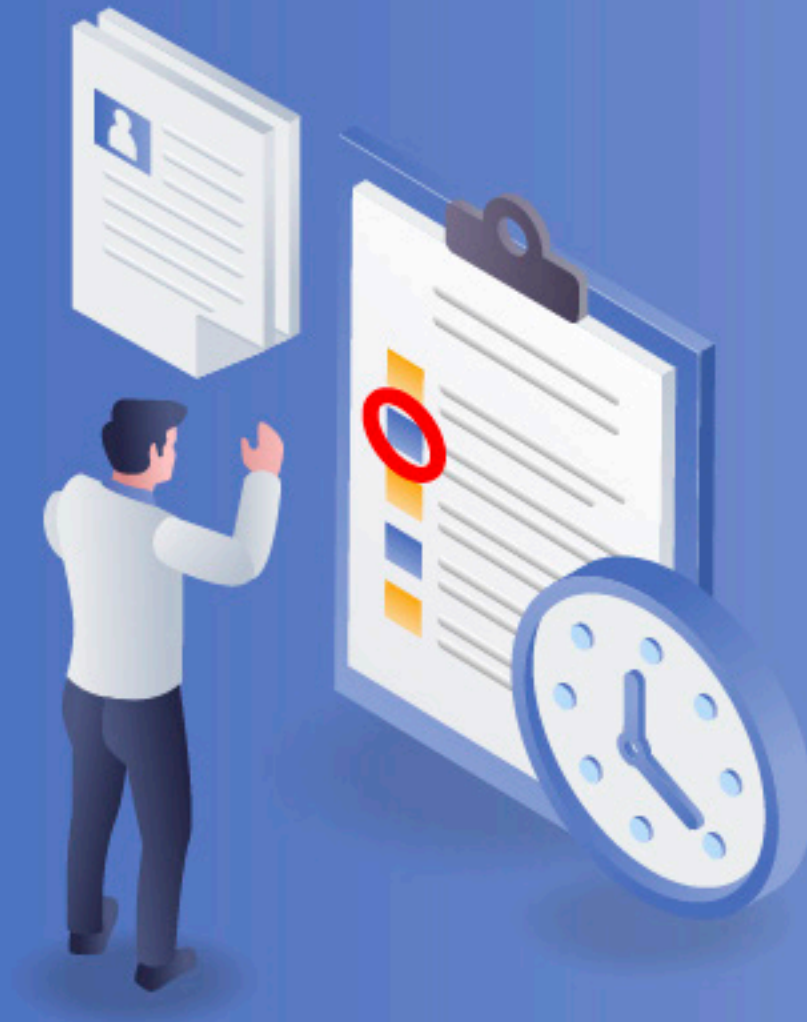




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## Traffic Management Towards Safe and Resilient Marawi City

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### ABSTRACT

Using the structural functionalist perspective, this paper looks into the challenges contributing to the traffic congestion in Marawi City that impedes the attainment of a safe, secure, and resilient community through a sustainable, seamless, and light transport flow. This study utilizes the qualitative approach specifically the case study design. Non-probability sampling was utilized in selecting the respondents. Key informant interviews and an unobtrusive research method were utilized to gather data. Triangulation was utilized in order to ensure the research validity. This study has three sets of respondents namely: the key implementers from the Marawi City Traffic Management Group, the selected commuters, and public utility vehicles drivers. Purposive sampling was done to select the respondents from the commuters and drivers. Multiple data triangulation was also utilized, thus, unobtrusive research method, specifically content analysis, was also conducted to gather data from public documents, laws, communications, newspapers, promotional videos, and photos. The following challenges encountered by the key implementers and the traffic enforcers from the Marawi Traffic Management Office, drivers, and commuters are the following: a. Presence of narrow roads within the city; b. The need for administrative support; c. The need for funds for the development of technical equipment and facilities; d. The need for capability building training of traffic enforcers; d. The need for discipline and cooperation among drivers and car owners; e. The presence of unlicensed drivers; f. The presence of illegal parking; g. The continuing construction of the drainage system. This study is aligned with Sustainable Development Goal 11: Sustainable Cities and Communities.

### INTRODUCTION

Sustainable Development Goals (SDG) 11.2 targets on affordable and sustainable transport systems by 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons. Like a living organism, the city acts as a complex system of functions that is able to develop and evolve in a period of time. The term 'resilience' means the ability to resist or survive by changing the available features of the city. It constantly adapts its form to environmental, social, cultural and climatic needs aligned to the changes brought about time. In this regard, the resilience of urban form represents a method to guide the growth of contemporary cities. Indeed, the issue of resilience occurs in the Sustainable Development Goals (SDGs) as well (UN DESA, 2019). As stated in Goal 11 of the United Nations Sustainable Development Goals (SDGs), "making cities and human settlements inclusive, safe, resilient, and sustainable," creating sustainable and resilient cities is becoming more and more important given the challenges that will inevitably arise from increased urbanization and growth (Bai *et al.*, 2016). The absence of reliable traffic measurements means that no one knows how much congestion there is (or whether it is getting worse) in their neighborhood, city or state, which for instance, in 2006 California voters approved

61%-39% a \$20B bond measure (Prop 1B) for projects "to relieve congestion, improve the movement of goods, improve air quality, and enhance the safety and security of the transportation system (Kurzhanskiy & Varaiya, 2014). This measure was intended to raise public awareness and blunt citizens' motivation to criticize or praise a transport agency's performance congestion, increase the security and safety of the transportation system, the flow of commodities, and the purity of the air. Through a variety of strategies designed to maximize both the benefits and drawbacks of transportation, traffic management affects both the supply of transportation systems and travel demand (Boltzea & Tuanb, 2016). While one can readily find online descriptions of Prop 1B-funded projects, it is not possible to learn how much congestion relief these projects have provided (Kurzhanskiy & Varaiya, 2014). Traffic congestion affects a nation's economy both directly and indirectly. It is a social and environmental blight. According to research, Americans lose 338 hours a year on average due to traffic in the United States. This situation is similar to what happens in most major cities worldwide, where demand for more traffic has outpaced the supply of available roads, making traffic management more difficult (Musa *et al.*, 2023). The daily movement of people and goods in the Marawi City area has become increasingly difficult due to the traffic conditions, that still remains a challenge. The traffic problem in this city has always been critical and is being compounded by the increase in population, available vehicles and day-

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to-day activities of the people. A fact about the traffic congestion increases almost on a daily basis especially during peak hours. The Republic Act 4136 known as “Land Transportation and Traffic Code” which is basis of all the driving laws in the Philippines Chapter IV “Traffic Rules” of this code provide components on different policy, viz: Article I- Speed Limit and Keeping to the Right; Article II - Overtaking and Passing a Vehicle, and Turning at Intersections; Article III – Right of Way and Signals; Article IV – Turning and Parking; and Article V – Miscellaneous Traffic Rules (Lawphil.net). This law is also responsible for the creation of the Land Transportation Office.

On the other hand, the National Transport Policy and the Implementing Rules and Regulations (IRR) of the National Economic and Development Authority’s Transport Vision is to have a safe, reliable, efficient, integrated, intermodal, affordable, cost-effective, environmentally sustainable, and people-oriented national transport system that ensures improve quality of life of the people with the end view of creating “new” economic growth centers outside of the country’s key cities for inclusive growth through access improvement and support to tourism, agro-industry, trade and logistics, and other economic sectors; promoting transport infrastructure investments. These policies guide and help localities in creating an easy traffic flow. The literature provides studies on how traffic management must be implemented in order to attain a safe, reliable and sustainable traffic flow that may contribute to the attainment of a progressive and sustainable community. The utilization of a Traffic Management System (TMS) can potentially alleviate traffic congestion on roads, enhance incident response times, and provide commuters with an improved travel experience (Djahel *et al.*, 2013). Experts in transportation have proposed several characteristics that are frequently wanted in a congestion measure; an effective congestion measure should contain: a.) be clearly stated, understandable, and simple enough for non-technical people to understand and analyze the results with ease; b.) show the actual state of service for all kinds of roads, c.) Take into account various system performances, such speed and travel time; d.) offer a range of values that is continuous; e.) possess the capability to be employed in statistical and predictive analysis; f.) provide values that are comparable to various road kinds, and g.) be broadly applicable to various types of roads. (Tanzina & Yodo, 2020). Many reforms and public management systems require modifications, with performance management serving as the ‘Achilles heel’. Governance in general, and co-production in particular, imposes an organizational environment that necessitates rethinking performance management, which is still conceptually rooted in the New Public Management paradigm (Lewandowski, 2018). The public sector (PS) has actively used information technology (IT); nonetheless, research shows that the failure rate is still significant, particularly for national and sectoral IT (NaSIT) applications. To

this purpose, various studies have been done to assess the performance of IT applications, with a large number demonstrating the relevance of planning in this regard (Alidousti and Sahli, 2024).

In their study, Naveed and Azhar (2022) discovered that five major public sector actors have a high degree of centrality and betweenness centrality. Thematic analysis found that these players influence the majority of network decisions through a hierarchical governance structure. Other actors confront numerous problems, including a lack of autonomy, overlapping authority, competing norms, and complex decision-making procedures. Furthermore, the findings suggest that, rather than top-down and control-based relationships, networks require self-governance methods in which individuals participate independently and interact with one another to produce shared solutions to challenges. It is widely acknowledged that network management is a vital component of network success. It is also recognized that different managerial behaviors are required in various network environments. Scholars have researched the relationships between network characteristics and managerial behaviors, but network culture’s influence on network managers’ activities has received little attention. The findings shed light on two distinct combinations of network culture types and management approaches that led to good network performance (Cristofoli *et al.*, 2020). According to Pradana *et al.* (2022), in order to sustain innovation, public leaders must embrace innovation legitimacy as a new organizational structure, making it more durable in the long run. Furthermore, public leaders must reduce innovation politicization by empowering bureaucrats to independently oversee innovation operationalization. Public leaders must pay close attention to innovation sustainability since a non-sustainable policy might disappoint those who work for it, losing their faith and passion. This unhappiness may constitute a barrier to gaining support for the following policies. However, there are a few studies about this phenomenon in the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM), Philippines. For this reason, the researchers believe that a study on the implementation of traffic management is highly needed in Marawi City specially that the Islamic City of Marawi is the Capital of the Province of Lanao Del Sur with a population of 207, 010 people (PSA, 2020) and a large urban center in the BARMM. Marawi City serves as the center of commercial activities and institutional services that attract many to find work and settlement in the city. Hence, the purpose of this study is to present the challenges encountered by the traffic enforcers of the Traffic Management Office, drivers and commuters and how the Local Government Unit of Marawi City will support the economic growth and other economic sectors which are aligned with the Sustainable Development Goal 11: Sustainable Cities and Communities. Specifically, this paper looks into the challenges faced by the agency in the implementation of Chapter IV (Traffic Rules) and

Chapter V (Penal and Other Provisions) of Republic Act 4136 otherwise known as an “Act to Compile the Laws Relative to Land Transportation and Traffic Rules, to Create a Land Transportation Commission and for Other Purposes.” TMSs gather information on traffic from a variety of heterogeneous sources, including cars, traffic signals, and in-road and wayside sensors (Souza et., al, 2016). A strategic perspective that relies on the dynamic interaction between the helices and the active role of cities embracing technology to support wider policies for driving urban growth and development should be used to guide innovation as a driver for the social and economic development of urban and local areas and autonomies (Parisi, 2017). Ergun *et al.* (2007) employed an algorithm that disregarded Hours of Service laws and performed computational experiments on somewhat simplified cases without taking loading and unloading times into account. This paper is focused on the challenges encountered by the Traffic Management Office of Marawi City, BARMM, Philippines in order to attain safe, resilient, and sustainable traffic management in the city. Specifically, it sought to answer the question: (1) What are the challenges encountered by the Traffic Management Office of Marawi City in implementing RA 4136? And (2) How can Marawi City address these challenges in order to contribute to the attainment of Sustainable Development Goals 11: Sustainable City and Community?

## LITERATURE REVIEW

### Traffic Management

Traffic management is the organisation, arrangement, guidance and control of both stationary and moving traffic, including pedestrians, bicyclists and all types of vehicles. Its aim is to provide for the safe, orderly and efficient movement of persons and goods, and to protect and, where possible, enhance the quality of the local environment on and adjacent to traffic facilities (National Academies, 2023).

### Public Transport

Public transport is defined as a shared passenger transport service that is available to the public (United Nations, 2018). It includes cars, buses, trolleys, trams, trains, subways, and ferries that are shared by strangers without prior arrangement. However, it excludes taxis, car pools, and hired buses, which are not shared by strangers without prior arrangement. It also excludes informal, unregulated modes of transport (para-transit), motorcycle taxis, three-wheelers, etc.

Public transport refers to a public service that is considered as a public good that has well designed ‘stops’ for passengers to embark and disembark in a safe manner and demarcated ‘routes’ that are both officially and/or formally recognized.

Hence, the access to public transport is considered convenient when an officially recognized stop is accessible within a distance of 0.5 km from a reference point such as a home, school, work place, market, etc. Additional

criteria for defining public transport that is convenient include: a.) Public transport accessible to all special-needs customers, including those who are physically, visually, and/or hearing-impaired, as well as those with temporary disabilities, the elderly, children and other people in vulnerable situations; b.) Public transport with frequent service during peak travel times; c.) Stops present a safe and comfortable station environment (United Nations, 2018).

### Sustainable Transportation

The term sustainable development was introduced in 1980, popularised in the 1987 report of the World Commission on Environment and Development (the Brundtland Commission), and given the status of a global mission by the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro in 1992.

The Brundtland Commission defined sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” The Commission noted that its definition contained two key concepts: needs, meaning “in particular the essential needs of the world’s poor,” and limitations, meaning “limitations imposed by the state of technology and social organisation on the environment’s ability to meet present and future needs.” The Brundtland Commission’s definition was thus not only about sustainability in the various senses of the term but also about equity, equity among present inhabitants of the planet and equity among generations. Sustainable development for the Brundtland Commission had environmental, social, and economic aspects, but remediation of current social and economic ills came first. The chief tools for the remediation were to be “more rapid economic growth in industrial and developing countries, freer market access for the products of developing countries, lower interest rates, greater technology transfer, and significantly larger capital flows, both concessional and commercial.”<sup>8</sup> Such trends were said to be compatible with recognised environmental constraints, but the extent of the compatibility was not explored (United Nations, 2018).

### Support to Economic Sectors

Pursuant to the relevant provisions of the Local Government Code, passenger and goods carried into, out of, or passing through Local Government Units (LGU) shall not be burdened by LGU-imposed transport procedures and costs. The DILG, in coordination with the Department of Trade and the Department of Public Works and Highways, shall pursue measures to eliminate any arbitrary charges/tool-like fees levied by LGUs on goods and people passing through their jurisdiction (NEDA, Rule VII, 31.2). Transport agencies shall strengthen convergence in support of agriculture, industry, trade, and tourism development by ensuring that these economic sectors are provided with adequate

transport infrastructure support and services through the implementation of Convergence Program (NEDA, Rule VII, 32.1).

### Related Studies

According to the research titled “Employer Views on Traffic Congestion” ( Policy Brief 115 of the Reason Foundation, February 2014), Traffic congestion is a problem not just for individual commuters but for business as well. While commuters are greatly concerned over rush hour traffic, businesses are also concerned with the off-peak hour (non-rush hour) delivery of goods. It was pointed out in the research that because businesses are concerned with congestion during both time periods, their view on traffic congestion different from those of commuters. Solving rush hour and off-peak congestion is also more challenging than merely solving rush hour congestion. The study stated that congestion affects employers in several ways. Primarily, it affects impacts corporate activities such as shipping/receiving, logistics, and distribution, client meetings, and other business activities. It also limits worker availability and productivity by affecting employees’ commutes. In the Philippines, the effects of congestion on workers and employees are sore issue. Congestion leads to workers arriving late; commuting hassles for workers, frustration/stress, long work commutes, long travel time, and loss of personal time.

According to the US Department of Transportation (DoT), traffic congestion may have three key sources. The first one is related to traffic-influencing events, such as incidents, working zones, and bad weather conditions. The second one is related to traffic demand, which means fluctuations in normal traffic and special events. The last source is the transportation infrastructure, which represents the traffic control devices and physical bottlenecks. Moreover, these bottlenecks are responsible for 40% of the overall traffic congestion, followed by traffic incidents, such as vehicles accidents with 25%, bad weather conditions with 15%, work zones with 10%, and poor traffic signal timing and special events with 5% each one. In this way, focusing on preventing traffic congestion and improving the overall traffic efficiency, large cities rely on traffic management systems (TMSs), which aim to reduce traffic congestion and its related problems. To this end, TMSs are composed of a set of applications and management tools to integrate communication, sensing and processing technologies. In summary, TMSs collect traffic-related data from heterogeneous sources such as vehicles, traffic lights, and in-road and roadside sensors. Furthermore, by aggregating and exploiting such traffic-related data into a cooperative manner (e.g. among vehicles) or into a traffic management center (TMC) concentrated in a cloud or in a data center, several traffic hazards can be identified and consequently controlled improving the overall traffic efficiency and providing a smooth traffic flow. Within TMS, one building block that composes it is the vehicular ad hoc networks

(VANETs), which provides data exchange between vehicles, roadside units (RSU) and TMC. In VANETs, vehicles are mobile nodes with an on-board unit (OBU) that has embedded sensors, processing units, and wireless interfaces in which vehicles can communicate among themselves to create an ad hoc network. To support such communications, VANETs rely on dedicated short-range communication (DSRC) specially designed to this end. However, despite RSUs are not a requirement, they can be used to improve network capacity, providing better management and Internet access, and different communication technologies such as 4G and long-term evolution (LTE). However, concentrating in dealing with the traffic congestion origin and in addressing its related problems, several TMSs have been proposed focusing on adjusting the speed of the vehicles in order to reduce the time spent in traffic lights, detect and prevent traffic congestion and suggest alternative routes to the vehicles. Succinctly, as traffic congestion is a daily concern, researchers from different areas have been attracted to develop TMS to deal with it. However, there are still challenges to be faced. In this way, this article focuses on presenting a study which can provide detailed information to researchers for understanding the main fundamentals and challenges related to TMS, covering different topics from communication to applications. Therefore, the main contributions of this article include (1) a comprehensive overview of the state of the art in TMS, (2) an in-depth classification, review, and qualitative analysis of some TMS applications, and (3) the main challenges and future perspectives. The remainder of this article is structured as follows. Section “TMS” gives an overview on TMS. In section “A classification, review, and qualitative analysis of TMSs,” we present a classification, review, and qualitative analysis of some related TMS. Section “Challenges and future perspectives” introduces some open challenges and future perspectives for TMS. Finally, section “Conclusion” concludes the article. (Souza, Brennand, Yokoyama, 2017)

Tian and Zhang suggested to use the TRANSYT traffic modeling software to find the optimal fixed-time signal plan and VISSIM micro-simulation software to affirm and evaluate the TRANSYT model and to help assess the optimal signal plan; build an adaptive frame signal plan and refined and evaluated the plan using VISSIM with VS-PLUS emulator. Through micro-simulation, it was shown that delay in the adaptive signal control was shortened noticeably than that in the fixed time control. (Rongrong Tian and Xu Zhang, 2013)

Guo introduced a new method for area-wide traffic signal timing optimization under user equilibrium traffic. The optimization model was formulated as a multi-dimensional search problem aimed to achieve minimized product of the total travel time associated with urban street network and the variance of travel time for unit distance of travel. A genetic algorithm was developed to derive the model solution. A simulation control protocol embedded in PARAMICS software tool capable of

conducting area-wide micro simulation is adopted to design the logic frame and function module of the area-wide traffic signal control system. His results shown that mobility improvements are achieved after applying the proposed model along with the genetic algorithm for area-wide signal timing optimization, assessed by extended capacity ratio, and reductions in through and turning movement delays, as well as average and variance of travel time for unit distance of travel. (Jianhua Guo, Ye Kong, Zongzhi Li *et al*, 2017).

Taylor (1992) believes that charging for roads is a way to alleviate traffic problems. McKnight believes that conventional traffic management and improvement of vehicle standards are not particularly effective in the reality of rapidly increasing demand for road use. He also believes that the control of the use and purchase of private cars is the key to effectively control traffic congestion. Coomber *et al.* (1997) proposed different charging methods and prices for parking lots with different functions in the city to alleviate traffic congestion.

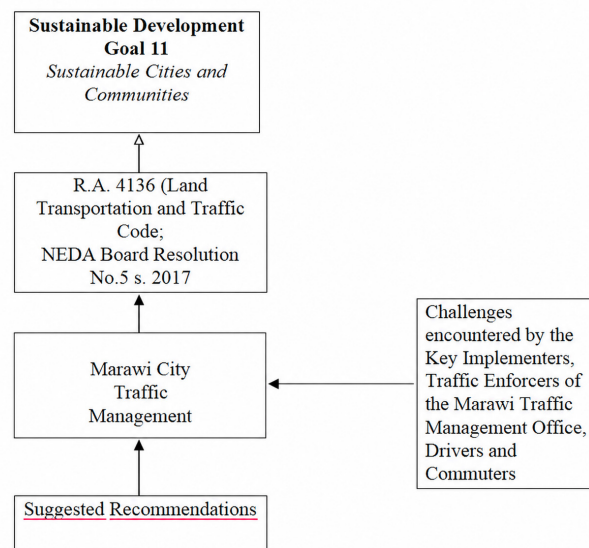
### Theoretical Framework

The structural functionalism theory is used in this study. Talcott Parsons' work is closely tied to the theory of structural functionalism. Parsons' theory focuses on the mechanisms by which people join a specific society in order to secure its continuation and upkeep. Parsons defines society as a globally interconnected value-based social structure (Parsons and Bales, 1955). Participation in the social structure occurs when one individual interacts

with others in accordance with the many functions and roles that each individual holds within the system (Parsons and Bales, 1955). Institutionalized rules distinguish the hierarchically structured subsystems that comprise the global social system. These norms establish expectations and restrictions for certain duties and positions, and they are intended to be congruent with society's integrated value system on the one hand (Parsons and Bales, 1955). These are further characterized in terms of a set of pattern variables, such as particularistic vs universalistic values. The family is especially essential in this context (Parsons and Bales, 1955). This can be applied to the study of Marawi City's growth and development in connection with the establishment and maintenance of a sustainable, dependable, and safe traffic flow.

According to Kew's (2017) thesis, a community requires a particular level of social cohesiveness, solidarity, and integration to survive. In light of this, he went on to add that structural functionalists emphasize the need of attempting to identify, characterize, and even promote the primary origins and forms of social cohesion.

Another theory that this paper anchors on is the Sustainable Development Goal specifically SDG Number 11 that is to "make cities inclusive, safe and affordable (UN DESA, 2023). While on the legal note, this paper also utilizes the Philippine Republic Act 4136 otherwise known as an "Act to Compile the Laws Relative to Land Transportation and Traffic Rules, to Create a Land Transportation Commission and for Other Purposes.



**Figure1:** Schematic Diagram of the Study

The theory cited provide a background in the proper understanding of the research variables included in this study which describes the challenges to the attainment of safe, resilient, and sustainable traffic management. The first variable is the Sustainable Development Goal 11 which is Sustainable Cities and Communities. This is

the target goal that needs to be achieved in the City of Marawi. The second variable represents the different laws and rules and regulations relating to transportations and traffic code as well as the resolutions implemented by the rule making body. The next variables are the problems encountered by the key implementers, Marawi Traffic

Enforcers, drivers and commuters relating to traffic problems in Marawi City. The third variable pertains on how the Marawi City Traffic Management manage the different issues relating to traffic problems in Marawi City, and the next variables are the suggested recommendations to resolve the traffic congestions in Marawi City.

Most of the traffic congestion existing in Marawi City are relating to narrow road, lack of technical equipment and facilities, lack of cooperation among drivers and car owners; the presence of illegal parking, and the continuing construction of the drainage system.

## MATERIALS AND METHODS

This study utilizes the qualitative approach specifically the case study design. Nonprobability sampling was utilized in selecting the respondents. Key informant interview and unobtrusive research method were utilized to gather data. Triangulation was utilized in order to ensure the research validity. This study has three sets of respondents namely: the key implementers from the Marawi City Traffic Management Group, the selected commuters, and public utility vehicles drivers. Purposive sampling was done to select the respondents from commuters and drivers. Multiple data triangulation was also utilized; thus, unobtrusive research method specifically content analysis was also conducted to gather data from public documents, laws, communications, newspapers, promotional videos, and photos. The researchers approach the respondents and give them an informed consent document to sign, indicating that they are freely participating in the interview. This research involved an in-depth interview and a focus group discussion.

Being a location of the provincial offices and business establishments, Marawi City is frequently visited by the people especially from Iligan City, Lanao del Norte, Lanao Del Sur, and other localities in BARMM. This paper argues that the development in the status of the city's Traffic Management System can contribute to the city's growth and development leaning to SDG 11. This one aspect of the city can contribute to the holistic growth and development of the city and the larger community.

## RESULTS AND DISCUSSION

This part presents the challenges encountered by the Traffic Management Office of Marawi City in implementing RA 4136 that causes traffic congestion in Marawi City and the recommendations on how the city can address these challenges in order to contribute to the attainment of Sustainable Development Goals 11: Sustainable City and Community.

A. Challenges Encountered by the Traffic Management Office (TMO) of Marawi City in the implementing RA 4136 that causes of traffic congestion in Marawi City

There are eight challenges presently faced by the Traffic Management Office of Marawi City in terms of the implementation of RA 4136. These are: a.) The presence of narrow roads; b.) The need for administrative support; c.) The development of technical equipment

and facilities; d.) The need to attain training, seminars, and other capability-building activities; e.) The need for discipline and cooperation among drivers and car owners, f.) The presence of unlicensed drivers, g.) The presence of illegal parking, and h.) The presence of the drainage system construction.

The presence of narrow roads is one of the problems with traffic congestion in Marawi City. The respondents noted that the vehicle capacity to operate in Marawi is only 3,000 vehicles, but during their assessment, they found out that there were an estimated 8,000 plus vehicles operating in Marawi City. To add to this data, some vehicles (motorcycles, private vehicles, and cargo trucks) are coming not only from Marawi City but also from nearby cities and municipalities. It can be noted that Marawi City serves as an interlink for other cities and municipalities in Lanao del Norte and Lanao del Sur Provinces. There is a challenge in terms of the increase in the number of vehicles using the city roads vis a vis the road capacity, exceeding the maximum capacity of operating vehicles on the road. According to the respondents, this creates heavy traffic problems since the roads in the city are narrow. The respondents added that the road can only be widened by a few inches if some of the structures on the side of the road are removed. Another recommendation is the conduct of road clearing. Adding to the challenge of narrow roads is the presence of street vendors along the city roads. According to the respondents, construction of an could be an ambitious plan. This finding is supported by the study of Matson *et al.* (2006) which revealed that New or widened roads are often proposed to relieve congestion or to support economic growth, however there is little appraisal of road schemes once they are built. It has been shown through case studies in the UK and the Netherlands that the benefits from reduced congestion and shorter journey times are often short lived as new road network capacity is taken up by induced traffic growth (Matson *et al.*, 2006). The need for administrative support for the strong and proper implementation of policies, rules, and regulations, as well as city ordinances. The respondents noted that there were city ordinances created, but they were not implemented because some drivers do not follow and obey the rules and regulations. Also, the administrative support may lead to the increase in the number of human resources in the Traffic Management Office like the traffic enforcers who will be tasked to implement the R.A. 4136 on the ground. According to Dunn (2018) that an adopted policy is carried out by administrative units that mobilize financial and human resources to implement the policy. Hence, to minimize traffic congestion, the local administration may strengthen the implementation of the policies with the addition of more human resource.

On the development of technical equipment and facilities, the respondents noted that traffic lights are highly needed in the city to minimize traffic congestion. The respondents emphasize that traffic lights are already part of Marawi rehabilitation, which is one of the main

priorities of the Marawi City TMO. On the other hand, CCTVs are also important in a safe and sustainable traffic management. However, the presence of power supply problems is a challenge with regards to the traffic light operations. While the concern on internet connectivity also adds to the concern of CCTV operations. Currently, CCTVs were initially installed within the city, but when they were monitored, most were already damaged, others were stolen, and many are already non-functioning. Accordingly, the CCTVs were prioritizing monitoring peace and order in Marawi City. This finding is supported by the study of (Souza, *et al.* 2017), which states that According to the US Department of Transportation (DoT), traffic congestion may have three key sources. The first one is related to traffic-influencing events, such as incidents, working zones, and bad weather conditions. The second one is related to traffic demand, which means fluctuations in normal traffic and special events. The last source is the transportation infrastructure, which represents the traffic control devices and physical bottlenecks. Moreover, these bottlenecks are responsible for 40% of the total amount of traffic caused by congestion, with 25% coming from traffic incidents like car accidents, 10% from construction zones, 15% from inclement weather, and 5% each from special events and poorly timed traffic signals (Souza, *et al.* 2017). As a result, focusing on preventing traffic congestion and large cities rely on Traffic Management Systems (TMSs), which strive to lessen traffic congestion and its associated issues, to improve the overall traffic efficiency. To do this, TMSs are made up of a collection of management tools and applications that integrate communication, sensor, and processing technology (Souza, *et al.* 2017). In conclusion, TMSs gather information on traffic from a variety of sources, including vehicles, traffic lights, and in-road and wayside sensors. Additionally, a number of traffic hazards can be identified and subsequently controlled, increasing overall traffic efficiency and ensuring a smooth traffic flow, by aggregating and exploiting such traffic-related data in a cooperative manner (e.g., among vehicles) or into a traffic management center (TMC) concentrated in a cloud or in a data center (Souza, *et al.* 2017).

The highly needed people to manage traffic congestion on the roads are the traffic enforcers and the patrol highway officers. In order to equip them with knowledge about traffic management and enhance their skills in conducting their functions, these people need to attain trainings, seminars, and other capability-building activities. In the case of the patrol highway officers, one of the respondents noted that they attended seminars and trainings relating to traffic management, and such trainings were organized and conducted by the Road and Traffic Administration (RTA) coming from Cagayan de Oro City, Cotabato, and Region XII. On the other hand, one of the respondents also noted that in the case of the Marawi Traffic Management Enforcers, there was a lack of capability building trainings that would help enhance their skills. In fact, one of the respondents noted that

for nine years of his service, he only attended training relating to traffic laws, which was conducted by the RTA coming from Cagayan de Oro City. Hence, they need other training not only for their specific duties and functions but also for their professional development. This finding is supported by the study of (National Academies, 2023), stating that traffic management is the organization, arrangement, guidance and control of both stationary and moving traffic, including pedestrians, bicyclists and all types of vehicles. Its aim is to provide for the safe, orderly and efficient movement of persons and goods, and to protect and, where possible, enhance the quality of the local environment on and adjacent to traffic capability and facilities. Ramavhunga, (2018) states that in order to address these challenges, the following can be done namely: a training to improve traffic officer's abilities; continuous training to improve efficiency; increased involvement by the state to increase efficiency and diversifying training to make it effective. Hence, traffic enforcers in the Marawi Traffic Management should be supported in terms of capability building training and professional growth.

The need for discipline and cooperation among drivers and car owners is the most important action to be taken by the people in the community to minimize traffic congestion. Among the problems encountered by the Marawi traffic management enforcers is the behavior and actions of drivers on the road. One of the respondents noted that some drivers are blocking the road in the middle of the road while having conversations with other vehicle drivers, some drivers seem to not notice the guidance from the traffic enforcers; some are overtaking in an already narrow road even in a situation of heavy traffic; some motorcycle drivers are not following the proper loading and unloading area for passengers, and other drivers are also violating the overloading policy. This data is aligned to the study of (Jeepara, *et al.* 2011), stated that human factors that are the main contributing factors for road traffic accidents include both driving-related behavior (drinking and driving, speeding, and traffic law violations) and impaired skills (lack of attention, exhaustion, and physical disabilities). Other causes for road traffic accidents, according to the 2011 study titled "Road traffic accidents in Eastern Sri Lanka: An analysis of admissions and outcome" by P. Jeepura and S. Pirasath, include poor vehicle design, the high speed of vehicles, poor roads, an increased number of vehicles on given areas of roads, the mechanical failure of vehicles, overloading, poor lights, animals crossing the roads, inadequate traffic law enforcement, and the delay implementation of road safety measures. This implies that drivers should take extra care when driving their vehicles on the road.

Unlicensed drivers also added to the problem of traffic issues in Marawi City. The respondents provided the data that there are driver's licenses which have expired; some have no license while driving their vehicles, and other vehicles have no plate numbers. One of the

respondents also noted that there were minors of age driving motorcycles without driver's licenses. Thus, there is a need for the conduct of seminars for drivers not only as a requirement for the provision of licenses but also on equipping drivers about the importance of proper rules and regulations relating to the traffic code. Under Chapter II of Registration of Motor Vehicles, Article I, Section 5, provides that "All motor vehicles must be registered." (a) No motor vehicles shall be used or operated on or upon any highway of the Philippines unless the same is properly registered for the current year in accordance with the provisions of this act; and (b) any registration of motor vehicles not renewed on or before the date fixed for different classifications, as provided hereunder, shall become delinquent and invalid." This finding is supported by Chapter III, Article I, Section 19 of R.A. 4136, which provides that "Except as otherwise specifically provided in this Act, no person shall operate any motor vehicle without first procuring a license to drive a motor vehicle for the current year, nor while such license is delinquent, invalid, suspended or revoked. The license shall be carried by the driver at all times when operating a motor vehicle and shall be shown and/or surrendered for cause and upon demand to any person with authority under this Act to confiscate the same. Wherefore, drivers violating this law will be subject to punishment."

The presence of illegal parking is also adding to the traffic congestion problem in Marawi City. The key informants responded that some of the drivers are parking anywhere despite the signage that says, "No parking," still they park in restricted areas. Drivers also do double parking on the roads of Marawi City. This creates heavy traffic in the city. Under Article IV, Section 46 of R.A. 4136, it is stated that "no driver shall park a vehicle, or permit it to stand, whether attended or unattended, upon a highway in any of the following places: a.) within an intersection; b.) on a crosswalk; c.) within six meters of the intersection of curb lines; d.) within four meters of the driveway entrance to a fire station; e.) within four meters of a fire hydrant; f.) in front of a private driveway; g.) on the roadway of any vehicle stopped or parked at the curb or edge of the highway; and h.) at any place where official signs have been erected prohibiting parking." This finding is supported under Article IV, Section 46 of R.A. 4136, which provide that, "No driver shall park a vehicle, or permit it to stand, whether attended or unattended, upon a highway in any of the following places:(a) Within an intersection; (b) On a crosswalk; (c) Within six meters of the intersection of curb lines; (d) Within four meters of the driveway entrance to and fire station; (e) Within four meters of fire hydrant; (f) In front of a private driveway; (g) On the roadway side of any vehicle stopped or parked at the curb or edge of the highway; (h) At any place where official signs have been erected prohibiting parking. Wherefore, drivers violating this provision are subject to punishment in accordance with the law."

The continuing construction of the drainage system in Marawi City is also a problem that causes traffic

congestion. The respondents noted that some people have no discipline in throwing away their garbage or waste, and some people don't care about the environment. The waste they are throwing anywhere causes blockages in the highways, resulting in stagnant flooded water, especially during rainy seasons. As a result, the vehicles cannot immediately move due to the high level of flood water on the road, resulting in heavy traffic. This finding is aligned to the study of Dipnoan (2014) which states that highway surface drainage systems and problems of water logging and concluded that detrimental roadway elements contribute to highway concerns like accidents. This adds to the list of other roads and highways concerns like the substandard roadway alignment or geometry, shoulder defects, absence or inappropriate pedestrian facilities, narrow, presence of defective lanes including approaches of bridges, roadside hazards, undefined pavement center and edge lines, poor sight distances and visibility, unmarked or presence of inappropriate design of intersections, direction signages, lack of serious roadside hazards, and more (Dipnoan, 2014).

This research advances that proper drainage is a very important consideration in the design of roads and highways. Inadequate drainage facilities can lead to premature deterioration of the highway and the development of adverse safety conditions such as hydroplaning.

Under Section 1 of NEDA Board Resolution No. 5 (s.2017) on National Transport Policy, it provides that to achieve the Transport Vision, the Government hereby adopts the National Transport Policy which all elements of the transport system and all sub-sectors of transportation, including passengers, shippers, service providers, investors, agencies and instrumentalities of government and those involved in the movement of people and goods and in the transport development, management, operations, and use.

In order that Marawi can attain a safe, resilient, and sustainable traffic management, the Local Government Unit of Marawi City can look into the challenges on traffic congestion to resolve the different issues encountered by the key implementers, the Marawi Traffic Management Enforcers, Drivers, and Commuters and can also look into the recommendations stated below.

### Recommendations

In light of the findings of this study, the following recommendations are offered in order to address the challenges found. These recommendations hope to pave the way for the city to attain a safe, resilient, and sustainable traffic management leading further to the contributions of Marawi City, BARMM, Philippines to the achievement of SDG 11.

1.The Local Government Unit of Marawi should coordinate with the Department of Public Works and Highways (DPWH) on road widening projects to increase the capacity of traffic corridors and add lanes for vehicles in order to achieve smooth traffic flow, reduce accidents,

**Table 1:** Analytical Design of Results on Traffic Congestion in Marawi City

<b>Analytical Dimension</b>	<b>Key Issues Identified</b>	<b>Analysis/Interpretation</b>	<b>Supporting Literature</b>	<b>Implications</b>
Infrastructural Factors	Narrow roads; increasing number of vehicles; limited road capacity	Traffic congestion is structurally embedded due to mismatch between infrastructure capacity and traffic demand; road expansion alone may not solve congestion due to induced demand	Matson <i>et al.</i> (2006)	Need for integrated infrastructure planning with demand management strategies
Institutional & Governance Factors	Lack of administrative support; weak enforcement; limited personnel	Gap between policy formulation and implementation weakens traffic regulation; insufficient manpower reduces compliance	Dunn (2018)	Strengthen administrative capacity, increase enforcers, and ensure consistent policy implementation
Technological Factors	Non-functional traffic lights; damaged/stolen CCTVs; poor electricity and internet	Inefficient traffic management systems limit monitoring and control of traffic flow; technology issues extend beyond availability to maintenance and support systems	Souza <i>et al.</i> (2017)	Invest in sustainable, well-maintained traffic management systems and infrastructure support
Human Resource & Capacity Building	Limited trainings; lack of professional development for enforcers	Traffic management requires continuous skill development; lack of training reduces operational effectiveness	National Academies (2023); Ramavhunga (2018)	Enhance continuous training programs and institutional support for personnel development
Behavioral & Socio-Cultural Factors	Undisciplined drivers; unlicensed drivers; illegal parking; non-compliance	Human behavior is a major contributor to congestion; violations persist due to weak discipline and awareness	Jeepara <i>et al.</i> (2011)	Promote behavioral change through stricter enforcement and public awareness campaigns
Environmental & Situational Factors	Drainage construction; flooding; poor waste disposal	Environmental mismanagement affects road usability and contributes to congestion, especially during rainy seasons	Dipnoan (2014)	Improve drainage systems and enforce environmental management policies

and provide safety benefits.

2.The Marawi City Planning Office should pursue the plans to install facilities and adequate road signs such as traffic lights, overpasses, bus stops, intersections, markings, loading and unloading areas, and pedestrian lanes on every road to provide guidance and information to drivers and commuters.

3.The Local Government Unit of Marawi should support the professional development of traffic enforcers by conducting trainings, seminars, and programs for the traffic enforcers of the Traffic Management Office for sufficient knowledge in managing traffic rules and

regulations, and also for the drivers, who must be required to attend seminars about road and driving etiquette to have sufficient knowledge about traffic rules and regulations and other laws relating to land transportation and traffic code.

4.The Local Government Unit of Marawi should strictly implement the traffic rules and regulations, and other ordinances relating to traffic management should strictly impose sanctions and penalties on those who violate the traffic rules and regulations.

5.There should be full support from the Philippine National Police and the Armed Forces of the Philippines

for traffic operations in order to impose disciplinary measures on abusive drivers, car owners, and commuters. 6.The Local Government Unit of Marawi should ban on-street parking by implementing zonal parking control to make more effective use of road capacity, manage parking duration on-street in order to increase the turnover rate, and deter vehicles from long-term parking on-street by introducing a parking charge system in addition to the parking duration control.

7.The Local Government Unit of Marawi should implement proper segregation of waste and proper throwing of garbage to avoid blockages in highways and stagnant flood water during the rainy season.

8.Drivers and operators must see the importance of traffic management knowledge through seminars and the proper use of licenses.

## CONCLUSION

In conclusion, the challenges identified in this study highlight the need for safe and sustainable traffic management in Marawi City. The presence of narrow roads within the city poses a significant obstacle to smooth traffic flow and increases the risk of accidents. Furthermore, administrative support and adequate funding are crucial for the development of technical equipment and facilities that can enhance traffic management. The lack of capability building training for traffic enforcers hinders their ability to effectively regulate traffic and ensure public safety. Discipline and cooperation among drivers and car owners are essential to maintaining order on the roads, while the presence of unlicensed drivers and illegal parking further exacerbates congestion issues. Additionally, the on-going construction of the drainage system adds to the complexities of the traffic management. Addressing these challenges through the recommendations forwarded is vital not only in terms of logistical and infrastructural development of the city but also a salient social development that can help the citizens and institutions in Marawi in the improvement of their daily lives. This shall also pave the way to the achievement of a safe, resilient, and sustainable traffic management system in the city, thus further contributing to society's achievement of Sustainable Development Goal 11: Sustainable Cities and Communities.

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