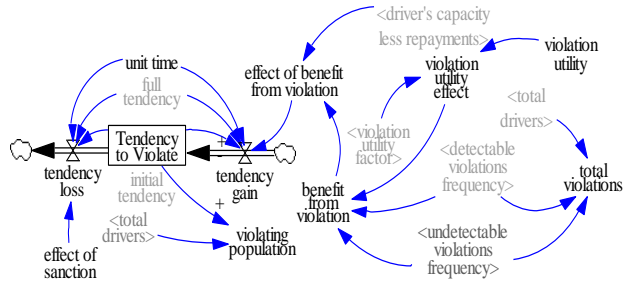




A system dynamics approach to understanding traffic law compliance problem in commercial motorcycle operation

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System dynamics method



Commercial motorcycles



Enforcement operation

Facts about commercial motorcycle transport

- Share of commuters who use commercial motorcycles daily in most Nigerian medium size cities, including Ado 70% - 80%
- Share of city of Ado population directly employed as commercial motorcycle drivers >1.5%
- Share of drivers* who own their motorcycles in some Nigerian cities including Ado 30% - 55%
- Motorcycle share in registered motor vehicles in Nigeria 20% - 30%
- Share of drivers previously involved in an accident in many Nigerian cities including Ado 60% - 82.8%
- Motorcycle share in total road traffic accident in Nigeria 20% - 30%
- Motorcycle share in total RTA fatality in Nigeria 33%

*Drivers refer to commercial motorcycle drivers

Research problem and methodology approach

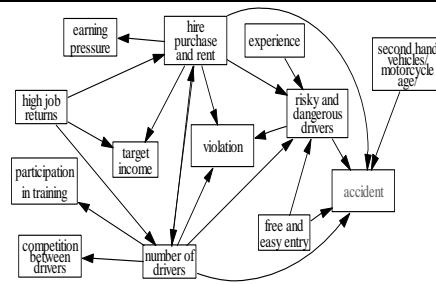
- Safety challenge is identified as a major challenge facing this transport.
- A study of this challenge is undertaken using systems analysis
- The process involved consultation with stakeholders and extraction of their mental model of system characteristics
- The qualitative data obtained is analysed by coding. The following characteristics, amidst others, emerged:
 - drivers' population growth
 - competition
 - expensive ownership (motorcycle acquisition) options
 - “trade is strenuous”
- These characteristics form feedback loops; thus they are developed into a CLD



The process in figures

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Causation code	Description	Quotes
Enforcement coverage/arrest (method of arrest affects accident)	The process and method of conducting arrest often results in accident as drivers attempt to flee enforcement agents	"Also, the police. At times, we while riding, we have observed that the police worry us a lot. Just before we get to police stand, we begin to fidget. Some okada drivers, especially when Road safety (FRSC officers), when some okada drivers remembers they don't have helmet, will want to (make a sudden U-turn) turn back suddenly (enforcement method). Doing that causes problem for the driver behind who might be having helmet. Because of fear of arrest by Road safety—they charge N2000, N3000. All these things are reason why accident happens." R2FG1
Enforcement coverage (method of arrest) affects dodging arrest	Whenever they think officers might arrest them	
Dodging arrest affects accident	When drivers attempt to dodge arrest, it can result in an accident	
Deterrence affects violation	The extent to which drivers are dissuaded from violating affects the number of violations they commit.	"Policy laws made for okada have not been followed up, e.g., use of crash helmet. Thus the laws have not been obeyed. Excuses given by the public about the use of crash helmet include: possibility of putting charms inside helmet; likelihood of it spreading skin infections; and religious factor, particularly in the north." R1IX



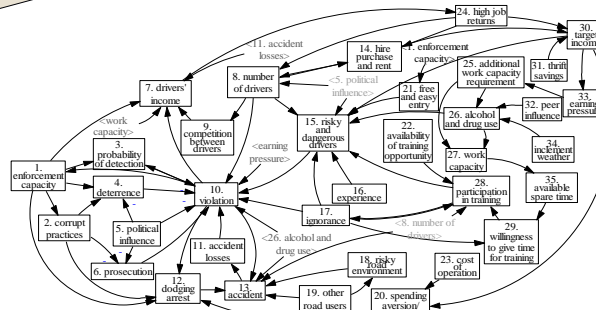
Miles et al. (2014) recommend writing a narrative that lists all items in a causal network. According to them it helps analysis to be less mechanistic and more coherent. A narrative for the causal network in figure 8.19 is presented here:

Enforcement capacity (1) which represents the combined ability of traffic enforcement agencies in the study location affected several other items. It was found that whenever there were more officers on patrol, fewer drivers worked due to increased probability of detection (3) of a violation by enforcement officers. This was more so as more monitoring by officers meant more spending on fines and bribery for the drivers. Thus, more violations (10) led to more enforcement capacity (1) which led to reduced drivers' income (7). Notwithstanding, there were times an increase was noted in violations (10). This was because violations (10) offered some financial benefits too (increased drivers' income (7)). Whenever violations increased, more officers were drafted to increase enforcement capacity (1) and match the problem. This obviously would result in

1. Generated a set of causation codes

2. Clustered codes into 5 themes (each theme is represented as a network)

4. Generated a descriptive narrative of combined narrative



3. Merged the 5 networks

A growing drivers' population is causing further growth through the increasing awareness of the high profit margin in the trade. This is mentioned in summary number 2 in section 8.7.2.1

Expensive ownership options available are promoting population growth but raising earning pressure within the trade. This is mentioned in summary number 3 in section 8.7.2.1

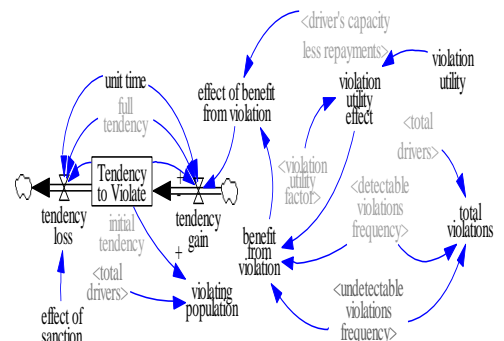
Increasing competition should reduce population growth but its effect is weak. This is mentioned in summary number 2 in section 8.7.2.1

Strenuous working condition is making drivers to turn to violations and career-switch plans. This is mentioned in summary number 3 in section 8.7.2.1

Career-switch plans are promoting savings habit and adding to or sustaining earning pressure. This is mentioned in summary number 3 in section 8.7.2.1

5. Developed hypotheses from the narrative

6. Generated a CLD from the hypothesis

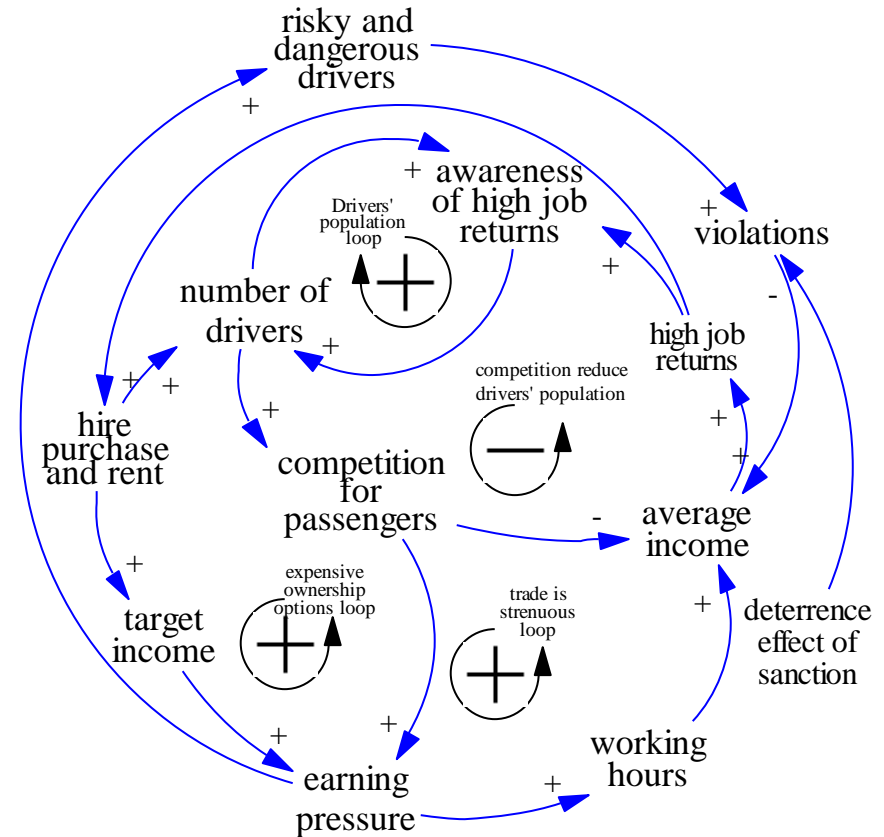


7. Developed the CLD into SFM

Four feedback loops are explored here:

- Drivers' population growth loop
- Competition loop
- Expensive ownership options loop
- Trade is strenuous loop

These loops point to why drivers face work pressure in the system



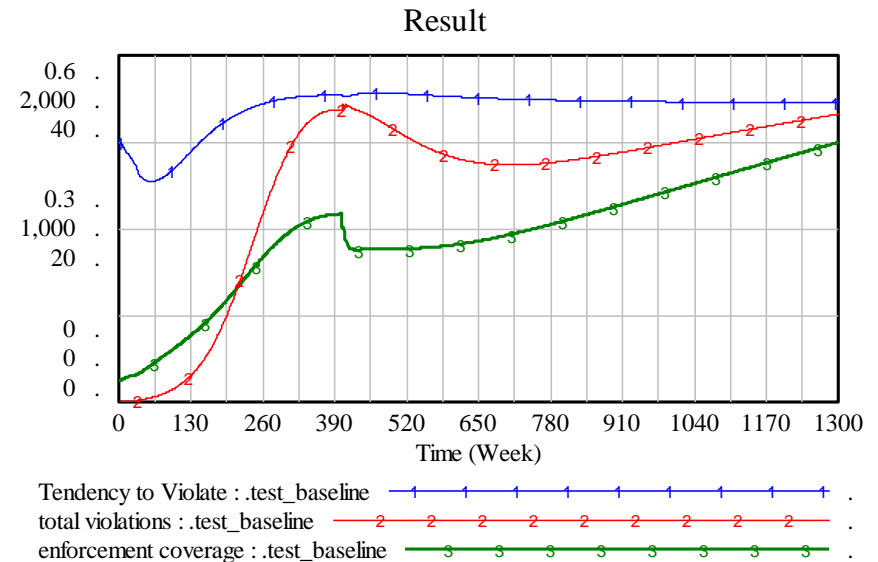
Abridged causal loop diagram of system interactions

CLD transformation to SFM

- From the CLD, the following factors are further explored in a SFM in this presentation:
 - Violations:
 - tendency to violate;
 - total violations
 - Deterrence effect of sanctions:
 - enforcement coverage;
 - recruitment rate;
 - corruption/prosecution rate
 - Hire purchase and rent:
 - expensive ownership options share

Baseline result interpretation:

- Tendency to violate
- Total violations
- Enforcement coverage

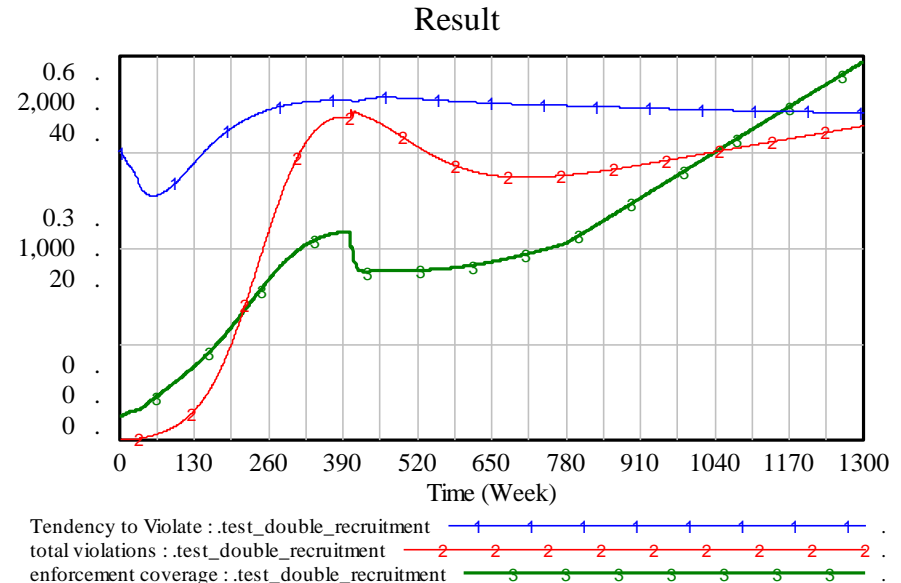


Graph of base case scenario

Scenario 1

Double recruitment rate:

- Insignificant changes to tendency to violate
- Insignificant changes to total violations
- Significant additional enforcement coverage

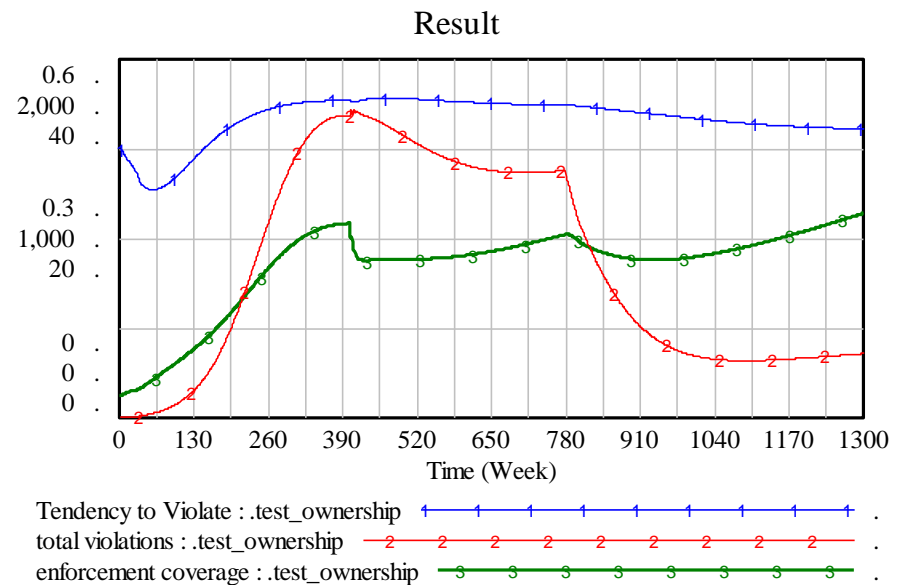


Graph of doubled recruitment rate scenario

Scenario 2

Remove expensive ownership options:

- Minor changes to tendency to violate
- Substantial reduction in total violations
- Significant reduction in enforcement coverage



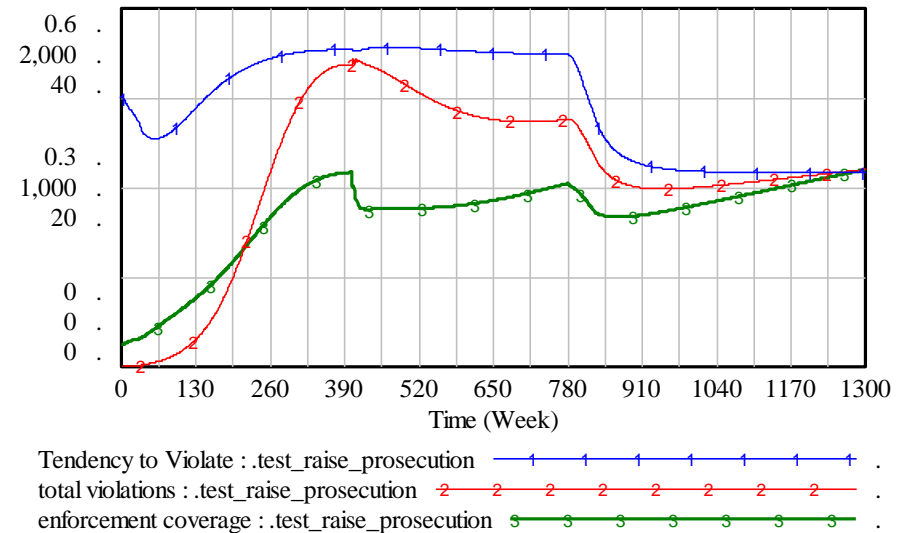
Graph of removal of expensive ownership options scenario

Scenario 3

Raise prosecution rate:

- Substantial changes to tendency to violate
- Less than expected reduction in total violations
- Significant reduction in enforcement coverage

Result

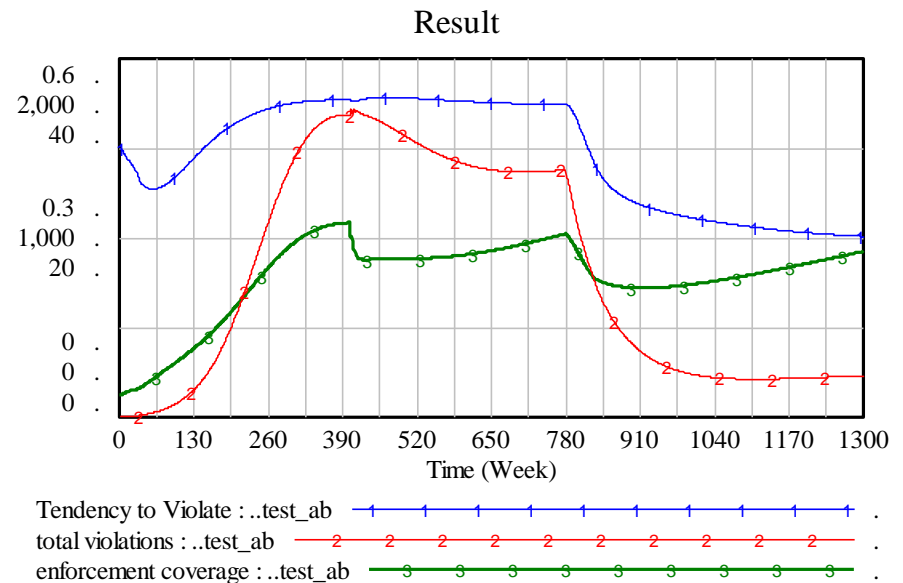


Graph of increase in prosecution rate scenario

Scenario 4

Combination of increased prosecution and removal of expensive ownership options:

- Substantial reduction in tendency to violate
- Substantial reduction in total violations
- Significant reduction in enforcement coverage



Graph of combination of increased prosecution and removal of expensive ownership options

Conclusions:

- This is an exploratory model of driver behaviour using system dynamics
- It suggests that the stress of work is an important contributor to regulatory difficulties
- It also suggests that providing incentives to drivers without improving sanction may not generate good behaviour
- It indicates that a combination of measures can be more effective in reducing violations
- There are indications that corruption problem makes increasing the number of officers involved in policing less effective
- It is suggested that a strengthening of internal regulation might be a way forward



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Questions?



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