

# Rwandan Road Safety 2030: Strategies for Safer Roads

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# 1

## Executive Summary

Rwandan Road Safety 2030: Strategies for Safer Roads aims to develop a flexible framework that will help authorities in Rwanda develop road safety programs to meet their specific needs. Achieving success in this problem space requires the careful development of a safe system and adapting interventions to the changing environment, rather than simply using existing projections and collected data. The framework outlined in this report was informed by extensive interviews with professionals in relevant fields and a survey of road safety literature that combines information about Rwanda with international best practices.

This report goes further into the economic methods of determining the costs associated with crashes and identifies various funding sources for road safety initiatives. This report details the methodology used in order to calculate the economic cost of road accidents in Rwanda, which is estimated to be between \$150-300 million USD per year.

Next, a safe system approach is described starting with the United Nations's "Five Pillars of Road Safety". Each of the road safety pillars is analyzed along with relevant actions that can be taken within Rwanda. After this analysis, three key areas are identified as possible areas of improvement by the authors: developing a national helmet standard, improving national road safety education programs, and investigating helmet subsidization measures. These three solution avenues are described in detail and findings are presented.

# 2

## Background Information

### WHO ARE WE?

We are a group of third-year engineering undergraduates at Harvard University enrolled in ENG-SCI 96: Engineering Problem Solving and Design Project. Our team is composed of nine undergraduate engineers, two graduate students, and a faculty member of the Harvard John A. Paulson School of Engineering and Applied Sciences. This particular report and its enclosed data were compiled by three members of the larger team in an effort to focus primarily on government outreach and incentives: Fraser Darling, Cole Dollinger, and Sarah Goldfarb.



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## MOTIVATION

In January 2021, our team of engineers were introduced to Tuvurinde, a nonprofit organization whose global mission is “to improve lives”. More specifically, the organization is interested in domestically manufacturing helmets in Rwanda in order to decrease road traffic injuries across all of Africa. From January to May 2021, our team of engineers were tasked with defining and framing the problem presented to us, conducting research, and generating solutions to address the issue of road safety in Rwanda. During this process, we crafted a problem statement in order to better characterize the issue:

*The World Health Organization places Rwanda in the top 15 countries in Africa for road traffic casualties. Poverty forces road users to compromise on road safety by pressuring them to work under suboptimal conditions and to prioritize income. A lack of high quality helmets and insufficient road safety education result in severe injuries that lower Rwandans' economic productivity, thereby reinforcing poverty. Furthermore, Rwanda has not proposed an official national long-term strategy to address this issue. Although stricter law enforcement and public awareness campaigns have decreased road traffic injuries, additional road safety interventions are necessary to further reduce the number of casualties and improve the quality of life in Rwanda. How might we help Rwanda become one of the 15 safest countries in Africa for road traffic casualties?*

After we framed the problem, we were able to identify key stakeholders and impact areas to address in an effort to decrease road accidents in Rwanda. In particular, we were motivated to collaborate with and provide resources for the government because they are ultimately the decision-makers and enforcers of any proposed solution within the country. To this extent, government intervention will include some combination of regulations, enforcement, and garnering support from citizens.

# 3

## Stakeholders, Risk Groups, and Current Efforts

### 3.1 STAKEHOLDERS

The figures below outline relevant stakeholders in the efforts to reduce road traffic injuries and deaths in Rwanda. Specific relevant branches of the Rwandan government were highlighted in order to identify their role in helping promote safer roads.

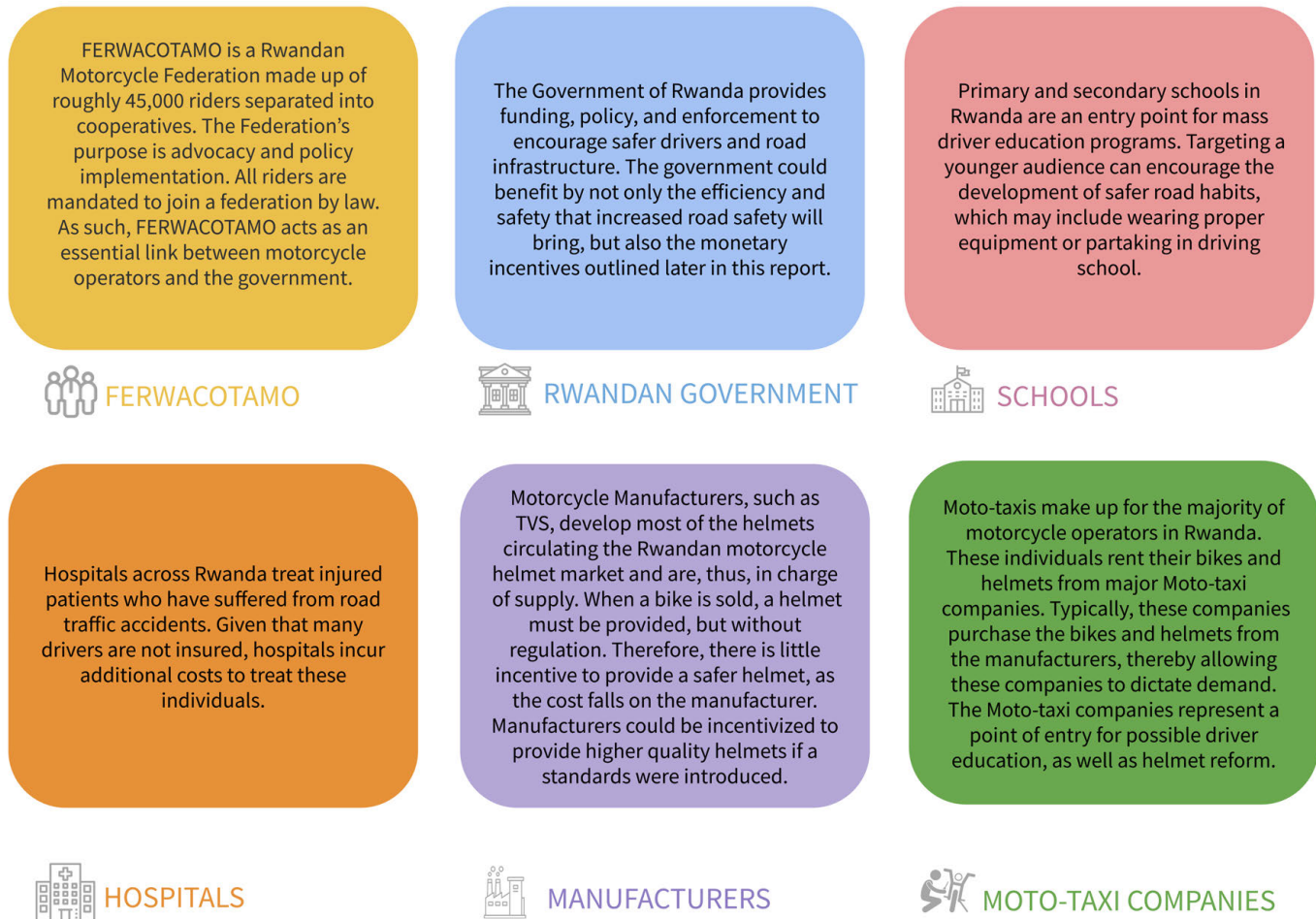


Figure 3.1: Stakeholders Map



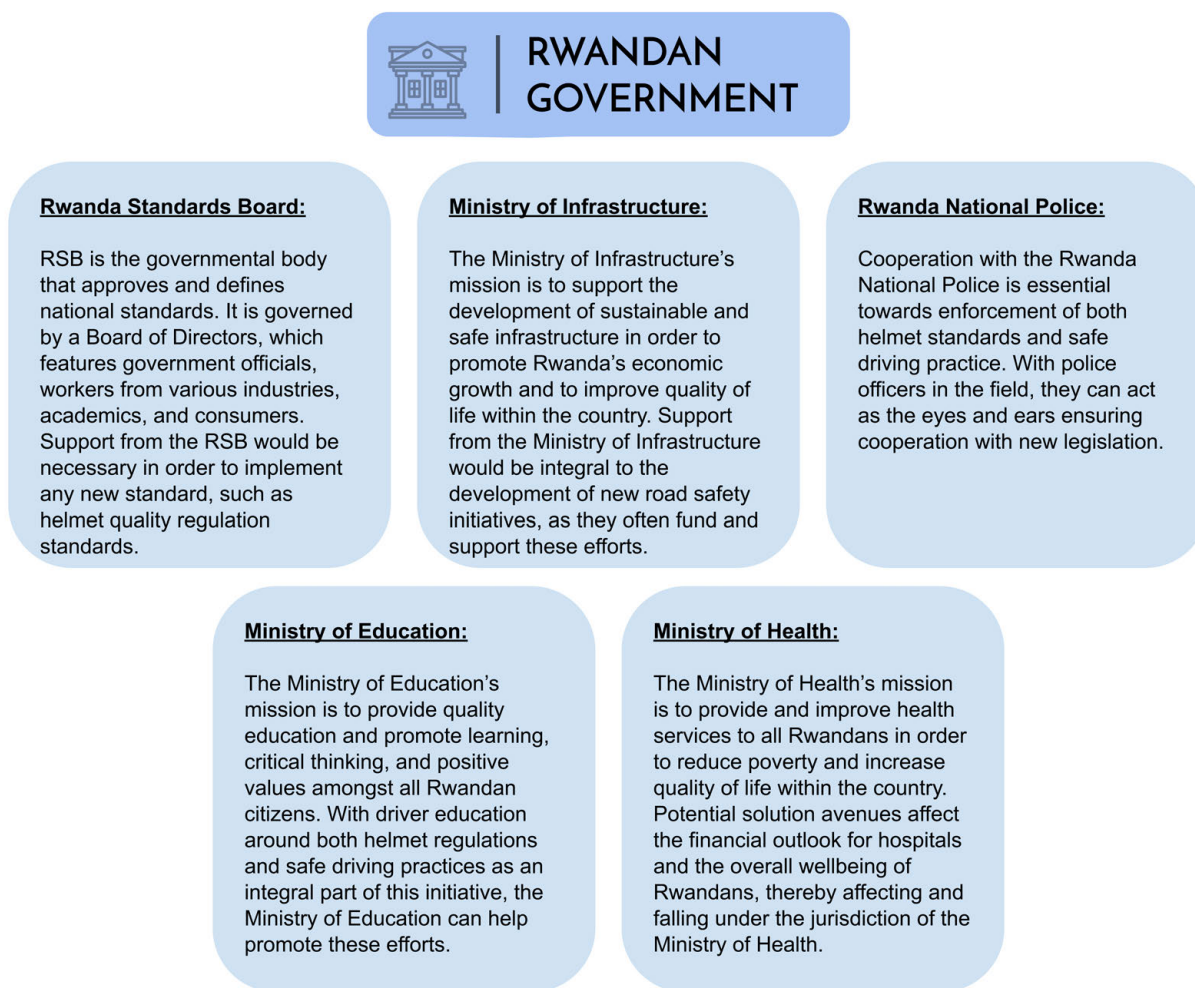
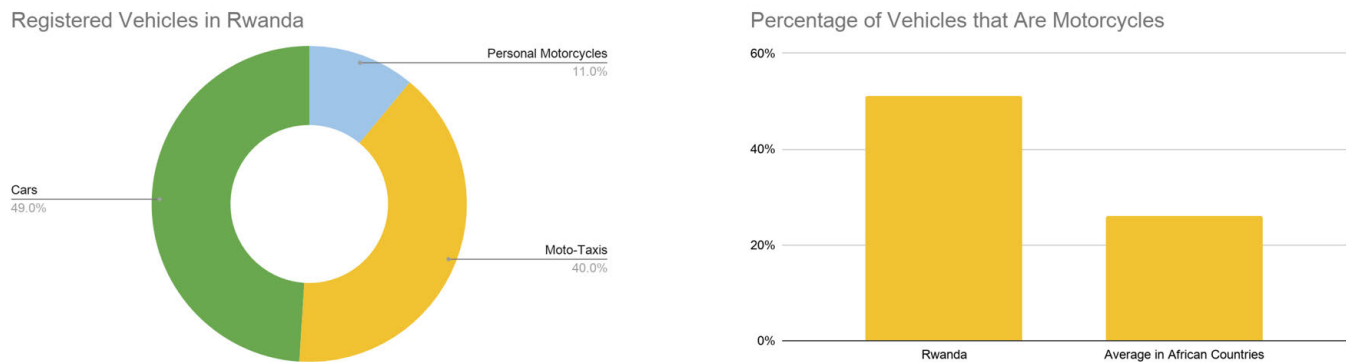


Figure 3.2: Relevant Government Branches

### 3.2 RISK GROUPS

Everyone who uses the road network in any capacity is at risk of an accident. Motorcycle riders are a key group with whom to collaborate in improving road safety because of the overwhelming number of moto-taxi drivers on Rwandan roads.



**Figure 3.3:** Registered Vehicles in Rwanda and in Surrounding Countries

With approximately double the percentage of motorcycles on the road, as compared to the population-weighted average of all WHO-reporting African countries (51% vs. 26%), Rwanda has a disproportionately large number of motorcyclists.<sup>22</sup> Considering the motorcycle population is also reported to be 20x more likely to die in accidents compared to car operators, Rwandan road users are at a greater risk than those in neighboring countries.<sup>13</sup> Since Moto-Taxis constitute the majority of the motorcycles on Rwandan roads, it is essential to address this population for potential solutions.

In addition, these drivers operate underneath larger Moto-Taxi companies, meaning that new and existing regulations may be enforced amongst riders through the Moto-Taxi companies.<sup>18</sup> Therefore, these drivers make up a majority of the motorcyclists on the road and have a uniform target point (the companies) to change their behavior. Furthermore, these drivers are responsible for the lives of the passengers whom they are carrying. With 38.7% of drivers having experienced a crash in their lifetime, improving equipment and education of each Moto-Taxi driver has the potential to save both the driver and their passenger from severe injury.<sup>15</sup>

### 3.3 CURRENT EFFORTS

#### ***FERWACOTAMO***

The Federation's purpose is advocacy and policy implementation, acting as a pivotal link between riders and government agencies. FERWACOTAMO has been involved in many road safety interventions and has been recently focused on COVID safety for Moto-Taxi operators and passengers.

#### ***Healthy People Rwanda (HPR)***

Healthy People Rwanda is a non-governmental organization focusing on empowering disadvantaged youth, single

mothers, and other projects around the development of healthcare in Rwanda. Within the road safety sphere, HPR launched a First Aid Initiative program in 2017 aimed at promoting road safety and first aid. This program has focused on education of driving students, training of health club teachers, volunteers, and motor drivers, as well as advocacy meetings.<sup>12</sup>

### ***Police***

The police force within Rwanda is in charge of enforcing proper helmet and road behavior. Recently, the police have led road safety initiatives within primary and secondary schools. They have also worked increasingly with foreign coach companies to improve driving safety on their frequent Kenya/Uganda to Kigali trips.<sup>3</sup>

# 4

## Rwanda 2030: Playbook

### STRATEGIC OBJECTIVES

At the core of road safety projects lies a “Safe System Approach” that incorporates the following ideas:

1. Crashes will always occur, no matter the prevention efforts using the roads incorporates an element of risk.
2. The people responsible for designing and maintaining the roads have to share responsibilities within the general framework.
3. Interventions should be seen as long-term goals rather than one-time efforts.
4. A multi-sectoral approach should be taken that incorporates different aspects of the government’s goals.

The overall framework of this playbook is broken into three sections. Firstly an outline for an economic case is developed. This includes determining the material and socioeconomic costs of vehicular accidents, determining funding sources, and allocation of resources through different initiatives. Secondly, the ‘Five Pillars of Road Safety’ from the UN’s decade of road safety project, are outlined. The activities that are most relevant to Rwanda are highlighted in greater detail. Finally three major intervention points are identified and solutions to address these areas are discussed.

## DEVELOPING THE ECONOMIC CASE FOR ROAD SAFETY

### *Introduction*

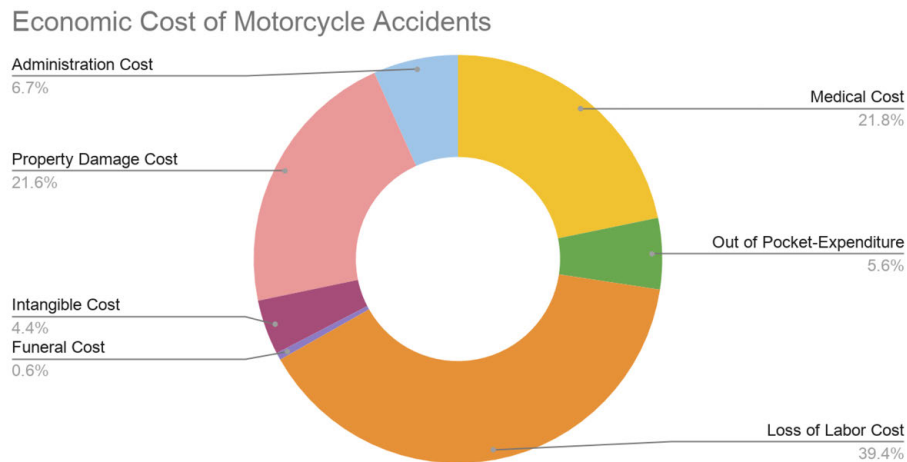
Several systems need to be developed in order to implement the needed policies. Firstly a framework for calculating the overall cost of car and motorcycle crashes must be completed to determine the magnitude of the problem and the quantity of resources that should be allocated towards solutions. Secondly a funding system must be implemented that maintains the needed amount of money for the desired projects. Finally a plan of action that determines exactly how the funding should be distributed to these projects.

### *The Cost of Crashes*

Determining the overall value of preventing a crash is a crucial point of any road safety agenda. However, many problems exist when determining an exact price. The value of a life's statistical benefit to society is a greatly debated topic. However, the report *Towards Zero*, by the Organisation for Economic Cooperation and Development, uses a useful approach by breaking down this problem into two sub-categories.<sup>8</sup> The first is the **human capital approach** using economic analysis to determine the lost output value, and the second is a **willingness to pay approach** that focuses on how much individuals or organizations are willing to pay to prevent crashes. A mixture of these two approaches can be used to address the issue of Rwanda's road safety injuries and deaths. While the human capital approach is far more common, using a willingness to pay metric allows for a more relatable value associated with reducing risks. Appendix A: Human Capital and Willingness to Pay Metrics highlights these metrics in further detail.

The balance between these two approaches is different from country to country, and the level of depth is primarily determined by the amount of data collected and resources allocated for the studies. Relevant data may include factors such as insurance policies and how much compensation people would be satisfied with after a vehicle accident. A 2011 study (published in 2013) from the Kigali Teaching University Hospital (UTH-Kigali), does exactly this, breaking down the casualty and accident related costs of 269 motorcycle accidents.<sup>13</sup> To do this, a combination of human capital and willingness to pay metrics was used and a full breakdown of how these costs were calculated can be found in appendix A.

The data shown in figure 4.1 identifies the breakdown of the **\$1.23 million USD** cost incurred to treat the **269 accidents**. This equates to approximately **\$5000 USD per patient**.<sup>13</sup>



**Figure 4.1:** Economic cost of motorcycle accidents, from De La Croix et al.

With a population of 12.6 million people and a reported 258 crashes per 100,000 people, Rwanda experiences roughly **30,000 road crashes resulting in injury per year**.<sup>1</sup> Multiplying these 30,000 injuries from crashes by the average **\$5,000 USD per crash** from the UTH-Kigali study, we can estimate a potential cost of roughly **\$150M USD**.

An alternate analysis can be done by scaling Vietnamese road crash costs for Rwanda's lower GDP. Road injuries cost Vietnam more than \$5.4 billion USD annually, which accounts for 2.9% of its GDP.<sup>2</sup> Scaling this to Rwanda's GDP of \$10.4 billion USD, this would extrapolate to **\$300M USD in costs**.

These two methods are simply to provide ballpark estimates and make assumptions surrounding the similarity of Kigali crashes to rural crashes, as well as the types of crashes in Vietnam to those in Rwanda. In order for a more accurate projection, further studies must be completed over extended periods of time to understand the trends and accuracies of these costs. For the purpose of this report, we can estimate that Rwanda incurs an annual cost of **\$150-300M USD** due to road crashes.

While the annual costs of these crashes are important, more essential is predicting the annual savings due to intervention. In Vietnam, with an annual road crash cost of \$5.4B USD, AIP's intervention influenced an annual savings of \$385M USD, or 7% of the cost.<sup>2</sup> If a similar result to Vietnam is achieved, Rwanda would be able to save 7% of their annual \$150-300M USD cost – **\$10.7-21.4M USD**. Again, key assumptions are made surrounding the similarity of Rwanda's road situation to that of Vietnam, but we can estimate an annual savings of **\$10.7-21.4M USD**.

### *Funding Sources*

The traditional sources of funding for road safety programs are outlined below.

1. Government Taxation Programs - The government receives money through taxation programs, road safety measures are tied into the overall goals of the government, and usually contribute to the project budget aspect.
2. Fees and registrations - Fees that are associated with vehicle registrations, parking, permits for different types of vehicles and importing tasks, fines for not abiding by road safety rules and all systems set in place that charge drivers and riders extra fees above tax costs. This money can be collected by government agencies such as the police, as well as private sector agencies working on their behalf.
3. Insurance Premiums - The government will collect money from insurance companies that provide vehicle insurance premiums. More accidents lead to higher premiums, so this allows the government to raise more money for road safety programs. This money typically goes towards education and publicity initiatives.

Alternatively, the funding could be provided in the form of government grants towards road safety projects and having a 'safety tax' on items such as helmets that are crucial to the target demographic. Financial benefits towards safe road usage can change the behavior of manufacturers, importers, and infrastructure managers by changing the market principles.

### *Distribution*

There are two sides to distributing funding towards relevant road safety problems: the costs of preventing accidents, and the cost of dealing with the accidents that have already happened. Treatment costs are spread widely across different areas, which makes it difficult to create a centralized database to directly measure the impact of programs. The prevention costs, however, are straightforward in that they are only assigned to a few different interest groups.

In the same 2011 UTH-Kigali study, the total economic cost of motorcycle accidents in Kigali was 1,236,207.31 USD. This notably included medical costs (269,000.84 USD) and loss of labor costs (487,030.30 USD).<sup>13</sup> These treatment costs incurred from hospital care, insurance premiums, and capital losses greatly outweigh the prevention measures. However, with investment in prevention measures, these treatment costs can be decreased significantly, thus shifting spending from treatment to prevention and saving lives in the process.

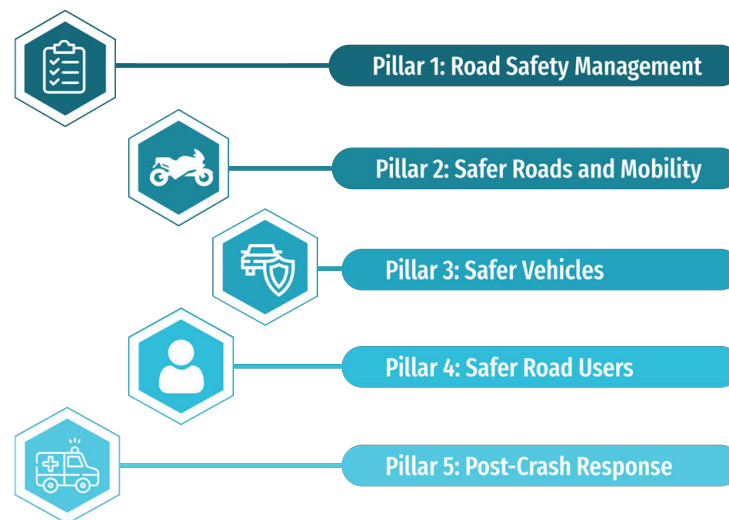
Below are some necessary steps for a realistic allocation program.<sup>19</sup>

1. Define a target.
2. Assess proposed safety measures.
3. Look into and develop alternative policies.

4. Estimate the effects of all different found measures.
5. Analyze the uncertainties present within the process.
6. Present a final policy and application program.

### THE FIVE PILLARS OF ROAD SAFETY

Announced by the United Nations general assembly in March 2010, the “Decade of Road Safety” was an initiative that aimed to reduce the number of worldwide deaths and economic loss caused by vehicle accidents by half. While the initiative failed to achieve a reduction worldwide deaths by 50%, the recorded worldwide deaths were 650,000 fewer than projected without the initiative. Thus, while the “Decade of Road Safety” was not able to reach its ambitious goal, it *can* serve as a useful tool for solution ideation and success quantification in Rwanda. Specifically, this initiative outlined five core strategies that underlie a successful system of road safety, as can be seen below.



**Figure 4.2:** Five Pillars of Road Safety

A brief outline of the 5 pillars can be found below, with an extensive overview in Appendix B: The Five Pillars of Road Safety.



### ***Pillar 1: Road Safety Management***

Pillar 1 consists of the creation of regional agencies that can collect data and strategize initiatives beneficial towards their region. The UN outlines six different activities to consider, but only the three most relevant to Rwanda are included here.

1. Based on the existing UN guidelines for road safety standards, create regional reports specific to various regions.
2. Establish a lead agency and national strategy on road safety to align different regions.
3. Secure funding to implement initiatives and monitor initiatives for emerging trends.

With the first pillar completed, a government agency is in place to enact the following pillars.

### ***Pillar 2: Safer Roads and Vehicles***

Pillar 2 calls for safer roadway systems for not only vehicle operators but pedestrians and cyclists through the implementation of different road construction techniques.

1. A unit of road developers and civil engineers should be created to eliminate ‘high-risk’ roads and work towards implementing safer road standards.
2. Record all accidents categorized by transportation methods, number and location of accidents – allows for understanding of the needs and dangers of road users.
3. Conduct continuous roadway safety checks, including speed management, work safety zone regulations, and proper intersections.

### ***Pillar 3: Safer Vehicles***

Pillar 3 calls for the enforcement of vehicle quality standards and education regarding safer vehicles. Due to the nature of most roadway accidents, increasing the safety of individual vehicles will directly benefit all people that use the road systems.

1. Lay out detailed requirements for driver training protocol and encourage vehicle standards such as mandatory helmets standards, seat belts, ABS braking systems, etc.
2. Track what vehicles and safety options are available in the market and ensure sufficient quality vehicles are available to consumers.

### ***Pillar 4: Safer Road Users***

Pillar 4 recognizes that driver education, from the level of beginners to the broader community, is an essential component to a safe road system. It particularly focuses on driver awareness of necessary guidelines and enforcement of said guidelines.

1. Develop awareness campaigns regarding dangers of unsafe road conditions and implement through social media/broadcasting.
2. Re-evaluate old laws to ensure they are reasonable. For new laws, reinforce them with documentation demonstrating the effectiveness and motivation of such initiatives.
3. Implement a graduated license system for new drivers, requiring them to complete a multi-stage process in order to advance to each level until fully certified.

### ***Pillar 5: Post-Crash Response***

Pillar 5 focuses on developing an efficient post-crash response system. Existing systems, such as ambulance care and first-aid awareness campaigns, have the potential to reduce the critical time between an accident and when the victim receives treatment.

1. Develop a pre-hospital trauma care system, such as teaching citizens to perform first aid and immediately calling an emergency phone number.
2. Continuously research most effective post-crash response systems / what does and does not work well for specific hospitals
3. An emphasis on rehabilitation measures can allow individuals to contribute to society and minimize the economic effects of those involved in serious accidents.

## **A RWANDAN PERSPECTIVE**

### ***Stakeholder Insights***

Beyond national statistics, hospital data, and an in-depth analysis of road safety standards across the world, comprehensive interviews with a diverse group of Rwandans and road safety experts provided further insight into solution avenues. For this report specifically, the interviewees were specialist in the following categories: research scientists, engineers, medical doctors, bike shop owners, motorcycle drivers (FERWACOTAMO members), motorcycle and helmet manufacturers, government employees, Asia Injury Prevention Foundation executives, Protec Tropical Helmets executives, and Healthy People Rwanda members. During interviews, each interviewee was asked various questions that related to their professions and relationship with road safety in Rwanda. These questions are included in Appendix C: Specific Interview Questions.

In addition to profession-specific questions, each interviewee was asked what they believed could be the effort that might have the biggest impact in reducing road injuries and fatalities in Rwanda. In response to this question, interviewees provided a very diverse range of answers, which are detailed in Appendix D: General Interview Responses. In summary, responses were generally able to be categorized in one of the following two categories: education (drivers, children, or passengers) or improved helmet quality.

Through conducting interviews with various stakeholders and gaining further insight into potential solution avenues moving forward, it became apparent that no single solution will mitigate the high rates of motorcycle injuries and deaths in Rwanda, but there exist many solution avenues that can have meaningful impacts on their own. Highlighted below are some of the most feasible and effective solution avenues that were suggested by interviewees, supported by the Five Pillars of Road Safety, and further reinforced by empirical data.

### ***Potential Solutions***

#### **Solution 1: Helmet Standards**

Combining the road and vehicle safety aspects of the pillars, as well as the numbers of motorcycles present on the streets and risk of motorcycle accidents, an area of possible improvement was identified to be implementing a set of standards for helmet quality. This adds to the First Pillar of Road Safety, as it would bring Rwanda closer to the existing UN standards, particularly UN ECE 22 that directly relates to helmet standards.

#### **Solution 2: Road Safety Education**

Road safety education programs have been highlighted by interviewees across disciplines as well as various national and international studies. In particular, FERWACOTAMO members, medical doctors, motorcycle manufacturing employees, engineers, and government officials all cite some form of educational program as the most impactful first step towards safer roads in Rwanda.

Furthermore, implementing universal and updated road safety education programs is further supported by the Fourth Pillar of Road Safety: Safer Road Users. Safer Road Users emphasizes the need for enforcement of regulations and education in order to increase safer driver and pedestrian practices.

#### **Solution 3: Subsidization Measures**

The need for high quality and affordable helmets has been emphasized by multiple interviewees. Unfortunately, high quality helmets tend to be economically infeasible for individual Rwandan citizens. Similar to Solution 2: Road Safety Education, this avenue is further supported by the Fourth Pillar of Road Safety: Safer Road User by encouraging safer equipment for all road users.

# 5

## Helmet Standards

### 5.1 CURRENT STATE OF HELMET STANDARDS IN RWANDA AND OTHER COUNTRIES

In evaluating Rwandan road injuries in the context of other countries, independent research and interviews with motorcycle safety experts identified the need for helmet standards / safety regulations. When comparing key metrics between Rwanda, Vietnam, Uganda, and the US, Rwanda still faced the highest road fatality rate despite the strongest compliance to helmet wearing laws. (Note: Vietnam and Uganda were chosen due to previous road safety initiatives in these countries).

	<b>Rwanda</b>	<b>USA</b>	<b>Vietnam</b>	<b>Uganda</b>
<b>Helmet Fastening Required</b>	Yes	No	Yes	No
<b>Compliance</b>	10/10	Unknown	8/10	5/10
<b>Helmet Safety Regulations</b>	No	Yes	Yes	No
<b>WHO Estimated Fatalities/100k People</b>	29.7	12.4	26.4	29

**Table 5.1:** Standards Across Countries

The data shown in table 5.1 identifies one factor that this high fatality rate can be attributed to - Rwanda's lack of safe helmet requirements. Despite a national helmet law and 10/10 compliance in wearing helmets, the law doesn't specify or enforce the quality of said helmets.<sup>22</sup> As such, a discrepancy exists in that users are wearing helmets, but these helmets aren't necessarily protective, leading to a fatality rate of 29.7 per 100,000 people.

To investigate how to implement helmet standards, prior standard implementation in Vietnam were used as reference. In Vietnam, through intervention from the Asia Injury Prevention Foundation, a new helmet standard was introduced. This standard, paired with a Universal Helmet Law, required all helmets sold in Vietnam to conform to the specified standard and has saved approximately 15,000 people in the decade since its inception.<sup>2</sup>

## 5.2 BENEFITS OF IMPLEMENTING HELMET STANDARDS

In short, the benefits of implementing helmet standards are significantly greater than the cost of doing so. The United Nations Motorcycle Helmet Study reports that, for low-income countries, the benefits of purchasing higher quality helmets outweighs the cost 2.2:1.<sup>21</sup> Comparing this with low quality helmets, the study states that the cost benefit ratio for mass adoption of low quality helmets is 1:1 and provides no monetary benefit to society.<sup>21</sup> With this in mind, high quality helmets are essential, and in order to ensure helmet quality, a uniform helmet standard must be put in place.

## 5.3 STANDARD IMPLEMENTATION

There are four steps involved in implementing a helmet standard. The first step is forming the guidelines to which a helmet needs to be judged. Once a standard has been decided on, the second step involves establishing legislation to enforce the new helmet standard. Then, in order to enforce the new standards, Helmet Testing Facilities must be built. And finally, the testing facilities must be used to enforce the new standards and the Police must enforce that the correct helmets are being worn on the streets. These processes can be seen below, but a detailed description of each process can be found in appendix E.

1. Determine Metrics to Establish a Standard.

- (a) Through comparing various global helmet standards, a safe helmet must have an information label and marking requirements, and have passed a impact, retention system, and roll off test.

*Note: This is not an expansive list, but simply an overview of the most universally used tests for standards testing.*

2. Establish Legislation to Implement Standards.

- (a) Establish a “Standards Committee” to regularly inspect and update the standards.
- (b) Require bi-annual inspections of helmet manufacturers .

3. Set up Testing Facilities.

- (a) Requires an assortment of testing equipment, that can be found, along with prices in the appendix.

4. Enforce Standards.

- (a) If helmets fail the tests outlined above, manufacturers will be subject to heavy fines.
- (b) Train police to recognize non-standard helmets, fine riders for non-compliance.

## 5.4 CURRENT ROADBLOCKS

### 5.4.1 PRICE

As outlined above, in order to implement testing facilities, cost will be a major factor. However, this cost is only a one time expenditure in that once the facility is set up, the only additional cost will be employees to run the testing. Proper care and maintenance can ensure long machinery lifetimes and prevent needless loss of capital. Additionally, the fines given to manufacturers for non-compliance will help cover any additional operational costs that are unforeseen.

### 5.4.2 MANUFACTURER COMPLIANCE

Though the riders are impacted greatest from these changes, the helmet manufacturers bear a significant portion of the cost.

With cost as the single most important driver in the purchase selection process of helmets, manufacturers are only able to sell their cheapest products. These helmets, without helmet standards, offer minimal protection and endanger the user. Giving manufacturers fines for failing quality helmets will make it in the manufacturer’s interest to create cheap, but effective helmets. This will require the manufacturer to implement more standards and checkpoints within their production lines and will incur a capital cost. The downside of this is that the price could fall back onto the consumer. This is where possible subsidization could be a factor, as outlined in later sections.

# 6

## Road Safety Education

### 6.1 MOTIVATION

Better education about the dangers associated with roadway use has the potential to decrease accidents. Many countries, including Rwanda have started to make education a priority within their road safety campaigns<sup>16</sup>, and are always looking for new perspectives and better ways to get their messages across. While criticisms exist with regards to these educational programs<sup>4</sup>, they are mainly due to a lack of evidence and resources to implement the needed programs.<sup>16</sup> Surveying worldwide techniques will allow for a diverse range of perspectives and also cross-referencing with different databases to see if results are statistically significant.

### 6.2 EDUCATION ACROSS THE WORLD

Worldwide road safety education programs can be split up by areas of intervention. The report “The efficacy of road safety education in schools: A review of current approaches”<sup>20</sup> by the Australian center for Automotive safety research identifies five key areas.

### 6.3 INTERVENTION POINTS - CASE STUDIES

Each of these different road safety education programs is assessed internally by the country that has implemented them. Program documentation has been cited, which can be used to form the basis of further studies on what should be implemented in Rwanda alongside current education programs.

### 6.3.1 INDIRECT APPROACHES

The idea behind an indirect approach is that during the teenage years there are many changes that humans have to overcome. This also happens to be the time when people start getting their driver's licenses and become a potential hazard on the roadway at a higher percentage than average<sup>14</sup>. Exposing youth to the dangers associated with unsafe road use can help prevent injuries and reduce their overall risk.

#### EXAMPLE 1: AUSTRALIA - REDUCE RISK INCREASE STUDENT KNOWLEDGE (RRSK)<sup>6</sup>

This program aims to provide secondary school students the tools they need to deal with the intrinsic and extrinsic pressures associated with roadway usage. It is an 8-part course where students travel to a designated education center and supplemented with regular classroom instruction.

#### EXAMPLE 2: UNITED STATES - LIFESKILLS TRAINING PROGRAM<sup>11</sup>

In the United States primary and early secondary aged children are provided with an educational program to reduce substance use and abuse. It is again resilience-based and utilizes techniques such as "behavioural homework" to learn cognitive skills and raise self-esteem, group discussions, and scenario modeling.

### 6.3.2 ONE-TIME INTERVENTIONS

Many different road safety initiatives are spread out through different sectors of governments and educational systems. Many of these organizations, such as the police, often conduct presentations in schools about the dangers of the roadway. Interactive exhibits, live demonstrations, and disturbing images of road accidents are some of the ways in which education can be provided over a shorter time frame.

#### EXAMPLE 1: AUSTRALIA - YOUTH DRIVER EDUCATION PROGRAM<sup>24</sup>

The YDEP is a 90 minute lecture given to all secondary school students in Australia. It covers crash statistics and identifies all of the main causes of crashes such as distraction, intoxication, fatigue etc. The main idea is to expose students to the ideas of choice, risks, and consequences.



## EXAMPLE 2: AUSTRALIA - ROAD AWARENESS AND CRASH PREVENTION PROGRAM<sup>5</sup>

The Australian Fire services conduct a secondary school awareness campaign focused on developing concentration and common sense with respect to road safety. A practical demonstration is given of crash procedures, and examples of real-life implications of crashes discussed.

## EXAMPLE 3: UNITED STATES - SAFETY CITY<sup>17</sup>

The Safety City is an unique program to provide elementary and earlier aged children with the fundamentals of road safety. For the youngest of kids they learn to cross the road safely, call emergency services, and avoid unsafe situations. A mock intersection is used to demonstrate these skills.

### 6.3.3 DRIVER TRAINING

Driver education is a critical stage of managing road safety. It is often thought of as the number one solution to managing road safety issues. However, the literature suggests a mixed effectiveness of this type of education. This means that any driver education system must be carefully balanced to avoid negative effects that might come up such as overconfidence and increased risk-taking behaviours. To combat this, an OECD study from 2006<sup>8</sup> created this useful goals for driver's education matrix.

	Knowledge and Skill	Risk Increasing Aspects	Self-Assessment
<b>Goals for Life and Skills for Living</b>	Understanding the importance of lifestyle, age, group, culture, social circumstances, etc.	Understanding the importance of sensation-seeking, risk acceptance, group norms, peer pressure, etc.	Understanding the importance of introspection, competence, personal preconditions for safe driving, impulse control, etc.
<b>Goals for and Context of Driving</b>	Understanding the importance of modal choice, time-of-day, motives for driving, route planning, etc.	Understanding the impact of alcohol fatigue, low friction, rush hour traffic, peer-age passengers, etc.	Understanding the importance of personal motives, self-critical thinking, etc.
<b>Driving in Traffic</b>	Mastering traffic rules, hazard perception, etc. Automating elements of the driving process. Co-operating with other drivers, etc.	Understanding the risks associated with disobeying rules, close-following, low friction, vulnerable road users, etc.	Calibration of driving skills, developing a personal driving style, etc.
<b>Vehicle Control</b>	Mastering vehicle functioning, protective systems, vehicle control, etc. Understanding the impact of physical laws.	Understanding risks associated with non-use of seat belts, breakdown of vehicle systems, worn out tires, etc.	Calibration of car control skills

**Table 6.1:** Goals for Driver's Education Matrix

They say that driver training must cover as much of this chart as possible if it is going to be effective in the real world. The driver must learn to understand not only what to do in certain road safety scenarios but also why these scenarios come into play.

#### EXAMPLE 1: AUSTRALIA - SAFE DRIVE TEST DRIVE<sup>23</sup>

Safe Drive Test Drive is a private one-day course aimed at novice drivers. It is focused on developing defensive driving skills, and uses in-car tutorials and demonstrations. The aim is to cover as many different road safety issues within a short time frame.

#### EXAMPLE 2: CANADA - BEGINNER DRIVER'S EDUCATION<sup>7</sup>

Canada implements an extensive driver's education program that includes a minimum of 20 in-class hours, 10 in-car hours, and 10 hours on further activities. This is part of their larger goal of improving road safety for all users, by addressing the problems at their very beginning.

# 7

## Subsidization Measures

### 7.1 MOTIVATION

Based on interviews with engineers and medical doctors in Rwanda, helmet subsidization programs were identified as a key government intervention point. Dr. Terry Smith—a biomedical engineer who currently manages a motorcycle crash impact test lab—showed that many of the helmets worn in Rwanda are imported from other countries, such as India and China. He performed the helmet impact test using a Monorail tester, which is used to quantify the head acceleration an individual would experience in a motorcycle crash at 35 km/hr. During this test, the most common helmets used in Rwanda sustained 831 g of force—enough to result in a skull fracture. In contrast, the helmets that are currently used in Vietnam sustained 183 g of force, which would result in a concussion. Despite the better results using the Vietnamese helmet, it costs almost twice that of the Rwandan helmet. Conversations with Dr. Innocent Nzeyimana—the President of Healthy People Rwanda, a road safety advocacy organization—revealed that while many Rwandans are willing to wear helmets, most are unaware of how little protection they are receiving due to the poor quality of current helmets.

In addition to interviews with engineers and medical doctors, additional background research was performed in order to determine if subsidization of helmets was a worthwhile goal for the government. The 2016 United Nations Motorcycle Helmet Study found that the benefits of purchasing high quality, albeit more expensive, helmets outweigh the costs of purchasing lower quality helmets by a factor of 2.2. They found that if low-quality and cheaper helmets are purchased, the estimated savings and the costs negate each other, yielding a cost-benefit ratio of 1 and indicating no monetary incentive to support low-quality helmets.<sup>21</sup>

Thus, given that many of the most commonly used helmets in Rwanda do not provide adequate protection in terms of impact response specifications, helmet subsidization serves as a potential solution to ensure people can afford quality helmets that provide sufficient protection. Furthermore, helmet subsidization can also be financially advantageous, rather than solely beneficial for public health efforts.

## 7.2 CASE STUDIES AND EXISTING PROGRAMS

Although country-specific data would be required to provide a single number (e.g. percent reduction in injuries, money saved, etc.) to predict the success of a quality helmet subsidization program in Rwanda, analyzing similar programs in other countries may provide insight towards how this may improve road safety in Rwanda.

### 7.2.1 VIETNAM

As outlined in Section 5 - Helmet Standards, the Asia Injury Prevention (AIP) Foundation has worked extensively in Vietnam in order to reduce road traffic injuries and deaths. In addition to their introduction of a new, quality helmet, AIP implemented the "Helmets for Families" initiative.

This program was run through schools and either provided heavily subsidized safer helmets or allowed parents to exchange sub-standard / damaged helmets for subsidized, quality helmets. From this initiative, parents, teachers, and students from the 2013-2014 school year received 25,452 high quality helmets. Of these 25,452 high quality helmets, 4,289 were subsidized in exchange for sub-standard helmets.<sup>2</sup>

While the "Helmets for Families" initiative provided thousands of Vietnamese students, teachers, and parents with affordable, safe helmet options, it was only made possible by Protec Tropical Helmets, AIP's social enterprise helmet factory. Indeed, the free and subsidized helmets were funded specifically from the profits from Protec helmet sales that were reinvested back into AIP campaigns. Therefore, in order to achieve a successful quality subsidization program, a source of reliable and ongoing funding must be identified.<sup>10</sup>

### 7.2.2 UGANDA

Uganda has also aimed to decrease road traffic injuries and deaths in recent years. The Uganda Helmet Vaccine Initiative has promoted the development of helmet standards as well as legislative change to the Traffic and Road Safety Act. After three years of various programs, the Uganda Helmet Vaccine Initiative partnered with AIP and launched phase III of the "Your life is your wealth– wear a helmet!" campaign.

This campaign aimed to educate motorcycle taxi operators through hosting road safety workshops that focused on crash prevention, helmet use, and defense driving. Over 600 drivers attended and all attendees received a subsidized quality helmet for their participation.

The “Your life is your wealth– wear a helmet!” campaign may have been implemented at a smaller scale than the “Helmets for Families” initiative, but collaboration between AIP and the Uganda Helmet Vaccine Initiative still provided safer equipment for many drivers.

### 7.3 INTERVENTION POINTS

Through using Vietnam and Uganda as case studies, Rwanda can consider two potential routes in order to implement helmet subsidization measures.

First, a short-term, small scale solution—similar to the “Your life is your wealth–wear a helmet!” workshop from Uganda—may be considered. In order to implement a campaign such as this, the following steps must be implemented:

1. Identify manufacturing companies that would be interested in supplying free or reduced cost helmets for a one-time event to promote road safety.

Potential collaborators include:

- (a) TVS Motor Company
- (b) Ampersand
- (c) AIP + Protec
- (d) Future domestic manufacturing organizations

2. Identify organizations or branches of government that may be interested in hosting and organizing such an event.

Potential organizing bodies include:

- (a) FERWACOTAMO Motorcycle Federation
- (b) Healthy People Rwanda
- (c) Rwandan Ministry of Infrastructure
- (d) AIP + The Global Helmet Vaccine Initiative (GHVI)

3. Identify the educational material that would be shared at the workshop. Relevant material may be adapted from the Ugandan workshop or drawn from other countries, such as Canada, Australia, or the United States, as outlined in Section 6: Road Safety Education.

4. Identify methods of advertising the workshop. This may include publicizing the event at hospitals, encouraging FERWACOTAMO members to promote it, and/or collaborating with motorcycle distributors and bike shop owners.

By implementing a one-time, short term helmet subsidization initiative, Rwanda may simultaneously educate motorcycle drivers and begin to foster connections with important stakeholders, such as FERWACOTAMO and motorcycle manufacturing companies, who's support will be integral for future long-term solutions. Furthermore, workshops such as these may provide hundreds of drivers with new and safer helmets, thereby increasing safety for many Rwandan road users.

Second, Rwanda may consider enacting a long-term and ongoing helmet subsidization program, similar to the "Helmets for Families" initiative in Vietnam. Ongoing programs require far more planning than one-time workshops. Therefore, in order to emulate the "Helmets for Families" initiative, all of the steps above must be performed as well as the following:

1. Identify a long-term, sustainable source to fund the program. This would likely entail partnership with organizations such as AIP and Protec.
2. Identify the medium through which the program will be operating. For instance, "Helmets for Families" operated through schools. However, few Rwandan children use motorcycles. Thus, other media may need to be considered.

By implementing a long-term, sustainable helmet subsidization initiative, Rwanda can hope to keep motorcycle drivers safer on the roads in the event of accidents. This initiative, however, requires many steps to be taken beforehand in order to ensure a successful program.



# Human Capital and Willingness to Pay Metrics

## HUMAN CAPITAL

The key underlying assumption is that each road accident represents an amount of material and human capital. Material capital is the damages to vehicles and objects resulting from an accident, and human capital can be computed from the associated individual(s) loss of productivity. Past these numbers, the emotional and psychological costs add an extra layer of difficulty to determining these numbers as they are highly subjective and are often added to the overall score in an “immaterial cost section”. This subjectivity can be countered using the next approach.

## WILLINGNESS TO PAY

The amount to which people are willing to pay to prevent road crashes captures public sentiment as well as the “immaterial costs” mentioned above very well. The downside is that they lack the generality and specificity provided by the human capital approach. This metric can be calculated through surveying the population about their willingness to spend money on initiatives related to road safety.

	<b>Estimation of Costs</b>
<b>Intangible cost (i.e., pain, grief and suffering)</b>	Calculated as a percentage of lost labor output (i.e., 20%). Following similar approach by the Asian Development Bank (Asian Development Bank, 2003), intangible costs will be estimated as 20% of the total lost labor cost.
<b>Lost labor output (productivity losses)</b>	Caretaking cost cost calculated by multiplying the number of days of work lost due to the accident by each accident victim and caregiver by the average daily wage rate. For fatalities and permanent disabilities the calculation will be performed over the rest of their expected productive working life and discounted to an equivalent present value.
<b>Medical cost</b>	In-patient costs will be obtained by multiplying the estimated total number of in-patient motorcycle accident cases with the average in-patient treatment cost. Out-patient costs will be obtained by multiplying the estimated total number of outpatient motorcycle accident cases with the average outpatient treatment cost. The summation of in-patient and out-patient cost gives total medical cost.
<b>Out-of-pocket expenditure</b>	This will be computed by multiplying the average out of pocket expenditure incurred by patients by the estimated number of motorcycle accident cases.
<b>Funeral cost</b>	The estimated funeral cost will be obtained by multiplying the average funeral performance cost with the estimated number of deaths.
<b>Property damage cost</b>	The average cost of repair of motorcycle will be multiplied by the estimated number of victims whose bikes will be damaged. Motorcycle replacement cost will be computed by multiplying the average cost of replacing a motorcycle with the estimated number of motorcycles that will be damaged beyond re-pairs. The cost of valuable items lost will be computed by multiplying the average cost of valuable item lost by victims at the time of the accident with the estimated number of victims who lost items. The total property damage cost will be thus obtained by summing the motor cycle replacement cost, repair cost and the cost of valuable lost items.
<b>Administration cost</b>	Insurance cost is made up of average insurance claim paid to insured accident victim multiplied by the number of motorcycles insured. The police investigation cost will be obtained by estimating the gross hourly wage rate of a police officer multiplied by the number of reported annual accident motorcycles. As well as the estimated cost of other resources such as fuel, communication and stationary used during the investigations. The sum of the insurance cost and police investigation cost constitutes the total administration costs.

**Table A.1:** Estimation Method of Cost Components<sup>13</sup>



# B

## The Five Pillars of Road Safety

### PILLAR 1: ROAD SAFETY MANAGEMENT

*Activity 1 - Follow the existing **UN guidelines** for road safety standards, and work towards creating your own reports*

*Activity 2 - Establish a lead agency and national strategy on road safety*

To deal with the constantly changing environment surrounding road and vehicle safety, it is important that agency(ies) exist to spearhead the development of road safety rules and regulations. The development should be split up into different groups of long-term and short-term goals with responsibilities assigned to specific groups. These agencies should report to a particular branch of the government which will allow multi-sectoral working relationships to be formed. Partnerships of interest might include Universities and NGOs as well as creating a system for data collection.

*Activity 3 - Set targets and monitor system for national road safety initiatives*

In order to maintain a system such as this, a plan for securing a funding source is required. A complete business case is suggested, with detailed analysis of the relevant budget constraints and reliability of the different sources. This is a crucial step for the entire effort, as many of the different avenues require funding. For a monitoring system, again specific agencies should be chosen, and incorporate data collection techniques for better observation of long and short term trends.

## PILLAR 2: SAFER ROADS AND VEHICLES

### *Activity 1 - Advocate for safety at the road development level*

Dedication of a certain amount of the overall budget for the development of new roads should be encouraged. Additionally, setting a target to eliminate roads deemed as ‘high-risk’ by a certain date is also important for improving road safety. After this date, the road developers should be held legally responsible for improving road standards as well as undertaking the necessary data collection for studies of road conditions. A specialist unit could be created to work with road developers and civil engineers to aid in the following of UN standards and promotion of safe roadway development standards.

### *Activity 2 - Understand and regulate for the needs of all road users*

A great amount of research and development should be undertaken in order to better understand the safety needs of all road users. Travel and market demands, demographic and geographical conditions, and accessibility needs must all be taken into consideration. A record should be kept of all accidents, which must then be categorized based on transportation methods, number of accidents, and locations of accidents. This research can be used to design new roads. Additionally, an audit of road plans should perform a detailed assessment of whether or not the standards were met.

### *Activity 3 - Maintain safe operation and constant improvement of the existing roadways*

Road authorities should be conducting continuous safety checks and advising for engineering techniques that improve road safety. Checks include speed management, design of the roadways with vehicle speed in mind, and work safety zone regulations. Again, all common modes of transportation should be taken into account when designing and updating the specifications. Private sector partnerships also have great potential to ensure that safe design practices are applied through understanding the relevant human and vehicle characteristics of the problem.

## PILLAR 3: SAFER ROAD VEHICLES

### *Activity 1 - Apply physical vehicle safety regulations and testing protocol*

Different standards exist in regards to vehicle safety regulations that can be applied to this area, such as the United Nation’s World **Forum for the Harmonization of Vehicle Regulations (WP 29)**. This standard and ones like it lay out detailed requirements for driver training protocol and a list of vehicle standards that should be encouraged such as requiring helmets for all cyclists, seat belts, ABS braking systems, etc. for cars.

### *Activity 2 - Encourage development and education regarding safer vehicle conditions*

Consumer information regarding the safety metrics of the vehicles they use should be tracked as well as made publicly available. This information should especially be shared with government and private sector stakeholders who maintain fleets of vehicles. Furthermore, measures should be taken that advocate for all drivers to adopt safer vehicle equipment.

#### PILLAR 4: SAFER ROAD USERS

##### ***Activity 1: Develop and implement awareness campaigns***

An increased awareness regarding the dangers of unsafe road conditions can help to improve driver conduct. Awareness could be developed through a marketing campaign, the use of social media, and/or partnerships with various organizations. International standards for such campaigns should be constantly researched and their effectiveness must be investigated to ensure the maintenance of a world-class program.

##### ***Activity 2: Ensure compliance with existing laws and regulations, make sure laws and regulations are equitable as well as up to standards***

In order to ensure compliance with road safety regulations, they must be evidence-based and fair to those affected by them. Therefore, the majority of people on the roads must be able to afford to comply with road safety regulations and should not struggle monetarily in other aspects in life in an effort to comply. Furthermore, all new regulations should be accompanied by an official report and documentation that demonstrates the effectiveness and motivation of such initiatives. Laws regarding helmet standards, speed limits, driving while intoxicated, and seat restraints should be included.

##### ***Activity 3: Implement a graduated licence system for new drivers***

Most countries with effective road safety plans employ a graduated licence system for new drivers. This system requires new drivers to complete a multi-stage process in order to advance to each level until they are fully certified.

#### PILLAR 5: POST-CRASH RESPONSE

##### ***Activity 1 - Develop a system for pre-hospital and trauma care***

Before an ambulance can arrive on the scene, several actions can be taken to mitigate the effects of the crash. For instance, training citizens on how to perform first aid or how to extract someone from a vehicle are some possible actionable items. Furthermore, establishing an emergency phone number, that is well known throughout the population, heightens the likelihood that the hospital system will hear of the crash and respond faster. Better hospital systems are also much more equipped to deal with these emergencies overall.

##### ***Activity 2 - Perform research and development focused on best practices***

The healthcare system and best practices must continuously improve and evolve with the changing conditions within any country. Post-crash response should be thoroughly researched within the agencies responsible for overseeing these policies.

##### ***Activity 3 - Improve treatment of injured/disabled persons***

Immediate medical care is far from the only response needed to mitigate the long-term effects of road traffic accidents. Rehabilitation measures for those injured and those bereaved can help minimize lasting physical and psychological

side effects. These measures may include an effective legal response for fair settlements, as well as road insurance policies to ensure that those affected can continue to maintain their standard of living. Employers can also be incentivized and encouraged to hire those with disabilities to further minimize the economic effects for those involved in more serious crashes.



## Specific Interview Questions

### ASIA INJURY PREVENTION FOUNDATION EXECUTIVES

- What have you learned from your experience working with helmets in Vietnam that could be applied to Rwanda?
- Upon arriving in Vietnam, what influenced your decision to focus on helmet use?
- What were some initial difficulties in starting up AIP?
- What is something you know now that you wish you knew when you began AIP?
- Tell us about AIP's transition from focusing on just helmets to other road safety issues, such as speeding and driving skills.
- AIP has focussed efforts in Uganda, Kenya, and Tanzania. Could you tell us about your experiences there and what you learned?

### BIKE SHOP OWNERS

- What is your experience with riding motorcycles?
- Do you believe that road accidents are a major issue in Rwanda?

- How frequently do you see crashes involving motorcycles? What time of day/time of year do crashes happen most frequently? What do you think are the most common factors that contribute to these crashes?
- Do you believe that helmet quality affects injuries in Rwanda?
- How well do motorcycle helmets fit your head?
- Do you believe that people would purchase a new helmet if they knew it was safer?

#### ENGINEERS

- What are the minimum requirements of the most basic, cost-effective helmet standard?
- ECE 22 helmets can be expensive, thereby requiring high technical capacity. Have you found any other designs or standards that are more reasonable for Rwanda to implement?
- When designing one's own standards, which testable metrics do you believe are most important when evaluating the overall effectiveness of a helmet?
- From an engineering perspective, is there an existing simple and affordable add-on that could improve the helmets that are currently in use?
- Do you think it would be feasible and helpful to try and create an add-on that makes the current helmet more secure?
- How much does comprehensive helmet testing equipment cost? How much would establishing a test lab with the Rwanda Bureau of Standards costs?
- In the event that Rwanda cannot establish large-scale laboratories with intense testing equipment, how might they approach testing domestically manufactured helmets?
- What is the biggest obstacle to establishing helmet standards?

#### GOVERNMENT EMPLOYEES

- What road safety measures are your ministry currently focusing their efforts on?
- Beyond your ministry, do you know of any initiatives within the government to address road safety in Rwanda?
- What challenges has the government encountered when trying to implement road safety measures across the country?
- More specifically, what challenges has the government encountered when trying to test helmets and develop a helmet standard?

- What does the government need most help on when developing and implementing a curriculum in schools (develop material, execution, etc.)?
- What resources does the government currently have for building and maintaining helmet testing facilities? Has there been work towards this thus far? If so, who has been leading it?

#### HEALTHY PEOPLE RWANDA MEMBERS

- What is your role in HPR? What are your responsibilities?
- What do your current road safety efforts look like?
- Are there any resources that you currently need in order to support these efforts?

#### MEDICAL DOCTORS

- In which field of medicine do you specialize? Do you work directly with motorcycle crash incidents?
- What type of injuries do you see with road accidents? What is the most frequent?
- Based on the severity of injuries, do you believe that people are wearing helmets? Do you believe that they are wearing them properly?
- Do the head injuries you see tend to be lacerations and skull fractures or are they more internal in nature (e.g. concussions)?
- Are there many maxillofacial injuries? Is there a need for more full-face helmets?
- How much strain do road accident crashes put on your hospital's resources?
- How many road traffic accident patients does your hospital receive each day?
- Do you have any personal experience using motorcycles on a regular basis?
- How safe do you typically feel on these vehicles? Do you feel that the helmet provided is sufficient?

#### MOTORCYCLE AND HELMET MANUFACTURERS

- Tell us a little more about your company. What is your involvement with the company? How is business going?
- Do the motorbikes come with helmets when they are shipped?
- Do you sell helmets along with these bikes, or do you include them along with the purchase of a bike?

- Are you regulated by the government of Rwanda to buy a certain type of helmet with your motorcycle sale? Are people concerned about which helmet they get?
- What type of helmets do you distribute? Do you produce and how and test them? If so, what steps do you follow? If not, where do you obtain them?
- Would companies like yourselves be open to facilitate a new helmet if it was safer for the public?

#### MOTORCYCLE DRIVERS/FERWACOTAMO MEMBERS

- What is your role within FERWACOTAMO? What are your responsibilities?
- What are the requirements to be a member of FERWACOTAMO? How does one apply and/or join?
- Could the requirements to join the federation be changed? For example, would it be feasible to ensure that all members were trained in road education courses?
- What other motorcycle federations exist? How do they differ from FERWACOTAMO and what are their influences/sizes?
- How often do FERWACOTAMO and these other federations interact with the government? How do they interact with the government?
- Does FERWACOTAMO help with the enforcement of road safety rules for motorcycles? If so, what actions do they take?
- Would FERWACOTAMO be interested in advocating for helmet standards and/or education programs to the government?
- What specific skills and knowledge is tested on the test to become a motorcycle driver?
- Do you believe that all drivers are drivers properly trained to operate motorcycles?
- What is the biggest cause of motorcycle accidents' injuries and deaths, in your experience?
- What actions does the federation take if a motorbike rider is found in violation of the road safety rules?
- Do you believe Road Safety Week has been effective in educating drivers?
- Have you noticed any specific problems with the current helmet designs?
- How do motorcyclists obtain their helmets?
- Do you believe that all helmets are of the same quality?



- Do you believe that motorbike riders are able to discern between helmets that meet required standards and those that do not?
- Would a more affordable helmet help reduce injuries, or are there other factors contributing to a greater extent (e.g. comfort, driver education, speed limits, etc.)?
- If there were a safe, tested helmet within the same price range as the current helmets, do you believe that it would be difficult to motivate motorcycle suppliers to start providing that helmet instead? What hurdles would you anticipate?
- What level of education do moto taxi drivers tend to achieve? Do they typically graduate elementary school? Middle school? High school?
- How does a motorcycle driver obtain insurance? What kind of insurance is there? Who controls insurance?

#### PROTEC TROPICAL HELMETS EXECUTIVES

- What have you learned from your experience working with helmets in Vietnam that could be applied to Rwanda?
- What were some initial difficulties in starting up Protec?
- How have things changed in the nearly 20 years since Protec was founded? What is something you know now that you wish you knew when you began Protec?

#### RESEARCH SCIENTISTS

- From a research perspective, is there an existing simple and affordable add-on that could improve the helmets that are currently in use?
- How would you describe the quality of the helmets that the majority of people use?
- Where are the most commonly worn helmets in Rwanda coming from? From which country are they being imported and which companies are manufacturing them?
- How may computational modeling reduce costs of testing helmets? How different are these models in predicting safety, in comparison to full-scale crash testing sites?
- What are some of the most dangerous forces for head trauma in motorcycle crashes?
- How well do you think various helmet testing standards capture real-world accident impacts?

- What is the general sentiment around helmets in Rwanda? What may influence a person to wear or not wear a helmet?
- How do you obtain materials or equipment for your research? Could this be translated to a larger scale? What is the relative cost, as compared to the current methods used to import materials and equipment for Rwandan citizens?



## General Interview Responses

WHAT ONE CHANGE MIGHT HAVE THE BIGGEST IMPACT IN REDUCING ROAD INJURIES AND FATALITIES?

- To create programs to improve rider conduct and expand road safety public awareness campaigns. (FERWA-COTAMO member)
- To lobby the government for crash prevention programs and road safety public awareness campaigns. (Medical doctor)
- To improve driver education and implement passenger safety awareness programs. (Motorcycle manufacturer)
- To improve bike inspection, mark or disable damaged equipment, start incentivized driver education programs, distribute helmet insert, mandate individual helmets, and increase full-face helmets use. (Bike shop owner)
- To require helmet certification and implement a testing program. (Engineer)
- To conduct thorough studies surrounding accident scenes and develop a helmet testing center in Rwanda. (Research scientist)
- To implement a country-wide school curriculum focussed on road safety education. (Government employee)

- To educate Rwandans about road safety. (Healthy People Rwanda Member)
- To find dedicated government officials who are willing to implement helmet standards, enforce helmet wearing, and educate the citizens. (Asia Injury Prevention Foundation Executive and Protec Tropical Helmets Executive)



# How to Implement Standards

## ESTABLISH A STANDARD

The first step in implementing effective standards is simply coming up with the guidelines to which a helmet needs to be judged. UN Regulation 22.05 is the baseline standard for many countries around the world, however this standard is expensive and impractical for a country like Rwanda. Through comparing various global helmet standards, it is apparent that five different criteria are utilized across the board and are essential towards safe helmet design.<sup>22</sup>

### 1. Information Label Requirements

- (a) Manufacturers must place a label on or inside the helmet with information on the manufacturer's name, helmet model, date of manufacture, and construction materials.

### 2. Helmet Marking Requirements

- (a) In addition to this manufacturer label, a certification sticker is required. This is often done by a third party or government standards committee and guarantees the helmet has been tested and approved by the relevant standards.

- (b) Requires testing facilities, but no additional capital

### 3. Impact Test

- (a) Involves a series of controlled impacts where a helmet is positioned on a metal head form and then dropped in a guided fall onto various steel test anvils (Flat, Hemisphere, Kurbstone, Roll bar, Edge or a Horseshoe type) in order to simulate different impact surfaces. The head forms are instrumented with an accelerometer to measure peak G force. The helmet is rejected if the peak acceleration is greater than 260 G's. This test simulates a crash at 35 km/h.<sup>9</sup>
- (b) Typically costs \$80,000-100,000 USD for a Monorail system to do Impact testing

#### 4. Retention System Strength

- (a) This tests the strength and effectiveness of the chin strap. Here, a helmet is placed on a metal headform and the strap buckled under the jaw. The jaw is loaded downwards with a 23kg mass for one minute. At once, the 23kg mass is removed (causing slack in the strap) and a 38kg mass is added (causing the strap to be tested). If the retention system breaks or has a maximum deflection of over 30mm, it fails.<sup>9</sup>
- (b) Typically costs \$10,000 Retention testing equipment

#### 5. Roll Off Test

- (a) The helmet is placed onto a headform and secured in place. Following this, a rotational load is applied and the helmet may shift, but cannot roll off the head. This test ensures security of a helmet during a crash.<sup>9</sup>
- (b) Included in Monorail impact system

Note: This is not an expansive list, but simply an overview of the most universally used tests for standards testing. These are a good place to start, but further standards testing should be considered.

### ESTABLISH LEGISLATION TO IMPLEMENT STANDARD

Once a standard has been decided on, legislation must be established to enforce the new helmet standard. In Vietnam, this consisted of three steps.

#### 1. Passing a Universal Helmet Law

- (a) The Ministry of Transport helped develop legislation and gain support from government officials. The Ministry of Health collected road crash data in hospitals. The Ministry of Culture created educational campaigns promoting the law.
- (b) Private sector and non-profits contributed funding and technical expertise
- (c) Government worked with helmet suppliers to ensure compliance with law was feasible, there were enough standard helmets available<sup>2</sup>

## 2. Required Inspections

- (a) Once legislation was in place, helmet inspections must occur. This requires testing facilities and regular testing of the helmets in the market.
- (b) Bi-annual inspections of helmet manufacturer to ensure compliance with the legislation

## 3. Creating a "Standards Committee" to Regularly Update the Standards

- (a) This standards committee consists of experts from STAMEQ (Standards, Metrology, and Quality), National Traffic Safety Committee, and other agencies. They also take input from manufacturers and road safety stakeholders to ensure proper standards and compliance.<sup>2</sup>

With these three avenues in place, there is now a law requiring the standard, an established method for inspections, and a board to ensure that standards stay up to date.

### SET UP TESTING FACILITIES

In order to enforce the new standards, Helmet Testing Facilities must be built. This naturally requires a building, as well as testing equipment. The costs of which entail \$100,000 USD for the proper testing equipment. This investment will allow for a monorail system that has 5 different headforms, as well as dynamic retention and helmet roll off test fixtures. If the more complex UN22.05 (ECE22) standard is desired, it will be an additional \$50,000-75,000 USD. Once a testing facility is set up with a simple monorail system, however, the system can be converted to conform to an ECE22 system without having to purchase new equipment. Only add on equipment will be required.

### ENFORCE STANDARDS

The final step in the process is to utilize the testing facilities to enforce the new standards and to, with help from the Police, enforce that the correct helmets are being worn on the streets. This will require checking helmets upon entry into the country, randomly sampling helmets from manufacturers bi-annually, and testing them in the Testing Facilities. If the helmets fail the tests outlined above, the manufacturer will be subject to heavy fines, incentivizing them to produce helmets that fit the standard.

For roadside police inspection, they must be able to certify that the helmet has the information and label and marking requirements outlined above. Additional inspection of the helmet sizing is important. A quality helmet is essential, however, if the helmet doesn't fit correctly it is useless.

In order to properly incentivize riders and manufacturers, fines should be implemented for improper helmets or helmet usage. After testing is set up, operators need to know the consequences of wearing improper helmets. In Vietnam, a countdown was used, where starting months prior to the universal helmet law, signs and messages were

posted warning people about the incoming legislation such that they wouldn't be caught off guard. This created anticipation and chatter about the law and ensured people weren't caught off guard by the new legislation. A strong effort of public awareness is essential towards safer helmet usage.<sup>2</sup>



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