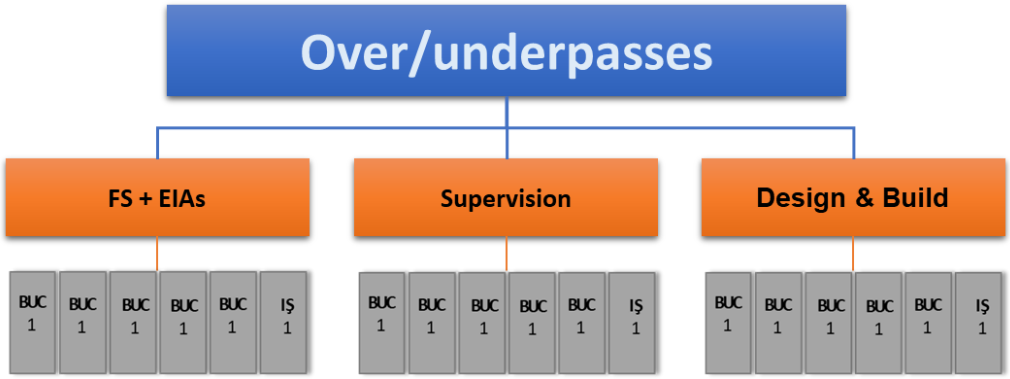


Figure 22 - Procurement strategy for implementing over/underpasses

The list of over/underpasses' locations is presented in the following table and their geographical location is visualised in the next two maps for Bucharest and Iasi regional directorates respectively.

Table 27 - List of over/underpasses

№	No	DRDP	Location
1	101	BUC	DN 2 – km 55+800
2	202	BUC	DN 6 km 9+200
3	203	BUC	DN 1 km 27+500/DJ 101B km 11+200
4	209	BUC	DN 1 km 79+580/DJ 100F km 0+000
5	210	BUC	DN 1 km 80+700/DJ 720 km 30+000
6	223	IS	DN 28 km 56+136 - railway

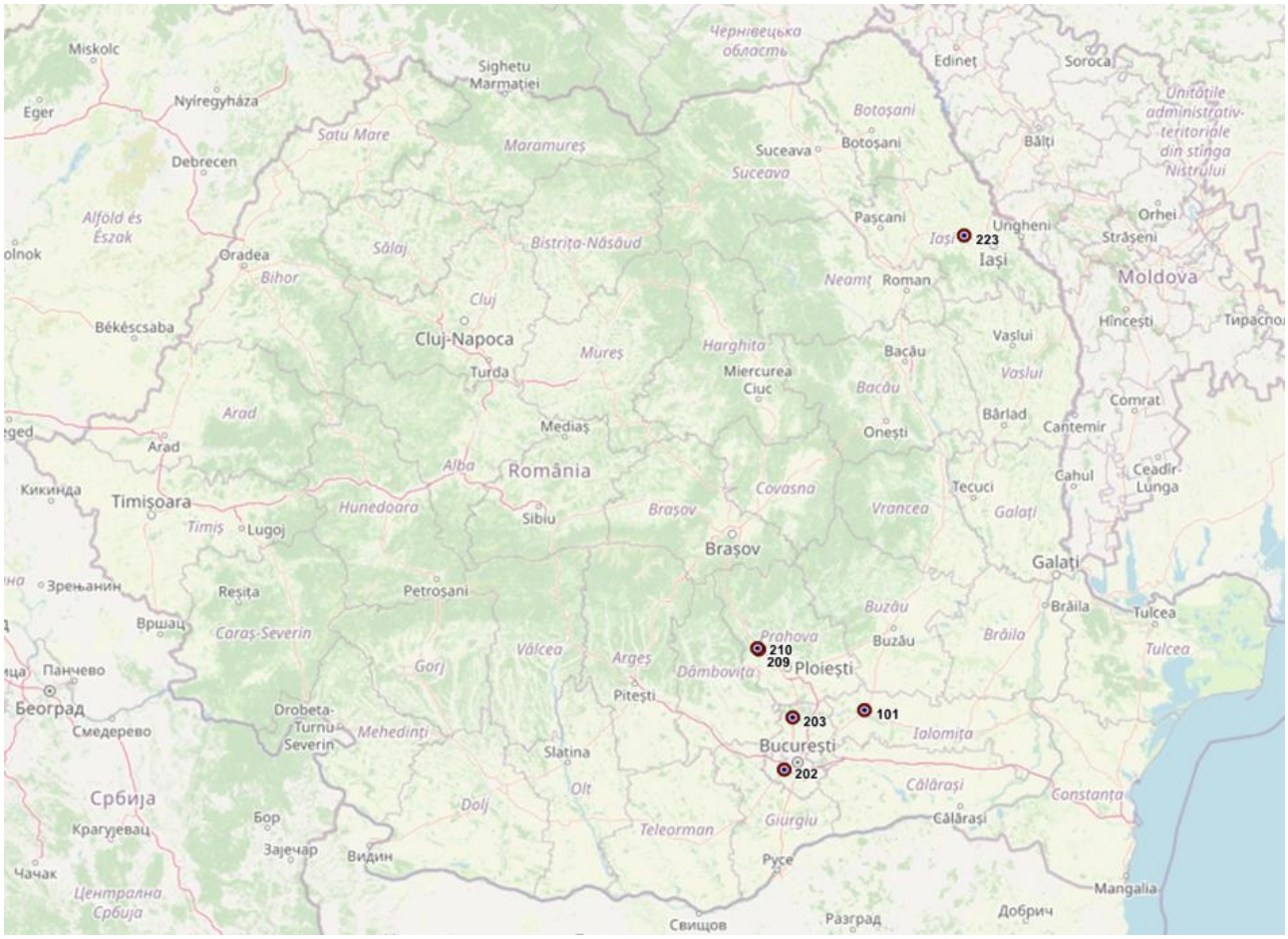


Figure 23 - Location of over/underpasses

The overall duration of implementation of an over/underpass project is estimated at 41 months, if no land acquisition is required and at 53 months respectively with land acquisition.

The Gantt charts for the six projects are presented here under.

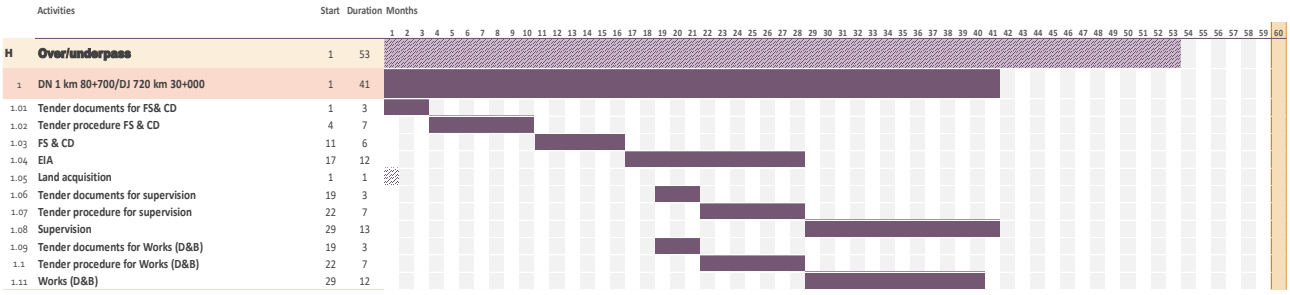


Figure 24 - Gantt chart for building over/underpass at DN 1 km 80+700/DJ 720 km 30+000

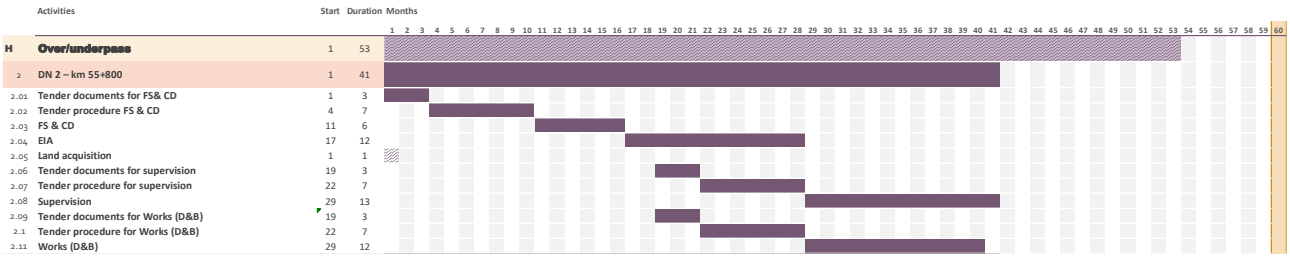
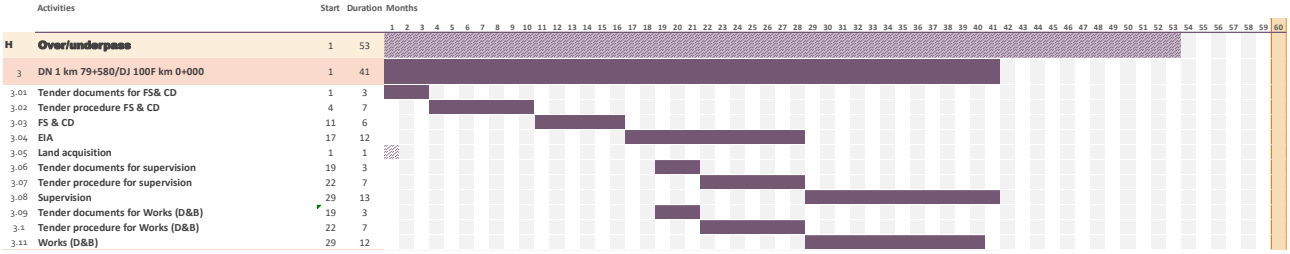
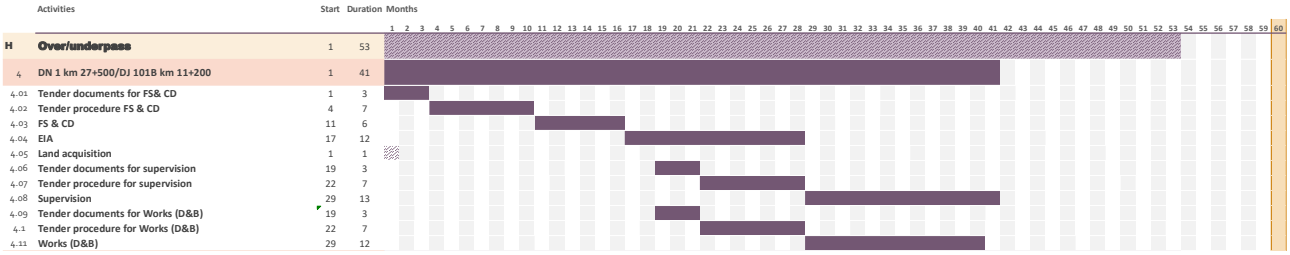


Figure 25 - Gantt chart for building over/underpass at DN 2 – km 55+800



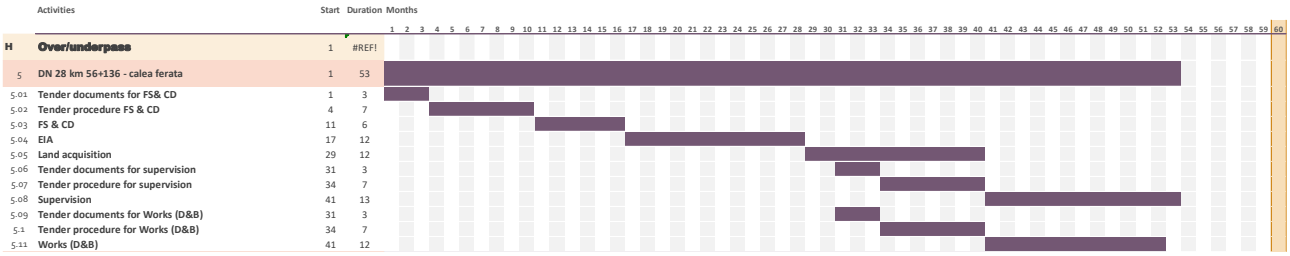
	Activities	Start	Duration
H	**Over/underpass**	1	53
3	DN 1 km 79+580/DJ 100F km 0+000	1	41
3.01	Tender documents for FS& CD	1	3
3.02	Tender procedure FS & CD	4	7
3.03	FS & CD	11	6
3.04	EIA	17	12
3.05	Land acquisition	1	1
3.06	Tender documents for supervision	19	3
3.07	Tender procedure for supervision	22	7
3.08	Supervision	29	13
3.09	Tender documents for Works (D&B)	19	3
3.1	Tender procedure for Works (D&B)	22	7
3.11	Works (D&B)	29	12

Figure 26 - Gantt chart for building over/underpass at DN 1 km 79+580/DJ 100F km 0+000



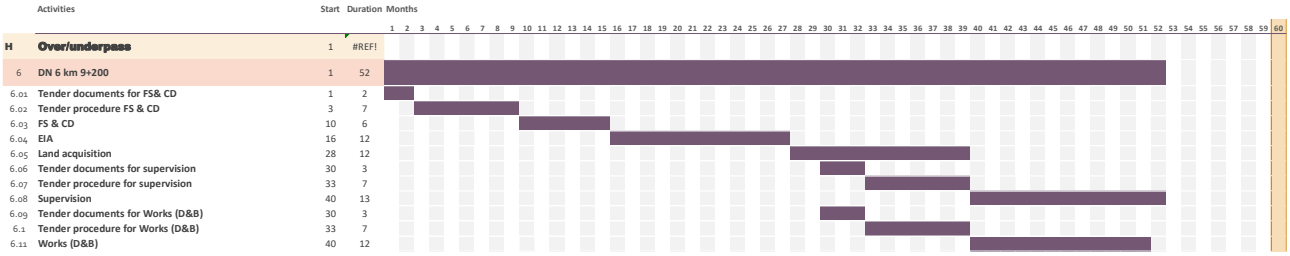
	Activities	Start	Duration
H	**Over/underpass**	1	53
4	DN 1 km 27+500/DJ 101B km 11+200	1	41
4.01	Tender documents for FS& CD	1	3
4.02	Tender procedure FS & CD	4	7
4.03	FS & CD	11	6
4.04	EIA	17	12
4.05	Land acquisition	1	1
4.06	Tender documents for supervision	19	3
4.07	Tender procedure for supervision	22	7
4.08	Supervision	29	13
4.09	Tender documents for Works (D&B)	19	3
4.1	Tender procedure for Works (D&B)	22	7
4.11	Works (D&B)	29	12

Figure 27 - Gantt chart for building over/underpass at DN 1 km 27+500/DJ 101B km 11+200



	Activities	Start	Duration
H	**Over/underpass**	1	#REF!
5	DN 28 km 56+136 - calea ferata	1	53
5.01	Tender documents for FS& CD	1	3
5.02	Tender procedure FS & CD	4	7
5.03	FS & CD	11	6
5.04	EIA	17	12
5.05	Land acquisition	29	12
5.06	Tender documents for supervision	31	3
5.07	Tender procedure for supervision	34	7
5.08	Supervision	41	13
5.09	Tender documents for Works (D&B)	31	3
5.1	Tender procedure for Works (D&B)	34	7
5.11	Works (D&B)	41	12

Figure 28 - Gantt chart for building over/underpass at DN 28 km 56+136 – railway level crossing



	Activities	Start	Duration
H	**Over/underpass**	1	#REF!
6	DN 6 km 9+200	1	52
6.01	Tender documents for FS& CD	1	2
6.02	Tender procedure FS & CD	3	7
6.03	FS & CD	10	6
6.04	EIA	16	12
6.05	Land acquisition	28	12
6.06	Tender documents for supervision	30	3
6.07	Tender procedure for supervision	33	7
6.08	Supervision	40	13
6.09	Tender documents for Works (D&B)	30	3
6.1	Tender procedure for Works (D&B)	33	7
6.11	Works (D&B)	40	12

Figure 29 - Gantt chart for building over/underpass at DN 6 km 9+200