Study on Performance of Road Signs and Markings along TANZAM Highway in Mbeya Region, Tanzania

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Abstract

Road users require information in order to complete their journey safely, legally and efficiently. As such, variety of traffic signs and markings are provided to advice drivers on legal restrictions, identify potential hazardous and guide them towards their destinations. Because of important information provided to road users through road signs and markings, there is a need for appropriate signs and markings planning, designing and implementation programs such as regular maintenance and replacements of traffic signs and markings. The inventory of road signs and marking from Uyole to Iyunga along TANZAM highway was conducted. The performance of road signs and markings were determined based on preset factors used to assess the signs and marking conditions. The study investigated that the average performance index of road signs from Uyole to Iyunga is 2.96 (59.2%) which indicated good condition. The condition of roads signs could increase to very good if the signs were free from obstruction of tree brunches. For the case of road marking the average performance index is 1.19 (23.8%) which indicated fair condition. The performance was less than 50% which demand immediate maintenance and replacements. The conditions of road markings were characterized with poor reflectivity, missing road marking and faint edge and center pavement lines. In order to increase visibility and reflectivity of road signs and markings for the case of this study it is recommended to have a plan by road agency for regular cleaning of the signs board and covered markings by mud/dust. But also in order to increase safety to road users, reduce delays, improve comfort and confidence to drivers it is important to install the missing signs, replace knocked down signs and worn out markings and improve night time retroreflectivity of road sign and marking along TANZAM highway.

Keywords: TANZAM highway; road signs; road markings; Performance class; Performance index.

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1. Introduction

Investigation of performance of road signs and markings was done by considering disabilities of road signs and markings found during inventory activities along TANZAM highway. The disabilities are those resulting into wrong or misinterpretation and lack of messages provided by signs and markings which eventually leads to traffic delays, congestions, problem in maneuvering and increased rate of accidents along road stretch [1]. The disabilities for the case of this study were considered as parameters for determination of performance of road signs and markings.

The road signs and markings are applied along the road networks to enforce regulation to road user, to guide and inform road user on road side features, direct the road users to the appropriate destination and warn the road users on dangerous situation and objects/features ahead [1, 2]. Generally road signs and markings are applied to reduce possible road accidents which may occur and to provide smooth and continuous traffic flow. However in case of wrong messages delivered or misinterpretation by road users and missing signs/markings at appropriate locations reduce level of service of the road stretch.

Roads are the dominant way of transportation of people and goods in the world. It is estimated that 1.2 million people die every year due to road accidents around the world [3, 4]. It is reported that improper and poor condition of road signs and markings contributes significantly to traffic accidents and vehicle crashes [5, 6, 7, 8]. In Tanzania during the year 2016 about 10,297 traffic accidents occurred on which 3,381lives died and 9,549 people injured. From the lives died due to traffic accidents about 79.3% were male and 20.7% were female and from the people injured about 72.1% were male and 27.9% were female [9].

To reduce traffic accidents and enhance road safety to road users it is important to conduct inventories and analysis to determine performances of road signs and markings at regular scheduled time. Investigation of road signs and markings performances provides understanding and awareness to road agencies and authorities on conditions of road signs/markings for improvements. However it is recommended by this study to integrate the performance indices into road and traffic management systems, for planning, implementation and monitoring programs. For the case of Tanzania, the trunk, regional and highways are managed by TANROADS (Tanzania road agency) while rural and district roads are managed by TARURA (Tanzania rural roads agency) on which TANROADS use ROADMENTOR as road management software for road planning, design and monitoring for maintenance and rehabilitation programs while TARURA use DROMAS a software for road maintenance management system [10, 11]. However both of the systems have not incorporated road signs and markings performance parameters which can be used for prioritization, budgetary cost estimates and maintenance and replacement programs [3, 11]. For this study the performances of road signs and marking along TANZAM highway were investigated and analyzed. The analysis was based on the preset factors as road signs and marking disabilities and score value for each factor.

a.   *Performance of road signs*

Road signs are used to give instructions or provide information for continuous smooth flow of traffics. The

ability of road signs to provide appropriate message to road users is termed as road sign performance. Several factors can reduce performance of road signs which includes improper location of the signs, poor retro-reflectivity, over and under sizes of stems, boards, word sizes and pictorial/symbols, hidden from trees and road side obstructions, missing due to vandalisms, damaged or knocked out by vehicles and worn out due to aging [12]. Sizes of different road signs including boards and stems, size of word messages, orientations and approach distances are given in most of road sign guidelines and specifications [2, 13, 14].

The materials used for sign board/plate and sign post are of aluminum alloys, galvanized steel, plastic coated steel or steel treated primers to prevent them from corrosion attack [2]. Sign board support frames and fasteners should be made from stainless steel or aluminum alloys [2]. The face of sign board heading to vehicle headlight should be of retro-reflective materials except parts painted black [2, 14]. Different colours have different intensity of retro-reflectivity measured in the unit of candelas per square meter (cd/m2) [15]

It is recommended to indicate date of sign installation so that to determine life time of particular road signs [15]. However for the surveyed road segment from Uyole to Iyunga along TANZAM highway there are no dates of installation or replacement found on sign boards.

The road agencies and authorities should have regular road sign inventories in order to identify signs with disabilities, missing and locations which require installation of new signs. The road signs are grouped into four categories which are regulatory/mandatory, warning, guidance and informatory but also symbols, codes and sizes of each sign are given in MoID [2] and MUTCD [14].

b.   *Performance of road markings*

It is the measure to determine the function-ability of road markings on delivering intended function. The major function of road marking is to provide appropriate messages to road users for smooth and safe navigation of road users along road networks. The parameters which were used to determine performance of road markings are reflectivity during night time, worn-out due to vehicle braking and aging, removed/missing due to road defects and maintenance operations, hidden from mud, dusts, rubbish and road side obstructions, miss location and under/oversize markings and word messages.

The materials used for road markings includes traffic paint, thermoplastic, preformed plastic epoxy, snowplowable raised pavement markers, methyl-methacrylate, polyester, polyurea, waterborne paint, modified urethane. However thermoplastic, preformed plastic and epoxy are more durable materials than paint [16, 17]. For the case of TANZAM highway, only paint type was used for road marking and lines throughout surveyed road segment. During service life of paint and thermoplastic markings they become worn out due to tire braking, accidents and aging. Their resistances against removal from road pavement are different which is mainly due to different surface adhesion and skid resistance properties which affects their service lives and initial costs [18].

Most of highways and street roads are left for long time without replacement of pavement markings and lines. However, there should be regular and systematic maintenance and replacement program in order to have best performance of pavement markings for smooth and safe traffic flow. According to MoID [2] the pavement

markings are grouped into three categories which are regulatory, warning and guidance. Symbols, codes, sizes and mark type for each mark and line categories are given in MoID [2] and MUTCD [14].

2. Investigation procedure

Investigation for this study involved inventory of traffic signs and markings from Uyole to Iyunga along TANZAM highway with total a length of 15.1KM. The road segment was divided into three homogeneous sections depending on concentration of road signs and markings which were Uyole (chainage 116+240) to Ilomba (chainage 121+440), Ilomba (chainage 121+440) to Mafiati intersection (chainage 126+240) and Mafiati (chainage 126+240) to Iyunga (chainage 131+340).

a.   *Investigation approach*

The inventory included identification of disabilities on road signs and markings/lines for each road section from Uyole to Iyunga along TANZAM highway. For the case of road signs, the disabilities/factors were checked on sign boards and stems. The factors checked on sign boards were board materials, board sizes, shapes, colours, sizes of symbols and fonts, reflectivity and defects. For the sign stems the factors checked were materials for stems, height of stems, defects and whether the stem is slanted or bent. Other factors which were observed during signs inventory were location of missing signs either due to vandalisms, knocked down by vehicles or not installed, miss location, orientation from vehicle direction and obstruction from trees, grasses and road side objects. For the case of road markings, the factors checked were mark sizes, mark and line colors, word font sizes, worn out, defected due to pavement distresses, reflectivity, location of missing marks/lines due to maintenance, and overlay and hidden from mud and dusts and rubbishes. The factors were grouped into six groups and scores for each group were given. Figure 1 is the road map of study area from Uyole to Iyunga along TANZAM highway.
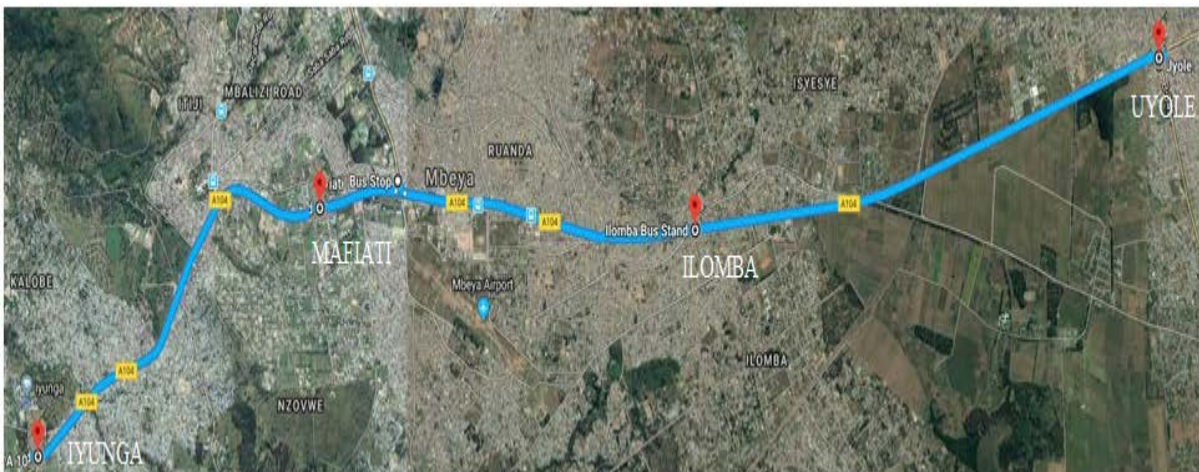

Figure 1: Road section from Uyole to Iyunga (google map)

b.   *Inventory of road signs and markings*

The method used to collected road sign and marking data and information was field manual inventory technique. Inventory of road sign and marking is a part of road management system which serves many purposes such as keeping records on where signs and markings are located, identification of problem areas, planning and budgeting for signs and markings replacements and identification of missing and dislocated signs and markings. The inventory also involved night time visual inspection to determine whether signs and markings provide adequate retroreflectivity levels through driving along the road section which enabled to determine number of signs and markings in compliance with nighttime reflectivity. On the annex figure A and figure B are the photos of night time reflectivity of road signs and marking from Uyole to Iyunga along TANZAM highway.

For the purpose of analysis of the performance of road signs and markings/lines the following groups of factors were considered during inventory process. The factors are missing road signs and markings/lines, poor reflectivity, broken/deflected, under/over sizes and comprehend. The description of each group factors for road signs and markings/lines are given in table 2.1.

Table 2.1: Factor used during inventory of road signs and markings

Factors	Road signs	Road markings
Missing	Signs which are knocked down, vandalized, not installed and miss location.	This includes unmarked places due to pavement maintenance and overlays and completely worn out due braking and abrasions of tires and miss location.
Poor reflective	Include all signs manufactured of materials that do not conform to MUTCD and all non reflective signs.	Include all marking materials that do not conform to MUTCD and all non reflective markings.
Brocken/defected	All signs which have defects on their stems, boards and faces. Including slanted and bent stem and boards.	All defected markings and lines due to traffic accidents, rutting, potholes, corrugation and wearing of the road surface.
Hidden	All signs which are hampered by vegetation and any other obstruction but also not aligned to the direction of traffic flow.	All marking covered or obstructed by temporary installed facilities and un cleaned vegetations, mud, dust, rubbishes and oils.
Under and over size	All signs that their sizes of the boards, legend (graphical and word message), offset and height of sign from the edge surface of the road do not conform to MUTCD.	Markings that their thicknesses, patterns, size of graphical and word messages do not conform to MUTCD.
Comprehend	All signs which conform to the manual of uniform control devices.	All markings which conform to the manual of uniform control devices.

The performance of road signs and markings for the purpose of this study were given in terms of indices as road sign performance index (RSPI) and road marking performance index (RMPI). However, score of 0 to 5 for each assessment factor was given, 0 being the worst condition and 5 being the best condition. For the case of analysis road signs and marking categories were considered to have the same weight. However further investigation is required to determine severity levels of disabilities/defects. Table 2.2 gives scores for each assessment factor.

Table 2.2: Categories of road signs and scores to assessment factors

Types of sign/marking		Regulatory/mandatory Scores for each factor	Warning	Guidance	Informatory
	Missing	0	0	0	0
	Poor reflective	1	1	1	1
Assessment	Brocken/defected	2	2	2	2
factors (F)	Hidden	3	3	3	3
	Under and over size	4	4	4	4
	Comprehend	5	5	5	5

$$\text{RSPI and RMPI} = \frac{1}{N}\left[\sum_{K=1}^{N}\left[\frac{\sum_K S \times F}{\sum F}\right]\right] \tag{1}$$

Where: RSPI – road sign performance index

RMPI – road marking performance index

S – score for a given factor

F – number of observation for each factor of a particular sign or marking category

N – number of sign or marking categories

In order to determine the performance and condition of road signs and markings along surveyed road segment for the purpose of this study, the ranges of performance indices, class and condition of road sign and marking are given in table 2.3. Unsatisfactory performance of road signs and markings/lines along road networks contributes to excessive traffic delays, accidents and congestions which result into loss of per capita and country economy. The responsible agencies should conduct regular evaluation to determine performance of road signs and marking at least for two years time interval [19]. The performance indices of road signs and markings for this study were determined using equation 1.

Table 2.3: Conditions, classes and ranges of performance indices for road signs and marking

Range of RSPI and RMPI	0.0 – 1.0	1.01 – 2.0	2.01 – 3.0	3.01 – 4.0	4.01 – 5.0
Percentage range	0 – 20	20.1 – 40	40.1 – 60	60.1 – 80	80.1 - 100
Performance class	E	D	C	B	A
Condition	Poor	Fair	Good	Very good	Excellent

The road signs performance index (RSPI) and road markings performance index (RMPI) can be used for road network planning and implementation programs for maintenance, replacements and installation of new signs and markings.

3. Results and discussion

The analysis of the data for road signs and markings/lines were carried out based on the disabilities found to each road signs and markings as parameters of analysis. The selected parameters/factors are missing signs or marking/lines, poor reflectivity, broken or defected, hidden, abnormal size, and those conform to MUTCD.

a. *Road signs*

The performance of road signs for TANZAM highway a road segment from Uyole to Iyunga was determined based on the selected factors and scores given to each factor (refer table 2.3). Road sign performance index (RSPI) can be used as a guiding criteria for maintenance, replacement and installation program. At the level of road network it is useful index for prioritization program of different roadwork activities, but also can be used as a factor for budgetary cost estimates of road sign activities. Table 3.1 gives current number of observations for each factor and road sign category for three road sections. The indices for each road section were calculated by using equation 1.

Table 3.1: Inventory data of road signs

Road stretches		Uyole –Ilomba				Ilomba – Mafiati				Mafiati – Iyunga			
Sign categories		**R**	**W**	**G**	**I**	**R**	**W**	**G**	**I**	**R**	**W**	**G**	**I**
Scores for	Density of sign category	4.2	4.8	3.3	1.3	4.4	8.1	2.9	0.6	4.5	4.7	2.5	0.6
each factor	Total signs	22	25	17	7	21	39	14	3	23	24	13	1
(S)	Present	17	21	16	6	15	38	11	2	19	16	13	1
0	Missing	5	4	1	1	6	1	3	1	4	8	0	0
1	Poor reflective	3	4	3	0	9	2	2	0	4	8	4	0
2	Defected	1	4	2	1	10	12	3	0	5	7	7	1
3	Hidden	7	6	5	1	9	8	6	0	9	15	8	1
4	Under and over size	1	0	5	2	5	0	4	0	3	3	10	1
5	Good	9	12	4	3	6	28	1	2	7	10	1	0
$\sum F$		26	30	20	8	45	51	19	3	32	51	30	3
$\sum SxF$		75	90	62	28	106	190	47	10	88	129	87	9

RSPI (Uyole – Ilomba) $= \frac{1}{4}\left[\left(\frac{75}{26}\right) + \left(\frac{90}{30}\right) + \left(\frac{62}{20}\right) + \left(\frac{28}{8}\right)\right] = 3.12$

RSPI (Ilomba – Mafiati) = $\frac{1}{4}\left[\left(\frac{106}{45}\right) + \left(\frac{190}{51}\right) + \left(\frac{47}{19}\right) + \left(\frac{10}{3}\right)\right]$ = 2.97

RSPI (Mafiati – Iyunga) = $\frac{1}{4}\left[\left(\frac{88}{32}\right) + \left(\frac{129}{51}\right) + \left(\frac{87}{30}\right) + \left(\frac{9}{3}\right)\right]$ = 2.79

RSPI (Average) = 2.96

The average performance of road signs from Uyole to Iyunga was determined to be good (refer table 2.4) with a performance index (RSPI) of 2.96. The road signs performance for individual sections, Uyole to Ilomba was determined to be very good with an index of 3.12 while for Ilomba to Mafiati and Mafiati to Iyunga were determined to be good with performance indices of 2.97 and 2.79 respectively. The performances of individual sign categories for the three road sections are indicated in figure 3.1. The figure shows lower performance of regulatory road signs compared to other categories for the three road sections. Regulatory road signs provide the most important messages for road users. It is imperative that regulatory signs are well understood by road users for smoothly and safely navigation along the road networks but also in order the road users to obey traffic signs it is necessary the national and international road signs to be comprehensive and consistent [20].
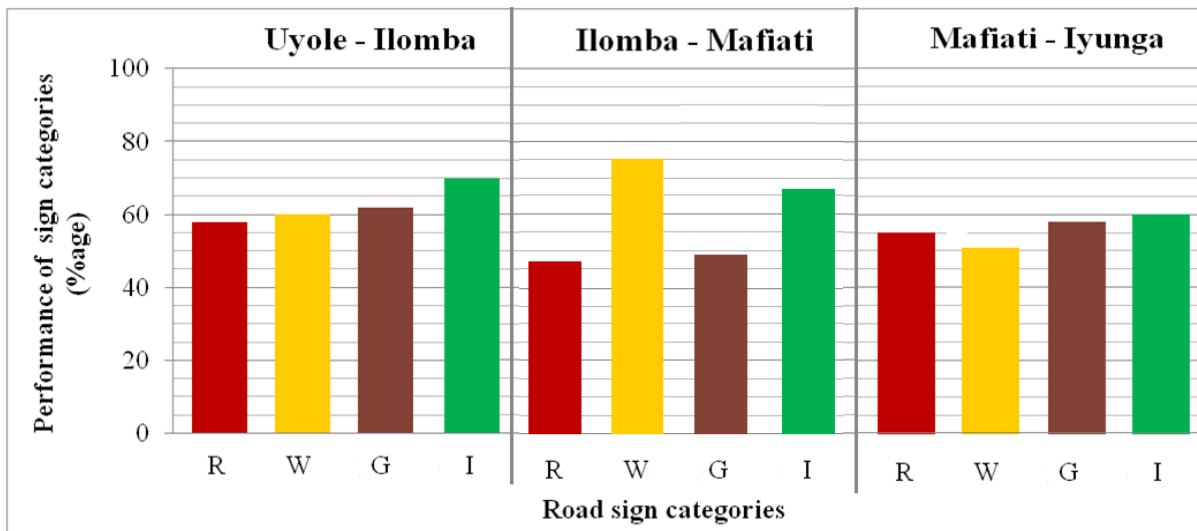

Figure 3.1: Performance of individual road sign categories for selected road sections

 However the whole study road segment from Uyole to Iyunga only one milestone exist which is located at coordinate E543816 N9013666. The road sign was found to be under size, not reflective, defected, poor legend and partly hided with shoulder grasses (figure 3.2). The milestones are among of the important guidance sign for drivers especially none regular road users because milestones help to indicate the distance covered and remaining distance to destination but also they provide information of the locations.

The author of this article suggested an alternate installation of milestones along TANZAM highway in Iringa region in 2016 when implementing a project of installation of road signs and reflective zebra crossing along TANZAM highway in Iringa, the project under TANROADS Iringa region. During implementation of the project the milestones were installed on both directions of road at an interval of 10KM zigzag on each side for

the purpose of assisting drivers and other road users from both directions to recognize the covered distance, remaining journey and current location. The traditional practice was to install the milestones on one side of the road and normally left hand side at an interval of 5KM. The alternate installation of road signs is being implemented in most of the new roads and rehabilitation of road projects in Tanzania.

Figure 3.2: Milestone at coordinate E543816 N9013666 showing its both sides

However it will be helpful to install satellite controlled GPS into modern vehicles to guide drivers and vehicle occupancies on their journey. This is because road signs and markings deteriorate with time and the maintenance and installation for most of the roads is not a regular practice and it requires budgetary resources such as funds, experts, skilled labours and priorities. Therefore the roads especially in developing countries are left without important road signs and markings for several years.

Figure 3.3: Some road signs along Uyole – Iyunga road segment having different disabilities

Figure 3.3 show photos of various road signs from Uyole to Iyunga road segment along TANZAM highway indicating different disabilities used as factors during inventory activities for analysis to determine road sign performance indices. In figure 3.3 the following disabilities were identified during road sign inventory: Photo A – a combined crossing signs for disabled (blind and wheeled persons) which is hidden from tree brunches, photo B – warning sign with defected word legend, partly hidden and under size stem, photo C – a pedestrian crossing sign with a sign board removed from a stem, photo D – knocked down a no entry sign, photo E – knocked down bus reserve sign, photo F – confused signs for no town buses (front) and town bus reserve (behind) at the same location, photo G – speed limit sign with defected sign board, bent stem which changed orientation of driving direction, photo H – missing T junction sign from both approaches. For best performance, the road signs and markings/lines should have the following properties: visible from far distance, easily and quickly understood by road users, self explanatory, retro reflective during night time, easy to make maintenance and replacement, durable and cost effective.

b. *Road markings*

Investigation of performance of road markings for a road segment (Uyole to Iyunga) for the case of this study was determined based on the selected disabilities/factors and scores indicated on table 2.3.The disabilities for each road markings and lines were determined during inventory activities and the data for each factor were summed up for each marking and lines categories and road section. Table 3.2 gives current number of observations for each factor and road marking and line category for three road section. The indices for each road section were calculated by using equation 1.

Table 3.2: Inventory data of road markings/lines

Road stretches		Uyole - Ilomba			Ilomba - Mafiati			Mafiati - Iyunga		
Marking categories		**R**	**W**	**G**	**R**	**W**	**G**	**R**	**W**	**G**
Scores	Density of marking/line category	5.0	2.7	1.3	5.8	2.3	1.7	4.5	3.1	1.8
for each	Total	26	14	7	28	11	8	23	16	9
factor (S)	Present	21	8	3	18	9	6	17	7	6
0	Missing	5	6	4	10	4	2	6	9	3
1	Poor reflective	19	6	2	17	7	6	3	7	6
2	Defected	9	3	1	11	1	5	2	3	2
3	Hidden	2	2	0	3	3	1	3	0	0
4	Under and over size	1	0	0	2	0	2	2	0	0
5	Good	2	0	0	1	0	0	0	1	0
∑F		38	17	7	44	15	16	16	20	11
∑SxF		57	18	4	61	18	27	24	18	10

RMPI (Uyole – Ilomba) $= \frac{1}{3}\left[\left(\frac{57}{38}\right) + \left(\frac{18}{17}\right) + \left(\frac{4}{7}\right)\right] = 1.04$

RMPI (Ilomba – Mafiati) $= \frac{1}{3}\left[\left(\frac{61}{44}\right) + \left(\frac{18}{15}\right) + \left(\frac{27}{16}\right)\right] = 1.42$

RMPI (Mafiati – Iyunga) $= \frac{1}{3}\left[\left(\frac{24}{16}\right) + \left(\frac{18}{20}\right) + \left(\frac{10}{11}\right)\right] = 1.10$

RMPI (Average) = 1.19

During inventory activities of road marking and lines for the case of this study, the continuous lines such as centre lines and edge line were divided into kilometer length for each road section. The disabilities identified for such lines were measured for each kilometer length and divided by a kilometer. Then the ratios of each disability were summed up and multiplied with total length of each road section. For the case of a single and concentrated mark were counted for each kilometer length and summed up for each road section.

The average performance of road markings/lines from Uyole to Iyunga was determined to be fair (refer table 2.4) with a performance index (RMPI) of 1.19. The performance of road markings/lines for respective road sections, Uyole to Ilomba, Ilomba to Mafiati and Mafiati to Iyunga were determined to be fair with performance indices of 1.04, 1.42 and 1.10 respectively. However the performance of individual road marking categories for the three road sections are less than fifty percent (figure 3.4) which requires immediate maintenance and replacement as it is not safe for traffic operation along road segment.
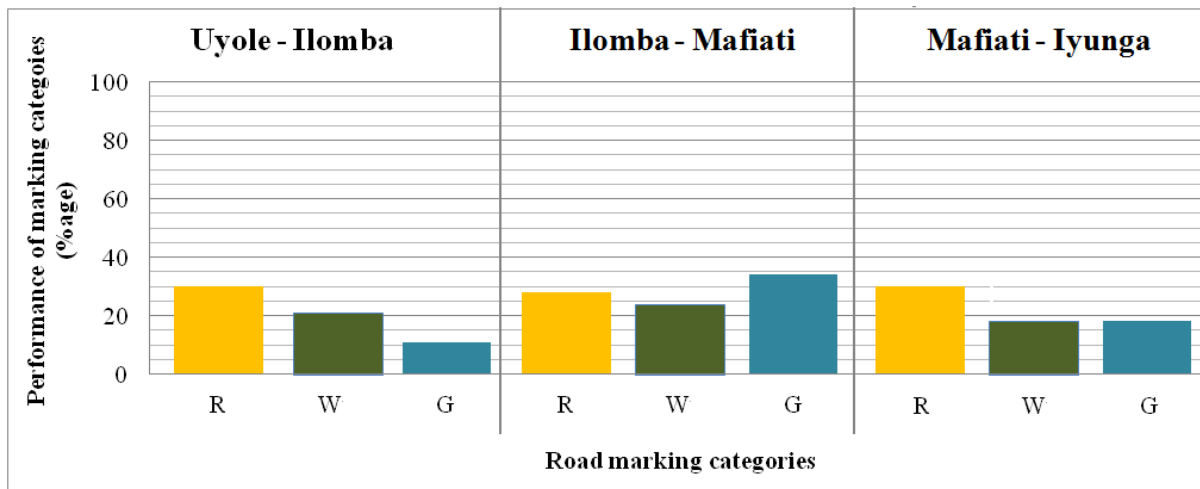

Figure 3.4: Some road signs along Uyole – Iyunga road segment having different disabilities

This is because it becomes difficult for drivers to detect safe places for overtaking slow moving vehicles and lane changing, quick identification of location for pedestrians, schools and animals crossing, quick response for turning direction and safety driving of far lanes due to edge drop-offs and other road defects. Such situations reduce comfortability and driving confidence especially during night time and heavy rainfall conditions which may result into accidents and vehicle crushes [21, 22].

The performance indices for road markings/lines and signs can be incorporate in roads and traffic management software such as HDM-4 and aaSIDRA. The road signs and markings indices can be used for budgetary cost

estimates for maintenances, system improvement, accidents monitoring and control.

Figure 3.5 show photos of various road markings and lines from Uyole to Iyunga road segment along TANZAM highway indicating different disabilities used as factors during inventory activities for analysis to determine road markings/lines performance indices.

Figure 3.5: Some road markings along Uyole – Iyunga road segment having different disabilities

During inventory of road markings and lines the following disabilities shown in figure 3.5 were identified: Photo A – missing edge and lane/centre lines, photo B – worn out edge and faint center lines, photo C – worn out and defected ramble strips, photo D – worn out pedestrian crossing, photo E – kerbstone covered with mud and missing kerbstone face marking, photo F – missing right and left turning arrows, photo G – faint turning arrow at intersection, photo H – faint lines for channelized island at intersection.

However road accidents and vehicle crushes are influenced by many factors such as human behavior, vehicle condition, road geometry, pavement condition, weather condition, road capacity and performance of road signs and markings. These factors have different contribution to traffic accidents and vehicle crushes. Therefore it is important for researchers to investigate contribution of poor performance of road signs and markings to traffic accidents along road networks.

4. Conclusion and recommendation

Traffic signs and markings are the aid to road users for smooth and safe traffic navigation along road network. To eliminate traffic accidents and improve safety to road users along road networks it is necessary for road agencies and authorities to make sure that the performance of road signs and markings are maintained to excellent level during their service life.

The results from data analysis indicated that the average condition of road signs for surveyed road segment from Uyole to Iyunga along TANZAM highway is good with performance index of 2.96 (59.2%). The condition of road sign can be increased to excellent through increasing retroreflectivity to aged signs. But also to increase visibility to road users from obstructed road sign, the tree brunches covering road signs should be removed. The average performances of individual sign categories were found to be 53.3% for regulatory signs, 62.0% for warning signs, 56.3% for guidance signs and 65.7% for informatory signs. With regard to these results only informatory signs have indicated very good performance and this is because they are recently installed along road segment but also they are few in numbers. The performance of regulatory signs is lower than other road sign categories regardless of their importance for smooth and safe navigation of traffic along road network. To increase safety to road users, reduce delays, improve comfort and confidence to drivers it is important to install the missing signs, replaced knocked down signs and improve night time retroreflectivity of road sign along TANZAM highway.

Investigation revealed that the current condition of road markings from Uyole to Iyunga along TANZAM highway requires immediate maintenance and replacement as their average condition is fair with performance index of 1.19 (23.8%). The performance of road marking was low and did not reach 50% average. The road markings were characterized with poor reflectivity due to worn out markings from vehicle tires and aging, several location of missing road marking and lines due to maintenance of road defects and overlays, missing and unpainted kerbstones. The performances of individual marking categories were found to be 29.2% for regulatory markings, 21.1.0% for warning markings and 21% for guidance markings. From the performance results of road marking for the case of this study it is recommended that whenever there is a plan to conduct pavement maintenance or overlays, the plan should include replacement of markings/lines. This is because most of road maintenance and overlay programs in Tanzania do not include replacement and maintenance of road markings and signs except for major rehabilitation and reconstruction.

In order to improve performance of road signs and markings it is important to integrate road signs and marking analysis criteria into road management systems for road planning, design, rehabilitation, maintenance and monitoring of road safety programs.

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5. Annexes

Figure A: Reflectivity of some road signs along Uyole - Iyunga road segment
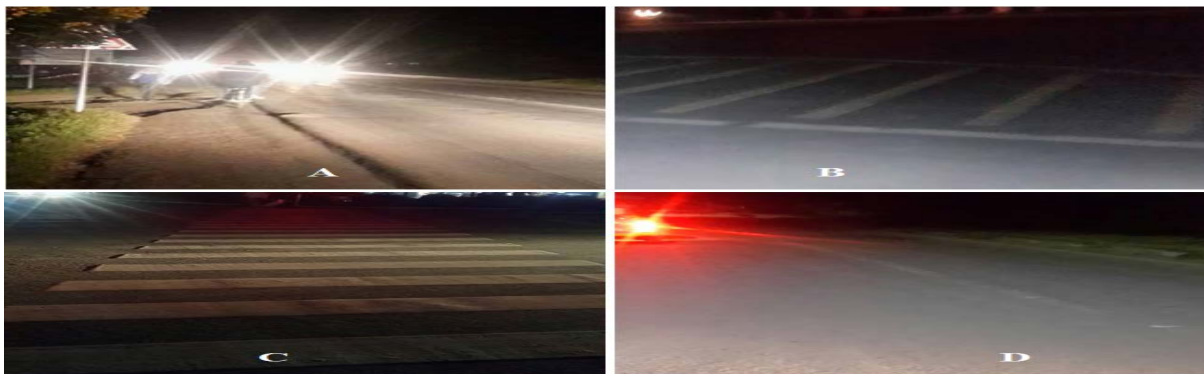

Figure B: Reflectivity of some road markings and lines along Uyole – Iyunga road segment

Table A: Road signs inventory sheet

INVENTORY OF ROAD SIGNS FROM UYOLE – IYUNGA ROAD STRETCH ALONG TANZAM HIGHWAY

LOCATION: MAFIATI - MWANSELWA SHEET No: 02 DATE: 25/04/2018 NAME: JACKSON KIMARO / DUWA HAMIS(S)

Installation date: NOT INDICATED

S/No.	Sign type	Category	Position (Right/Left)	GPS Easting	GPS Northing	Missing: Not installed	Knocked down	Vandalized	Reflectivity: None	Faint	Ok	Defected: Board	Legend	Support	Invisibility: Fully	Partly	Visible	Size: Board	Legend	Support	Shape	Colour	Remarks
1	NO PARKING	R	L	550028	9015315						✓	✓		✓		✓		LT3	—	185	CIRCLE	R/B	NOT WELL ALLIGNED
2	FILLING STATION	G	R	550057	9015284						✓						✓	500/20	30	50	RECTANGLE	W/R/B	
3	PEDESTRIAN CROSSING	W	L	550197	9015285						✓						✓	90/90/90	37	254	TRIANGLE	W/R/B	
4	WHEELED CROSSING	W	L	550197	9015285						✓						✓	90/90/90	37	277	TRIANGLE	W/R/B	
5	BLIND CROSSING	W	L	550253	9015280						✓						✓	90/90/90	38	200	TRIANGLE	W/B	
6	BUS RESERVATION	R	L	550267	9015280						✓	✓	✓				✓	60/60	25	165	SQUARE	B/W	
7	INFORMATION SIGN	I	R	550268	9015259						✓						✓	600/300	500	300	RECTANGLE	W	VARRIABLE DISPLAY MESSAGE
8	DIRECTION SIGN	G	R	550193	9015274						✓					✓		360/250	14	150	RECTANGLE	G/W	500M FROM TRAFFIC LIGHT
9	WHEELED CROSSING	W	R	550314	9015258						✓						✓	90/90/90	37	277	TRIANGLE	W/R/B	
10	BLIND CROSSING	W	R	550314	9015258						✓						✓	90/90/90	37	200	TRIANGLE	W/R/B	

Table B: Road markings inventory sheet

INVENTORY OF ROAD MARKINGS AND LINES FROM UYOLE – IYUNGA ROAD STRETCH ALONG TANZAM HIGHWAY

LOCATION: MAFIATI – MWANJELWA SHEET No: 02 DATE: 26/04/2018 NAME: JACKSON KIMARO (DUWA HAMISI)

S/No.	Mark and line type	Category	Repair/replacement date	Position (Right/Left)	GPS Easting	GPS Northing	Missing: Unmarked	Missing: Worn out	Reflectivity: None	Reflectivity: Faint	Reflectivity: OK	Defected: Road defects	Defected: Vehicle braking	Invisibility: Fully	Invisibility: Partly	Invisibility: Visible	Size: Pattern	Size: Thickness and arrow	Size: Word font	Colour	Remarks
1	KERBFACE MARKING	G		L/R	550028	9015316	✓		✓					✓						•	FROM MAFIATI TO SOWED MARKET W
2	ZEBRA CROSSING	R			549930	9015330		✓		✓			✓		✓		300/50			B/W	
3	STOP LINE	G			549931	9015317		✓	✓				✓	✓						B/W	MAFIATI TRAFFIC LIGHT
4	LANE LINE ARROW	W	XAPPLICABLE	L	549932	9015308					✓					✓				W	MAFIATI TRAFFIC LIGHT
5	EDGE LINE	R	NO!	R	549930 / 550292	9015336 / 9015358		✓		✓			✓		✓					Y	300M FROM MAFIATI TRAFFIC LIGHT
6	EDGE LINE	R		R	549930 / 550290	9015330 / 9015255		✓		✓			✓	✓						Y	FROM MAFIATI TRAFFIC LIGHT TO MWANJELWA.
7	STOP LINE	R			550292	9015285		✓		✓					✓					B/W	FROM MAFIATI TRAFFIC LIGHT TO MWANJELWA.
8	ZEBRA CROSSING	R			550292	9015289		✓		✓			✓	✓			300/50			B/W	
9	DIRECTION ARROW	R		L	550292	9015268	✓		✓				✓								ACCESS ROAD TO TAFLA HARDWARE
10	DIRECTION ARROW	R		R	550192	9015277	✓		✓				✓								ACCESS ROAD TO ARIBA COMMERCIAL