# HFES 64

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# "What the Organization Has": An Investigation of Situational Aspects of Safety Culture of Road Traffic Organization Using a Macroergonomic Approach

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This research applied a reciprocal model to investigate the safety culture of road traffic organizations for motorcyclists' safety. By focusing on the situational aspects, we applied the four steps of the macroergonomic approach to analyze a local government organization in Indonesia. We identified some weak elements of safety culture embedded in the sub-system level of the organization. The absence of proper education of motorcyclist candidates has led to failures in developing their skills and knowledge. In addition, we found that the existence of the item "if any" in the licensing registration procedure weakened the understanding of the importance of learning. Investigation of situational aspects revealed some critical issues regarding safety culture development by road traffic organizations.



## INTRODUCTION

The concept of traffic safety culture (TSC) has similarities with organizational safety culture (OSC). Therefore methodologies related to OSC can be applied to approach issues regarding TSC (Edwards, Freeman, Soole, & Watson, 2014). Among road traffic organizations (RTO), the government has the highest degree of jurisdiction over road users (Edwards et al., 2014; Wiegmann, von Thaden, & Gibbons, 2007). An investigation of road traffic safety culture is needed to obtain an overview of how the government develops safety culture, how road users apply it to their road traffic activities, and how all related members perceive safety. Based on this, we can design intervention strategies to solve problems from a single perspective.

A framework to investigate the relationships among road user perception, behavior, and safety management corresponds to the reciprocal safety culture (RSC) model developed by Cooper (2000). This framework enables systemic investigation of TSC to give a broad overview of traffic safety problems.

### "What the Organization Has"

The RSC model comprises psychological, behavioral, and situational aspects (Cooper, 2016). It means all members of the organizations will contribute to improving safety on a daily basis. "What the organization has" describes the situational aspects of the RSC model (Cooper, 2016). The situational aspect of safety culture represents the organization's policies, procedures, management systems, control systems, communication flows, and workflow systems, and all of these are integrated into organizational mechanisms to manage safety (Cooper, 2019).

The investigation of situational aspects can lead to the identification of safety issues attributed to programs, processes, and practices of improving safety behavior by the organization. It is important to reveal some elements of a weak safety culture within the organization, such as weak leadership, ignoring lessons learned, poor-risk appraisal, risk assessment and risk control, conflict in safety-productivity, a lack of knowledge, skills, and abilities and inadequate quality procedures or an absence of procedures/rules/standards (Cooper, 2019).

Kleiner (1999) utilized a macroergonomic approach to develop the safety culture of an organization in the nuclear power domain. The study revealed deficiencies between organizational expectations and the current situation. Based on the results, the organization designed an intervention to improve safety. As a whole, the study demonstrated the macroergonomic approach in analyzing the safety culture.

### The Objective of the Current Study

According to Wandani, Siti, Yamamoto, and Yoshida, (2018), the local government is suitable to manage the safety of motorcyclists. This based on the fact that motorcyclists' trip distance tends to be limited to the urban area.

To improve motorcyclists' safety in Indonesia, we investigated the safety culture of a local government as a case study. First, exploratory research about motorcyclists' safety when riding was conducted in the urban area in 2012 (Andrijanto & Gabariel, 2016). The situation revealed a poor traffic safety culture in the urban area. However, Andrijanto and Gabariel (2016) did not determine the situational aspect of safety culture to investigate RTO. This study analyzes the situational aspect of the local government.

## METHOD

### Macroergonomic Approach

A macroergonomic approach (Hendrick & Kleiner, 2002) is a systematic methodology for analyzing, designing, and evaluating a work system. The following ten steps are used to solve organizational problems:

1. System and environment scan
2. Production system type and setting performance expectation
3. Unit operations and work process

4. Identifying variances
5. Creating the variance matrix
6. Creating the key variance control table
7. Function allocation and joint design
8. Understanding roles and responsibilities
9. Designing/redesigning support sub-systems and interfaces
10. Implementing, iterating, and improving

The first four steps are an investigation of the work system, steps 5 and 6 are deep investigation, steps 7 and 8 are analysis and comprehension, step 9 is designing/re-designing, and the last step is implementing the design. In this study, we focused on steps 1 to 4.

**Step 1 System and Environment Scan.**

We interviewed two police officers at the management and operational levels. The objective of the interviews was to compare the organization's expectations with the current conditions.

The interviews focused on the following information about the licensing system: purpose, philosophy, objectives (technical, social, output, and input), boundaries (time), and expectation (customer system, news media system, local community system).

**Step 2 Production System Type and Setting Performance Expectations.**

In this step, the system function performance in issuing a driving license for prospective motorcyclists follows Sink and Tuttle's model (as cited in Hendrick & Kleiner, 2002), as shown in Figure 1. Questionnaires were used to measure the quality level (Q) of development for each process.

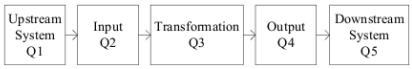


Figure 1 Performance criteria for investigating RTO

Q1 relates to the experience of driving in everyday life before a motorcycle rider applies for a license. Q2 is related to motorcyclists' understanding of traffic regulations. Q3 is related to their understanding of traffic signs, self-safety comprehension, and the safety of others. This process will assess the motorcyclist's understanding of traffic regulations, safety practices, and driving skills. Passing the tests means the driver has the competency to drive safely on the road. Q4 is related to the means of obtaining a driving license. Q5 is related to licensed motorcyclists' response to traffic rules. All contents were discussed by the local government organization, and the questionnaire was approved for research.

In more detail, the questionnaire in Step 2 consisted of six sections. The first section (Q1, Q2, Q4) covered the motorcyclist's background, but not their personal details. Motorcyclists were asked about their driving experience, such as driving knowledge resources (Q1), for example from whom to learn to drive, understanding of traffic regulations (Q2), and the means of obtaining a driving license (Q4). The second section (Q3) comprised 30 questions on basic traffic signs. The third section (Q3) measures the comprehension of self-safety via 11 hazardous situations for a rider. The fourth section (Q3) relates to comprehension of the safety of others via seven hazardous situations that may be dangerous for other road users. The fifth section (Q5) contains five control issues of rule enforcement with punishment. The sixth section (Q5) measured eight issues of rule enforcement with a warning.

Question in sections 2 to 6 were subjectively answered using a 3-point Likert scale. In section 2, participants were asked, "do you understand this sign?" for 30 traffic signs. The participants selected from "understand" (5), "not sure" (3), and "did not understand" (1). In sections 3 and 4, participants were asked, "Is this situation safe?" regarding example traffic situations. The participants responded "yes " (1), "not sure" (3), and "no" (5). Except for passenger must wear a helmet (HPP), apologize after hitting car wing mirror (ACS) and notify something wrong on another vehicle (NWV) responded by selecting "yes " (5), "not sure" (3), and "no" (1). In the last two sections, the question "How often have you performed this action?" for each action. The participants responded "often" (1), "rarely" (3), and "never" (5). Except for using an indicator when turning (TurnL) and using a wing mirror for checking (Smir) responded by selecting "often" (5), "rarely" (3), and "never" (1).

To determine the necessary number of samples for the questionnaire in Step 2, we used the Cochran formula for large populations with a proportion value of 50%, 95% confidence level, and 10% tolerable error. This research required 97 samples. The participants were motorcyclists with a specific local area number plate, randomly selected from a parking lot near the main road. A total of 65 motorcyclists were found to be using manual transmission, and 32 were using an automatic transmission. All participants were at least the legal minimum age to ride a motorcycle.

**Step 3 Unit Operations and Work Process**.

This step is to draw the current process of input, transformation, and output using a flowchart.

**Step 4 Identifying Variances.**

By analyzing the previous three steps, we could identify discrepancies between the expectations and the reality at the sub-system level of the organization.

## RESULTS

**Step 1**

In terms of the current condition and expectations, there were no discrepancies between Purpose and philosophy. The organization is fulfilling its function to actualize safety, discipline, and comfort on the road.

The technical objectives were aimed at improving the quality of drivers/motorcyclists through assessments that are representative of actual traffic conditions. A driving simulator

was installed to complement theoretical and practical tests. A safe driving booklet and presentation procedure were developed as a new mechanism to improve safety comprehension.

The social objectives sought to enhance safety comprehension. The RTO's annual program included five riding safety socializations to the road users, 62 traffic safety campaigns, and one visit by police to campus/school. The second aim to produce drivers who understand the rules and can ride safely on the road. Previous research reported 80% of traffic violations involved motorcyclists in the urban areas (Andrijanto & Gabariel, 2016).

The input-objectives are expected to tighten the procedure for applying for a driving license. The actual conditions using procedures derived from previous management. It also expects to provide supervision of the acceptance of prospective drivers. However, such supervision was a little loose.

An online registration process is expected to reduce the time between registration and a prospective driver taking the exam. They expect the registration to be available at any time and any place. In reality, manual registration was implemented at the office during a working day.

Several requests arose from the environment. Customer's expected a clear assessment procedure with feedback at each step. News media requested collaboration to provide information using digital media. The local community asked cooperation in driving safety workshops.

**Step 2**

*Q1 upstream system*. Investigation of traffic knowledge resource revealed that 35% learned from their parents, 37% studied various types of media (online resources, magazines, etc.), 5% were taught by police officers, and 23% learned from unknown resources. A total of 46% were taught to ride a motorcycle by friends, 31% by their parents, and 22% by relatives. A total of 33% learned to ride at age >16, 45% at 13–16, 16% at 8–12, and 5% at under 8 years old.

*Q2 input*. Even for licensed motorcyclists, 57% of the respondents did not know all the regulations, 34% understood a little content, and 9% understood well.

*Q3 transformation*. Figure 2 shows the answers to the 30 questions. Values from five to one indicate motorcyclists' level of understanding of traffic signs, from understanding to not understanding at all. The results suggest that the motorcyclists understood most of the traffic signs, except #25 and #26.

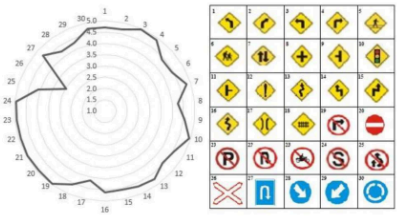

Figure 2 Traffic sign understanding

Figure 3 shows the results of self-safety in 11 hazardous situations. The results reveal that most of the motorcyclists could not comprehend hazardous situations. They tend to take a risk that may endanger themselves. Values from five to one indicate motorcyclists level of understanding the risks that affect their safety, from understanding to not understanding.

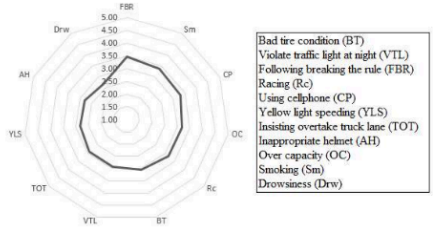


Figure 3 Self-safety comprehension

Figure 4 shows how motorcyclists perceived hazardous situations that may be dangerous to other road users. The results indicated that motorcyclists may still take risks that could endanger other road users. Values from five to one indicate motorcyclists' level of understanding of the risks that affect the safety of other road users, from understanding to not understanding.

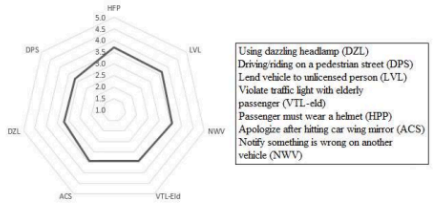


Figure 4 Others-safety comprehension

*Q4 output*. The investigation found 34% of participants obtained a driving license through the procedural process, 16.5% using the service bureau, and 49.5% using methods that ignored their test result. The results indicated that most of the motorcyclists tried to avoid the procedure or ignore the "failed" result of the three tests via a process that was not procedural. Although they failed the tests, with the help of a third party, the license was still issued. Thus they did not need to retest.

*Q5 downstream system*. RTO has a responsibility to control driver performance by enforcing traffic rules on the road. There are two kinds of enforcement, the first is using punishment/penalty, and the second is a warning without punishment. Figures 5 and 6 depict motorcyclist performance with punishment enforcement and with warning enforcement, respectively. Values from five to one indicate motorcyclists' level of compliance with traffic rules, from not breaking to breaking the rules. Figure 5 shows that most motorcyclists may break the rules even though there are penalties for violations. Figure 6

shows most of the motorcyclists may break the rule, except for using an indicator for turning and using a wing mirror.

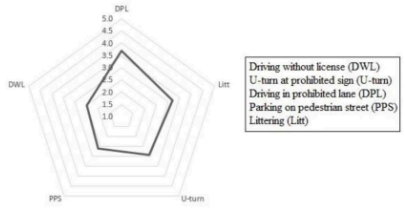


Figure 5 Rule enforcement with punishment

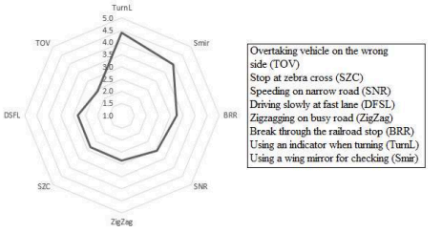


Figure 6 Rule enforcement with warning

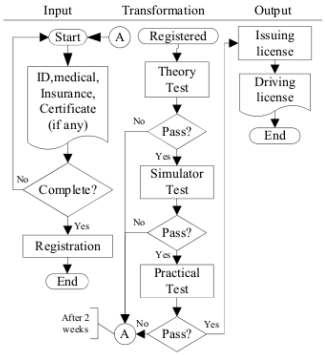


Figure 7 Flowchart of input-transformation-output

**Step 3**

Figure 7 shows the process flowchart of input, transformation, and output. The flowchart was created by obtaining a description of the system procedures from the police officers, which was confirmed by observing the actual process in the field.

The input consisted of a selection procedure of prospective drivers, who need to register by submitting a copy of their identification card, original certificate of medical checkup, insurance receipt, and certificate of driving lessons (if any).

Candidates are assessed via theory, driving simulator, and practical tests. Theory tests assess the candidate's comprehension of road traffic regulations, such as traffic signs, traffic rules, and safety. Simulator and practical tests assess the candidate's driving skills.

If candidates pass the three tests, their photograph and digital signature are taken, and they receive a license.

**Step 4**

The RTO expected drivers to be able to understand the traffic regulations through their programs and mechanism (Step 1), but results revealed only 9% understood these (Step 2, input). The status "if any" (Step 3 input process) revealed the absence of a certificate of driving ability in the registration process.

The RTO was assumed to have prepared an assessment that represents actual conditions (Step 1). However, results revealed a lack of proper understanding of safety performance, as shown in Figures 3 and 4. Based on interviews with the motorcyclists, we found they did not understand the assessment procedure very well. Instruction for conducting the test was not properly communicated. Due to a lack of information about the purpose of the test, participants were not able to prepare very well; most passed the theory test but failed in the simulator and practical tests. The simulator is a test that uses a manual transmission only, while 38% of the motorcyclist use an automatic transmission. In addition, they were not familiar with the motorcycle provided by the RTO for the practical test.

The RTO plans to tighten the procedure (Step 1). However, the acceptance procedure for the three tests was loosely controlled (Step 3); candidates may be able to obtain a license without following the correct procedure. A total of 66% of participants were using a third-party service to avoid the tests/retests (Step 2, output). However, the RTO still issued a driving license.

The RTO requires motorcyclists to obey the traffic rules (Step 1), but rule enforcement on the road did not direct driver behaviors effectively. Figures 5 and 6 indicated they may break a rule if there was no direct control on the road (Step 2, downstream). Although the results for using an indicator were good, the police officers doubted the validity of the responses. They claimed motorcyclists may not actually use a correct indicator when turning (using the right indicator for left direction). The results regarding using a wing mirror also positive; however, 21% of participants were found to have modified the wing mirror for aesthetic reasons.

## DISCUSSIONS

Based on the results for Step 2, upstream system, most motorcyclists acquired knowledge and skill from society. However, this knowledge did not relate to the traffic regulations they needed to understand as a basic knowledge of driving safely. Only 9% of participants knew the traffic regulations (Step 2, input). It seems the organization's efforts to educate had not been delivered effectively. Lack of knowledge also emerged in their behavior, as shown in Table 1, part A.

They did not understand two important signs, railroad crossing (sign no. 26) and overtaking prohibited (sign no. 25) well.

On the other hand, we believe there is a general lack of knowledge in society. Collaboration with local government was expected to clarify traffic regulation (Step 1) to improve road safety. However, no organization conducted formal education approved by the local government for learning traffic regulations (Step 2, upstream).

The local government has the authority to regulate traffic signs and it is very important drivers recognize these. In addition, they are required to be able to follow the rules contained in such signs. Figure 2 shows most of the participants were able to recognize 30 traffic signs (Step 2, transformation). Although they understood, it did not emerge in their behaviors. Discrepancies between understanding traffic signs and rule-following behavior illustrate a weak comprehension in motorcyclists' performance, as shown in Table 1, part B.

In addition, participants were found to appraise risk incorrectly, as shown in Figures 3 and 4. Although traffic signs are available to warn of hazardous situations, drivers seem to ignore these (Table 1, part C). The results revealed that both conditions (B and C) have a relationship with the examination procedures for obtaining a driving license (Step 2, transformation). The systems were unable to correctly assess driver competency, but they still received a driving license.

The situation above shows that the issuance of a driving license cannot represent the quality of the driver as expected by the RTO in Step 1. First, we found no proper education available in society. The RTO program and mechanism did not effectively educate motorcyclists (Step 4). "If any" status on the driving ability certificate leads candidates to ignore the learning process. Second, the system is unable to assess the driver performance accurately (Step 4). Drivers also engaged in unprocedural processes to obtain a driving license (Step 4). Finally, the rule enforcement on the road could not adequately control driver behavior (Step 4). In this case, the development of a weak safety culture has taken place within RTO.

Table 1 Relationship between traffic sign and driver behavior

| | Traffic sign | Behavior | Status |
|---|---|---|---|
| A |  | Overtaking vehicle/truck | Lack of knowledge |
| |  | Break through the railroad stop | |
| B |  | Parking on pedestrian street | Weak comprehension |
| |  | Illegal U-turn | |
| |  | Driving in prohibited lane | |
| C |  | Speeding on narrow road | Poor risk appraisal |
| |  | Stop at zebra cross | |
| |  | Violate traffic light | |

## CONCLUSIONS

A study on road safety issues needs to consider organizational culture. The government, as a road traffic organization, has a higher degree of responsibility to manage driver safety. It is necessary to identify some weaknesses of the safety culture embedded in an organization before intervening regarding safety management systems. Investigation of situational aspects using macroergonomics revealed organizational issues in developing a safety culture in terms of road traffic. According to a reciprocal model of safety culture, it is also necessary to investigate behavioral and psychological aspects. This study explained "what organization has" in terms of sharing road safety culture, but this remains unclear. It is also important to study the effect of situational aspects on other aspects. To significantly improve road traffic safety, it is necessary to clarify critical issues regarding certain aspects of the perception of road safety.

## ACKNOWLEDGMENTS

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