

A Risk Analysis and Safety Context on Nigeria Road

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Abstract

The starting point of this work was analysing of data from road safety corp. Applying safety to tanker/trailer on Nigeria road. Road transport system was studied. Accident was examined using *Haddon* Matrix. The three basic factors of road crash human, vehicle and road environment was pin point. However, a ban of trucks on Nigeria road was scrutinized with time lag effect on other industries. Tankers / Trailers expected casualty was estimated using probabilities. The summary table of Tankers / Trailers Road Traffic Crashes between 2007-2010 by RSC was used in the work. Recommendation and conclusion

Keywords: Safety on road, Expected Casualty, Accident, Risk on road, Hazard theory

1. INTRODUCTION

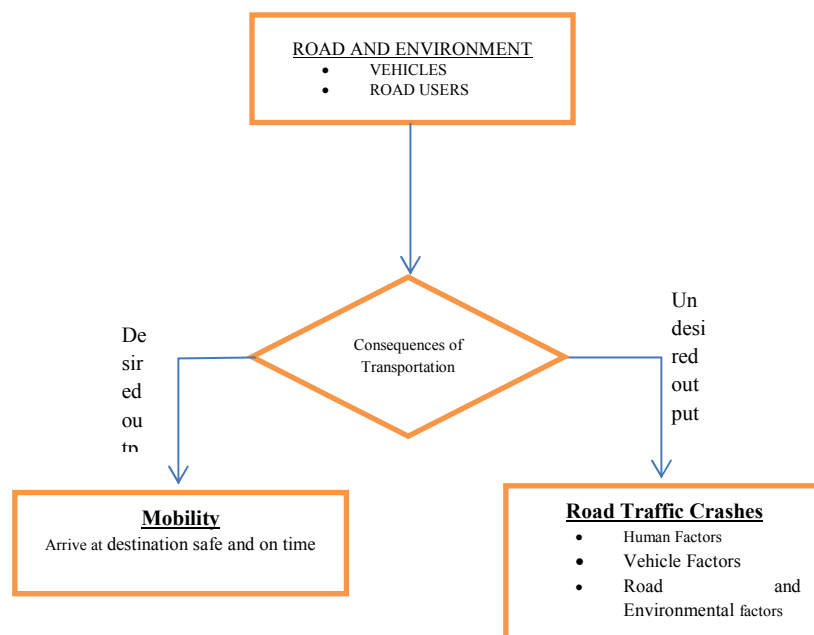
While the need for the mobility is well understood, the astonishing growth in the vehicle population with lagging infrastructure is producing lot of undesirable outputs, challenging the very sustainability of the Mobility Industry. Safety on the road is one of the major challenges of our age. Various components of safety system on road can be listed as:

- Road Safety
- **Vehicular Safety**
- **Occupant Safety**
- Environmental Safety

This report focuses on Vehicular and occupant safety

The challenge of improving safety calls for multi-disciplinary efforts. The overall system approach required to be addressed to improve safety can be well understood with the flow chart below.

1.2 ROAD TRANSPORT SYSTEMS



Looking at the Haddon Matrix which gives an analytical approach towards the factors influencing Road Safety.

1.3 Haddon Matrix

PHASE		FACTORS		
		HUMAN	VEHICLES AND EQUIPMENT	ENVIRONMENT
PRECRASH	CRASH PREVENTION	<ul style="list-style-type: none"> • Information • Attitudes • Impairment • Police Enforcement 	<ul style="list-style-type: none"> • Roadworthiness • Lighting • Braking • Handling • Speed Management 	<ul style="list-style-type: none"> • Road Design and Road layout • Speed Limits • Pedestrian Facilities
CRASH	INJURY PREVENTION DURING THE CRASH	<ul style="list-style-type: none"> • Use of Restraints • Impairment 	<ul style="list-style-type: none"> • Occupant restraints • Other safety devices • Crash protective design 	<ul style="list-style-type: none"> • Crash protective roadside objects
POSTCRASH	LIFE SUSTAINING	<ul style="list-style-type: none"> • First-aid skill • Access to medics 	<ul style="list-style-type: none"> • Ease of access • Fire risk 	<ul style="list-style-type: none"> • Rescue facilities • Congestion



A Typical Truck Accident on Lagos – Ibadan Express way.

2.0 Objectives of Study

1. Examine the structural situation of accidents on Nigeria Roads with respect to Trucks
2. Examine the quality of trucks along the Lagos – Ibadan corridor and observe whether the truck drivers follow strictly safety rules
3. Measure the volume of accident due to trucks on Nigeria roads.
4. Investigate the level to which truck Driver/owner have adopted the safety rules as to reduce accident.

3. Introduction to safety on road

The basic idea of this paper is to bring more safety on the road by accepting the road furniture as it is and to direct our efforts to other components of the total road traffic system so that it will provide more safety to the much less alterable human components. The human factor can be improved on with mandatory education for operators. This will reduce accident on the road.

Road accident can be caused widely by three major factors

- Human factor /Operator
- Vehicles /Equipment
- The Road / Environment

Even though road accident may be triggered by a number of elements. Its primary roots lie within the road user.

3.1 Reasons why there was need for a safety on Nigeria Roads.

With an estimated population of 156 million people occupying an area of 923,768 sq km having a land area of 910,768 sq km, water area of 13,000 sq km and coastline of 853 km, Nigeria is the most populated Black Nation in the sub-Saharan Africa. It contains over one quarter of the continent's industrial, commercial and other economic activities. These create transport demands which seem to have exceeded what the available transport infrastructures and services can cope with. The rapid deterioration in the Government-owned public transport system (Rail) and the unorganized operation of numerous private Truck owners, the inadequacy of road and parking spaces relative to this demand, coupled with unplanned growth and disorganised land use as well as ineffective traffic management and general urban planning, have all combined to compound the network of transport problems.

In Nigeria today, Road is the only major means of moving people and goods. From one point to another, considering the fact that it is the most accessible and cheapest. Stopping or banning Trucks on Nigeria roads is not the solution to the various accidents on the roads. Analysing the time line effect on the country if truck is ban.

3.2 When Trucks Stop, Nigeria Stops

A Timeline Showing the Deterioration of Major Industries Following a Truck Stoppage

3.2.1 The first 24 hours

- Service stations will begin to run out of fuel.
- Delivery of food items to cities will cease.
- Manufacturers using local and imported Raw materials will develop component shortages.
- Construction industries will start having shortage of cements, stone and sands
- Nigeria mail and other package delivery will cease.

3.2.2 Within one day

- Food shortages will begin to develop.
- Automobile fuel availability and delivery will dwindle, leading to sky-rocketing prices and long lines at the gas pumps.
- Without manufacturing components and trucks for product delivery, assembly lines will shut down putting thousands out of work.

3.2.3 Within two to three days

- Food shortages will escalate, especially in the face of hoarding and consumer panic.
- Supplies of essentials such as bottled water, powdered milk, and canned meat at major retailers will disappear.
- Stations generating Electricity using gas will start having problems leading to short fall in supply of power.
- ATMs will run out of cash and banks will be unable to process transactions.
- Service stations will completely run out of fuel for autos and trucks.
- Garbage will start piling up in urban and suburban areas.
- Container ships will sit idle in ports and rail transport will be disrupted eventually coming to a standstill.

3.2.4 Within a week

- Automobile travel will cease due to lack of fuel. Without autos and busses, many people will not be able to get to work, shop for groceries, or access medical care.
- Hospitals will begin to exhaust oxygen supplies.

3.2.5 Within two weeks

- The nation's clean water will begin to run dry.

3.2.6 Within 4 weeks

- The nation will exhaust its clean water supply and water will be safe only after boiling. As a result Gastro intestinal illness will increase, further taxing an already weakened health care system.

4.0 Expected Casualty

Tankers/Trailers are vehicle equipment for transportation of goods. Expected casualty is use in commercial transportation industry as a measure of risk but we are going to look at it from the point of forecast or predict the expected average number of casualty per year on a corridor of tankers/trailers route

The safety community define risk as product of probability (P) or frequency of occurrence (f) of an event and its consequences (c) the severity of its impact is considered Hazardous

The potential hazards can be numerous and diverse that the problem become one of how to easily and accurately

represent the safety risk of the system design. so that a decision authority could easily understand and make decision about which risk were acceptable.

A decision maker needs the following information.

1. The probability of individual hazards
2. The combined probability of major hazards
3. The assurance that hazards were independent
4. The assurance that no common mode failure exist between individual hazards

Considering hazards theory as regard to safety of vehicular equipment hazard. consist of three components or elements

1. Hazard source : the basic hazardous elements or danger
2. Hazard Initiating Mechanism : the factor that transform hard into mishap
3. Hazard Outcome : the mishap event, target and damage or threat

In hazard model, the hazard source is the basic hazardous element or danger sources that really create or spawns a system hazard. Hazard system source are typically energy source in the system e.g. hydraulic pressure, fuel ordnance rotating machinery and moving machinery.

Hazard Initiating Mechanisms are the specific causal factors. The hazard outcome is into three parts (a) Mishap event (b) the potential target that mishap impacted (c) the Mishap damage or consequence severity.

Haven seen, Hazard and mishap in full light we can define hazard as any real or potential condition that can cause injury, illness or death to personnel; damage to or loss of system, equipment or property; or damage to the environment. Hazard can also be considered as a potentially unsafe condition resulting from failures, malfunctions, external events, errors or combination thereof.

Now, having considered Hazard in general perspective, let us come back to Tanker/Trailers as transport equipment that can be hazardous and cause mishap.

However, the severity of its impact is measured in probabilities. The measure of its consequence can either be any positive or negative numbers. Hence, the value of risk(R) can be any positive or negative numbers. For risk then the larger the number the greater the risk. A Trailer provides a good case study

Case study 1: suppose there is a 10% chance that the trailer will receive 1000 naira in damage in driving from Lagos to Ibadan and a 90% chance that it will not receive any damage. The risk measure is 100 Naira (10% X 1000 Naira) for the trip.

Risk can be relatively high if the probability (p) of the event is close to 1.0 (high) and can be relatively high if the consequence(c) is extremely great, even if the probability (p) is small.

Case study 2: Assuming that for a given trailer/ tanker travelling from Lagos to Kaduna there is a 60% chance of casualties, a 30% chance of one casualty and 10% chance of 3 casualties we have accounted for all possible outcome (100%).

The complete equation for expected casualties is the sum over all possible event of the product of the associated probability p times it consequence

$$E_c = \sum P_i \times C_i$$

Where: n = the numbers of possible different event

P_i = the probability of the i^{th} event, and $P_1 + P_2 + P_3 + \dots + P_n = 1$

C_i = the consequence of the i^{th} event

The risk of journey from Lagos to Kaduna for the trailer / tanker in the example measured by expected casualty is $(0.6 \times 0) + (0.3 \times 1) + (0.10 \times 3) = 0.6$

If there is 1000 trailer/tanker traveling from Lagos to Kaduna on same corridor. We would expect a total of approx. 600 casualties. This is too high.

TABLE 1: SUMMARY OF CAUSES OF TANKERS/TRAILERS RTC, 2007- 2010.

Causes	Total	Probabilities	%
OBS	313	0.077918845	7.79
SPV	927	0.230769231	23.08
DGD	1098	0.273338312	26.41
TYV	337	0.083893453	8.58
BFL	359	0.089370177	9.14
MDV	51	0.012696042	1.3
OLV	92	0.022902664	2.34
DOV	116	0.028877272	2.95
LOC	89	0.022155838	2.26
RTV	34	0.008464028	0.87
DAD	5	0.00124471	0.13
SLV	11	0.002738362	0.28
WOV	36	0.008961912	0.92
DOT	27	0.006721434	0.69
BRD	10	0.00248942	0.25
MDI	19	0.004729898	0.48
OTHERS	493	0.122728404	12.54
TOTAL	4017	1	100

Source: FRSC, Sept.,2010

LEGEND:

OBS – obstruction; SPV – Speed violation; DGD dangerous driving; TYV – tyre violation; BFL brake failure; MDV mechanically deficient vehicle; OLV – overloading violation; DOV – dangerous overtaking; LOC loss of control; RTV – route violation; DAD driving under the influence of alcohol and drug; SLV speed violation; WOVI – wrong overtaking.

Table 2: Accidents Involving Tankers/Trailers on Nigerian Roads by Selected Routes

YEAR	Lagos-Ibadan	Kaduna-Zaria	Jos-Maiduguri	Calabar-Akamkpa	Lokoja - Abuja	Port Harcourt Aba	Total	%
2007	39	14	26	9	18	2	108	16.7
2008	68	34	21	14	19	3	159	24.6
2009	111	39	19	11	12	4	196	30.3
2010 June	78	28	14	11	50	3	184	28.4
Total	296	115	80	45	99	12	647	100.0

Source: FRSC, Sept 2010

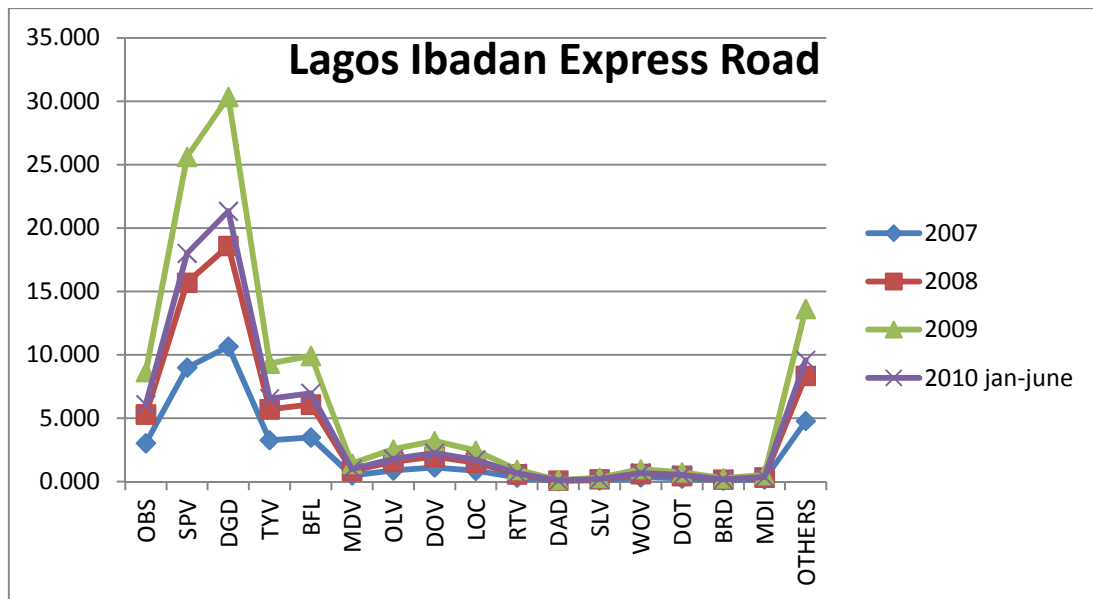


Fig 1

Using the two tables in above with probabilities of the individual cause of the accident in the year 2007 to 2010 for the Route Lagos – Ibadan Express Road. It shows that DGD - dangerous driving is considered as the highest cause of accident on Lagos – Ibadan express way. Our model which is the product of Probabilities and the resulting consequence $E_c = \sum P_i \times C_i$

With this table 3 was generated and the graph in fig 1 is drawn.

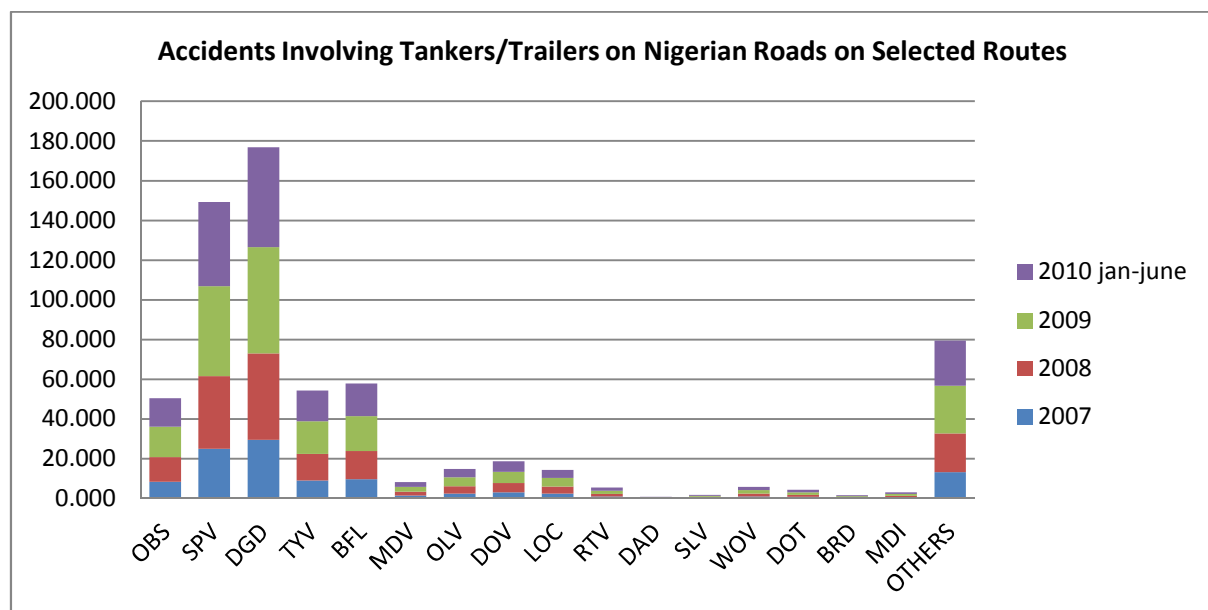


Fig 2

The Roads Considered in Fig 2 are those in table 2 above. In the table lagos Ibadan express road has the highest numbers of accident this is due to the volume of tanker / trailer that uses the route compared with other roads

5.0 RECOMMENDATIONS

DEATH – CAUSING accident, are some of the results of road accidents involving Trucks. Tremendous pressure is often placed on vehicles and roads.

5.1 Education

It is been observed that dangerous driving and Speed violation by tanker/ trailer drivers are the major causes of accidents on Nigerian roads. Mandatory education of tanker /trailer drivers on road safety is needed to reduce accident on roads.

5.2 Making Your Use of Road Safe.

Despite laws on traffic and safety regulations. Injury and death in road accident constituted a major problem.

Obviously, safety on the road cannot simply be legislated. Road user must take a measure of responsibility for their own safety and that of others.

Therefore, all road users should wisely take a careful look at their vehicle and the road situation.

Have you for example noted whether your vehicle is really safe? Are you driving with bad tyres and brakes? If so are you adequately protected? Are you constantly under stress? Do you drive reckless or breach legally established traffic rules.

Answers to those questions will reveal much about how safe you are when driving

5.3 Conscious of Dangers

Trying to manage an unreasonable motor vehicle can be dangerous. Also, tired vehicle driver are less efficient and make more mistakes while driving.

5.4 Bylaw

Fines and penalties for truck driver offenders should be look into. Overloading of truck is also a major cause of crashes involving trucks on Nigeria roads and the deteriorating effect of overloading on the road is visible, there is need to have installed on major Nigerian roads, weighbridges to ensure that vehicle operators comply with the loading regulations. There is the need to increase the fines from N100.00 (one hundred naira) by the Ministry of works or N10,000.00 (ten thousand Naira) only as stipulated in the FRSC (establishment) ACT to (N50,000.00 (Fifty Thousand naira) only. Overloaded Trucks should also have their journeys terminated at the arresting points

5.5 Prosecution.

It is not praiseworthy that the FRSC is instituting a new driver's licence. What is needed is strict compliance to the requirements for the issuance of **commercial vehicle licence** especially as it concerns trucks driver's licence. The FRSC should ensure that no driver of articulated lorry drives more than 4 hours continuously without resting for at least 40 minutes. Provision of tanker/trailer parks and rest areas along the route will aid this. Route associations of the drivers and owners such as, the Nigerian Union of Road Transport Owners (NARTO) and National Union of Petroleum, Energy and natural Gas (NUPENG), among others, should be carried along in developing strategies to evolve safe road culture in the haulage sector.

5.6 Technology.

It is significant that 23.08% of the causes of truck accident on Lagos Ibadan Express way were traceable to speed violations Speed limiting devices should also be installed on the trucks to avoid speed violation.

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Table 3: Accidents Involving Tankers/Trailers casted on probability.

Lagos Ibadan Express Road																		
Causes	OBS	SPV	DGD	TYV	BFL	MDV	OLV	DOV	LOC	RTV	DAD	SLV	WOV	DOT	BRD	MDI	OTHERS	TOTAL
Probabilities	0.078	0.231	0.273	0.084	0.089	0.013	0.023	0.029	0.022	0.008	0.001	0.003	0.009	0.007	0.002	0.005	0.123	1
2007	3.039	9.000	10.660	3.272	3.485	0.495	0.893	1.126	0.864	0.330	0.049	0.107	0.350	0.262	0.097	0.184	4.786	39.0
2008	5.298	15.692	18.587	5.705	6.077	0.863	1.557	1.964	1.507	0.576	0.085	0.186	0.609	0.457	0.169	0.322	8.346	68.0
2009	8.649	25.615	30.341	9.312	9.920	1.409	2.542	3.205	2.459	0.940	0.138	0.304	0.995	0.746	0.276	0.525	13.623	111.0
2010 Jan-June	6.078	18.000	21.320	6.544	6.971	0.990	1.786	2.252	1.728	0.660	0.097	0.214	0.699	0.524	0.194	0.369	9.573	78.0

The table 3 above is generated with Probabilities of causes of accident involving tanker/trailer on Lagos -Ibadan express road. Casualty of the accidents.

Table 4: Accidents Involving Tankers/Trailers casted on probability.

Accidents Involving Tankers/Trailers on Nigerian Roads on Selected Routes																		
Causes	OBS	SPV	DGD	TYV	BFL	MDV	OLV	DOV	LOC	RTV	DAD	SLV	WOV	DOT	BRD	MDI	OTHERS	TOTAL
Probabilities	0.078	0.231	0.273	0.084	0.089	0.013	0.023	0.029	0.022	0.008	0.001	0.003	0.009	0.007	0.002	0.005	0.123	1
2007	8.415	24.923	29.521	9.060	9.652	1.371	2.474	3.119	2.393	0.914	0.134	0.296	0.968	0.726	0.269	0.511	13.255	108.0
2008	12.389	36.692	43.461	13.339	14.210	2.019	3.642	4.591	3.523	1.346	0.198	0.435	1.425	1.069	0.396	0.752	19.514	159.0
2009	15.272	45.231	53.574	16.443	17.517	2.488	4.489	5.660	4.343	1.659	0.244	0.537	1.757	1.317	0.488	0.927	24.055	196.0
2010 Jan-june	14.337	42.461	50.294	15.436	16.444	2.336	4.214	5.313	4.077	1.557	0.229	0.504	1.649	1.237	0.458	0.870	22.582	184.0

The table4 above is generated with Probability functions of the causes of accident on Nigerian Road. The routes that were considered were the ones in table 2 above. Within the years 2007 to 2009.