UNDERSTANDING TRUCK OVERLOADING BEHAVIOUR AND ITS CONTROL : A REVIEW OF PREVIOUS STUDIES

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RINGKASAN :

Pelanggaran muatan di jalan raya tidak hanya terjadi di negara-negara yang sedang berkembang. Laporan dari berbagai negara menyebutkan terjadinya persoalan yang mirip di beberapa negara maju, bahkan Amerika Serikat. Penyelesaian persoalan ini banyak dilakukan tanpa melihat latar belakang terjadinya pelanggaran beban lebih dan umumnya dilakukan secara pragmatis tanpa menyentuh persoalan pokoknya.

Paper ini merupakan studi pendahuluan terhadap pelanggaran beban yang diambil dari berbagai pengalaman dalam negeri dan mancanegara. Dari berbagai studi ini ditemukan bahwa penyelesaian masalah pelanggaran beban lebih selama ini lebih memihak pada penyedia infrastruktur daripada berupaya menyelesaikan masalah secara komprehensif. Masih banyak celah yang ada dalam riset pelanggaran beban lebih terutama berkaitan dengan alasan dibalik perilaku pelanggaran beban.

Kata Kunci : Beban lebih, Angkutan barang, Penegakan peraturan beban, Dampak beban.

SUMMARY :

Overload offences have not been a problem if developing countries. Various countries as well, even in the USA. However, the solutions taken have not considered the background of overload offences but tended to be pragmatic and neglected the main problem.

The paper is a preliminary study of overload offences taken from some countries experiences. Study reveals that the solution has been focused on infrastructure providers side rather than dealing with the problem comprehensively. Various gaps found in the research mainly factors related to overloading behaviour.

Keywords : Overloading, Freight Transport, Load Enforcement, Loading Impact,

INTRODUCTION

Overloading is unlikely to be a problem for specific countries only. The problem of overloading is suffered across countries, including those which rich enough to provide sufficient road structure and geometry. Even though this problem had been identified prior to the world war (see USDOT, 2002), the growing concern triggered by overloading impact on road maintenance budget seems exploding since mid 80s. Indonesia, which has a great dependence upon truck transport, has been suffering from road damage attributed to truck overloading since the government relaxed the use of weigh bridge station (WBS) in 1985 (See Aly, 1990). A similar situation has also been recorded in Thailand and Papua New Guinea (Beatty and Anthony, 1988; Ruenkrairergsa, 1991) as well as in the US, UK,and Hungary (Koloszy, Szilassy, Agardy, and Gaspar, 1998; Prentice and Hildebrand, 1988; USDOT, 2002) In most cases overloading problems seem to hit into inter-urban and strategic roads which function to be economic-backbones for the country. This has caused these countries incurring remarkable costs of their national budget for road rehabilitation and improvement.

This paper addresses overloading from its nature, background, impacts, and control. It is aiming at providing basic information upon truck overloading to help the understanding process of overloading. Information come from a number of resources such as research report, articles, journals, and proceedings. This paper is going to be part of my dissertation in this topic which is expected to open a number of relevant future research in this area.

OVERLOADING AND THE ACTORS

The problem of overloading

The failure of Indonesian road authority, both Directorate General of Highways (DGH) at the national level and Dinas Bina Marga at either provincial or district levels, in providing roads that meet the geometric and structure standard, has deteriorated the impact of overload offences upon the life time of the structure. The Directorate General of Regional Infrastructure (formerly DGH; 2001) admitted that sub-standard road geometry in a number of main islands, such as Sumatera, Kalimantan, and Sulawesi, has contributed to the rapid deterioration of road surface in these islands. Road sections in these islands somehow provide less than 7 m width of carriageways. The sub-standard carriageway widths can double the impact on pavement which leads to a permanent deformation road surface.

In addition, the infrastructure supply has not been quite promising since the 1997 crisis. The crisis, which has seriously influenced the economic sector, has also sunk the budget of construction sector by –

40.5%. This makes Indonesian government relaxed the maintenance of road nationwide. The situation has been deteriorated by the massive overload offences in terms of number and the severity. DGH (1998) reported that 12 links of public road at Java experienced overloaded by 30 % of the total truck the population and 9 links at Sumatra experience overloaded over 30% of the total truck population. From initial monitoring of Sumatra Regions Road Project (DGLC, 1999) in Riau, Banda Aceh, and North Sumatra, it was discovered that 30-40 % of trucks, which offended load limit, carrying over 100% excess of the weight limit. For some extreme cases, trucks committed excessive load weight approaching 150 % over the statutory weight limit (STWL).

Overloading has not been a problem for developing countries only. Stein (cited in Transport Research Corporation; TRC, 1998) used the Wisconsin Department of Transportation data indicating that around 14 % of the 5-axle Combination Trucks travelled on all highway system were operating with at least 1 possible weight limit offence and over 6 % had gross weight violation. On the rural interstate, around 15 % of this truck type commited weight violation by 2% to 30%, while on the Rural Principal Arterial System was around 17.6% ranging from 16% to 20%. A Hungarian Study by Koloszy, Szilassy, Agardy, and Gaspar (1998) reported that over 10 % of the vehicles measured using WIM stations in Hungary during 1996-1997 travelled with excessive permitted loading limit. In some cases, the measured single axle loads were twice the legal limit, while the dual and tridem axles could reach 1.5 times over the relevant legal limits.

Who overloading ?

Overloading and Vehicle Types

Overloading involves a variation of Heavy Goods Vehicles (HGVs). Oetojo et al (2000) conducted a weigh in motion (WIM) survey along the Java Northern Arterial Road and found that HGVs category 3 (Rigid truck, 1.2 H) to be the most frequent overload offenders. The highest rate of offences committed by category 3 was 62.35% of the category population. Other category which were also committed overload offences, including category 4 (Rigid T 1.22; 55.6 %), category 5 (Rigid T 1.2-22 or T 1.2 22; 33.33%), category 6 (Rigid T 1.2-2.2 or T 1.2.2-2.2; highest rate 20.38%), category 7 (Articulated T 1.2-2; 33.33%), category 8 (Articulated T 1.2-22; 31.43%), and category 9 (Articulated T 1.2-222; 33.71%). Even though overloading behaviour has spread widely within many HGVs' category, it is quite reasonable that weight enforcement has been focused more upon Rigid 1.2 and 1.22 trucks which were found to have much more offences rates than other category.

Between Drivers, Good Owners, and Operator Management

Actors of overloading can comprise drivers, operator management, or owners of the transported goods (consignors). Santoso et al (2000) reported that 8 out of 10 truck drivers who travelled in overload situation admitted their significant roles in taking the risk of overloading. Considering small numbers of respondent have been interviewed by these authors, this clue might be misleading. In many cases, truck drivers do not own the truck, therefore, cannot decide to travel in overload situation or not. They merely operate the truck and do not have sufficient power to refuse orders either from the operator management or goods' owners in transporting goods. Unless drivers enjoy significant incentive for overloading, there is no reason for drivers to take such large risks in their journey. However, very little research have been found focusing on this area, either pro or against Santoso et al's finding. Supposed this finding was right, a deeper exploration is still required to find the individual role of drivers and roles of significant others for drivers in taking the risk of overloading.

Other factors relate to Overloading

1. Travel Distance and ports

Travel distance can significantly affect overloading behaviour. The longer journeys of the trucks, the occurrence of overloading seems to be inclining. Over 50 % overloading cases, especially which are involving category 3 HGVs, travelled for a long distance journey. Specific for this type of truck, overloaded cases were likely to be more frequent at the area of ferry ports than at other areas (Oetojo et al, 2000; Santoso et al, 2000; DGLC, 2004). Oetojo et al (2000) suspected that the space for manoeuvre and capacity of the ferry caused great difficulties for bigger trucks drivers. As the consequence, goods owners are likely to utilise smaller trucks. This, however, has not been finely proven. All of these researches did not deeply investigate the situation behind this phenomenon.

2. Type of Load

Overload seems to occur between trucks with variation of load types. Santoso et.al. (2000) found that overload is likely to occur on a road which allowing the accommodation of C-type mining transports. Recent monitoring of Sumatra Region Roads Project (2004) provided a rough overview that trucks carrying timbers constantly breach the Statutory Weight Limit (STWL) by over 100%.

Some of them even take the risk of carrying loads up to 150 % exceeding the STWL. The second worst behaviour followed by trucks with small goods on board and then trucks carrying coal and Crude Palm Oil (CPO). Lou Dan (2003) reported that overload was most likely committed by trucks which hauled low-price materials, such as coals and construction materials. It seems that overload correlates to major local product or commodities which its price is low therefore to cover the transport costs truckers need to take more weight. However, there is no statistical evidence issued by both Santoso et al and SRRP upon this situation. Data provided by in both documents have not been well explored. A deeper investigation will be required to discover actual correlation between overload and type of load.

3. Type of Road

Overload is likely to occur in the strategic road network. TRB (1999) quoted a Wisconsin study that reported the 15% weight violation at Rural Interstate System, 17.6% on the Rural Principal Arterial System. This study also recorded that 40% of the Equivalent Standard Axle Loads observed on the Rural Interstate were attributable to excess axle loading. This finding seems consistent with Santoso et al (2000) and Oetojo et al (2000) who found that overloading were likely committed by long haul truck.

Overload measures, therefore can focus more upon the strategic road such as Inter-province or Interstate arterial system.

4. The Advance of Truck Technology

Overload might also be driven by the presence of a better truck technology that provides higher axle capacity and stronger engines to enable carriers taking greater payload than those use an older technology. For Indonesia, there are two underlying problems associated with truck technology. First, truck manufacturers are more likely to produce of category-III HGV (1.2) than other category. The gross vehicle weight (GVW) of this single axle type varies between 10 and 24 tones. During year 1995, for example, it was reported that 18,051 units of this type were produced, while for multi axle trucks of the category-V HGV were 628 units only (DGLC, 1999C). This can contributes largely to overloading problem because one axle of this type is able to carry 13 tones of load. Second, as an impact of the severe economic crisis in 1997, large numbers of second-hand multi axle trucks were imported from many Asian countries, especially China. The dimensions of these trucks were mostly designed for those countries, which obviously have better infrastructure than Indonesia. These trucks look bulky and have longer rears overhang than those manufactured in Indonesia. The overhang seems to provide

greater opportunity for drivers, truck operators, or goods owners to travel with more loads on board. It certainly increases the number and severity of overload offences.

The Truck Size and Weight Study (USDOT, 2000) has also estimated the attraction of larger size and the suspension system of the recent truck which allows truckers to take more load than before. Truckers are likely to divert to larger size and weight where it is possible to reduce costs of transport. This indicates that the development of truck technology would increase the possibility of overloading in the network. There is also a tendency that truckers are likely to optimise the capacity of their truck size.

5. Trucking Management

Size of fleet owned by a truck operator would influence the level of control of truck owner toward the compliance of their drivers to the company policy. The larger size of the fleet, the control over driver's behaviour in taking load for their travel is getting lower. This would make greater possibility for the truck to overload which may reduce the replacement timing of the fleet (Pattullo, 2004). This can be deteriorated when business pattern between truck owner and drivers allows for drivers to take any risks in increasing their take home pay. Since many truck owners could not establish a good payment system for drivers, most likely drivers would take overloading risks.

REASONS BEHIND OVER LOADING

Economic Reason

From the carriers' or operators' point of view, taking a risk to travel in overload situation is associated with a simple and rational reason, that is, reducing operational cost of goods transport. The USDOT study (TRB, 2002) provided valuable information regarding response of shipper toward of TS&W policy. Using every potential cost which should be incurred by both public and private sector for impacts that might rise due to changes in truck size and weight policy, the study indicated that shippers would make use any opportunity in reducing transport costs. Shippers are likely to reduce Vehicle-Miles Travel (VMT) when it is possible to do so. The USDOT Study (TRB, 2002) estimated such situation would occur for most global scenarios proposed for the analysis. This explains the reduction in number of little truck that would happen when the scenario to permit larger trucks to operate in the US is deployed.

Overload can reduce transport cost in association with saving travel time, cutting load-unload costs, saving vehicle operating Costs (VOC), and reducing travel overhead, such as administration fee, permit fee, and retribution fee. In a case, a truck obtains a contract to transport high-density goods and goods with odd weight that enables utilisation the lower number of trips, either drivers,

carriers' management, or goods' owners are more likely to take the risk of overload than adding more trips to carry the whole consignment or operating larger number of trucks. Minimising number of trips can also cut travel time and at the same time can reduce cost of load-unload, VOC, and retribution fee. While minimising number of trucks may not reduce travel time, but certainly reduce VOC and overhead costs.

One rational perspective associated with overloading was introduced by Prentice and Hildebrand (1988). Using the gaming theory these authors estimated the impact of enforcement activity upon overloading behaviour. They assumed that truck operators would overload the truck if potential gain from overloading were higher than risks they hade to face when overloading. Prentice and Hildebrand, however, did not elaborate both benefit component of overloading and risks associated with overloading. The research seemed narrowing the risks of overloading to the risks associated with apprehension when overloading. This, however, has provided a good starting point to learn the rationale of overloading behaviour.

Likewise, Strathman (2001) assumed that freight carriers would set load weight levels that will result in maximum profit. Overload will occur if the additional revenues from taking excessive load are just offset by additional costs, including the expected penalty from detection through weight enforcement activity. Strathman illustrate the net operating profit per mile to the overloading carriers as the following:

$$\pi = r * (W_{Limit} + W_{excess}) - P_d * f(W_{excess}) - c * (W_{Limit} + W_{excess}) \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where,

π = Net operating profit per mile
r = Revenue per ton-mile, units
W_{Limit} = the legal load limit
W_{excess} = the load in excess of the legal limit, in tons
P_d = the probability of detection by weight enforcement activity per mile of travel
$f(W_{excess})$ = the penalty associated with overloading, which is defined to be a function of the level of overloading
c = operating costs per ton-mile, units

Equation *(1)* indicates that operating profits per ton-mile are maximised when revenue from overloading is similar with the marginal additional operating cost plus the marginal expected penalty. The expected penalty consists of two elements: P_d which represents the intensity of weight enforcement activity, and $f'(W_{excess})$ that indicates the severity of marginal fines imposed on apprehended overloading truckers.

Psychological Explanation

There is no research have been found working upon psychological aspects of overloading behaviour even though overloading decision might be influenced by psychological motive. Since

overloading is rationally driven, a number of rational theories appear to be relevant to the reason behind such traffic law violations as load limit offences. One of them is the theory of Planned Behaviour (TPB; Ajzen, 1991). The theory says that behaviour of a person toward taking a certain intended action can be predicted by the person's intention toward the behaviour. The intention of this person is influenced by his/her attitude (AT), subjective norms (SN) toward performing the behaviour and personal behavioural control (PBC) of that person to perform the behaviour. Attitude is defined as individual evaluation over the outcomes of such behaviour, SN is considered as perception of important others (referents) of this person upon the behaviour, while PBC relates to resources and past behaviour of the person in performing the corresponding behaviour. The PBC may have a direct influence to the behaviour. Ajzen named the improved TRA as the theory of Planned Behaviour (TPB). The model of TPB and TRA is illustrated in figure 1.

Overloading behaviour occurs because drivers, carrier's management, or good owners, take the risk on purpose. The intention to perform the behaviour was positive due to a positive evaluation of the benefit of overloading, a positive evaluation that overloading is accepted by referents, and there was no significant harms attributed to overload based on agent's experiences, while roads, vehicle, and tyre technology support the agent to do the behaviour.

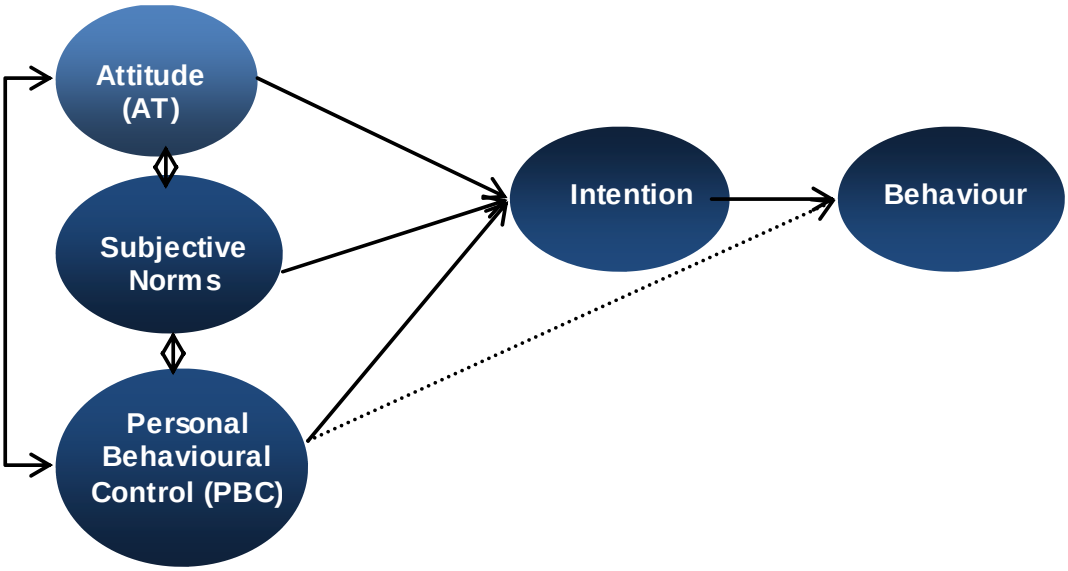

Figure 1. The Theory of Reasoned Action and The Theory of Planned Behaviour

As well as other traffic violation, overloading can be emotionally driven. A number of theories in association with sensation seeking or role identity might be applicable to explain overloading behaviour in some cases. These theories have been successfully explaining the phenomenon of aggressive driving and speeding which are likely similar with the phenomenon of overloading for a group of drivers. The theory of sensation seeking (Lajunen and Sumala, 1997; Nells, 1998) said that aggressive driving for drivers in certain ages, usually younger drivers, is considered to generate a sensational situation for these drivers. These drivers are proud of their ability either surviving from a dangerous situation or being superior over other drivers. Taking excessive weight on their truck can be considered as an aggressive behaviour which might invite trouble either for their selves or other road users. This would make these drivers habitually violating weight limit in any circumstances.

The Theory Role of Identity explains that some drivers may consider driving in dangerous situation has been an identity of their society (Forward, 1997). Taking a risk of overloading can also be considered to be an identity of a long-heavy hauled vehicle. In the situation where many drivers are not mature enough to drive a large truck, the phenomenon of overloading can be attributed to this motive. It is therefore important to consider driver characteristics in overloading behaviour.

IMPACTS OF OVERLOADING

The impact of overloading is somehow controversial. From macro-point of view, overloading is claimed as benefiting the national economy of the country. Ruenkrairergsa (1991) highlighted that overloading has benefited Thailand in amount of 100 times over the budget required to maintain the road in its service status. The calculation was based on additional transport costs associated with extra fuel required for shipping repetition, and additional costs associated with the enforcement of axle load limits. This seems to rise a controversy against the general opinion about overloading, but it is quite reasonable. Regardless poor investigations around this perspective area, those who pro to Ruenkrairergsa argued that overloading is required to stand with the vicious competition in transport industry, keeping for consumer goods or agricultural commodities price low, reducing the extensive use of fuel, and avoiding hassles in load control. (leebe, 1999; Lou Dan, 2003). From this perspective, overload is deemed to increase the efficiency in infrastructure utilisation.

From narrower perspectives, which use infrastructure providers' eyes, overloading is merely viewed as causing significant hassles in keeping

the level of service of road surface. The impact of overloading for infrastructure provider can be direct or indirect. The direct impact of overloading upon infrastructure providers is increases in maintenance costs, while indirect impacts include increases in risks of accidents and increases in externality associated costs, especially related to congestion, noise and air pollution.

Impact upon road structure

After nearly a century of explorations, in the period of 1958-1960, the AASHO yielded the *'fourth power law',* which represents the declination in pavement serviceability attributed to a heavy vehicle axle.

It is appeared that pavement serviceability relate to the fourth power of its static load (Anon, 1986). This was converted to the load pertained to the road by mixed traffic into a number of ESAL. The number of ESALs, *N*, caused by static load, *P*, then is expressed as:

$N = \left(\frac{P}{P_0} \right)^n$, while n = 4 and P_0 is generally assumed to be 80 kN (18 kips) *(5)*

The invention of *the fourth power law* has contributed significant simplification for pavement design as well as provided a simple tool for evaluating the road damaging potential of vehicles. The law has been used broadly throughout the world in pavement design. It is also enormously influenced political decisions concerning the axle loads of trucks, and hence the economics of freight transport.

Following the fourth power of law, Manulang and Gultom (2005) estimated additional costs imposed to road authority due to overloading in the North Coast of Java Arterial System. They found that additional costs generated by overloading within these arterial system was equivalent to two and a half times of normal expenditures needed for rehabilitation works to keep the road on service. An overloaded road would require reconditioning in every 6.5 years, while a normal load would take 20 years. Manulang and Gultom, therefore, suggested to apply excess load charge equivalent to Rp 7,322,00 per tonne-Km of excess load in order to compensate reduction in lifetime of the pavement.

Impact upon Traffic Safety

The contribution of trucks in traffic accidents cannot be seen as the involvement of trucks in accidents. The presence of trucks in the traffic might have increased the potential of accidents to occur. Vision block associated with the dimension of the truck and slow travelling truck might cause tension to smaller-car drivers. Because of these, those drivers tend to overtake even though the front vision is blocked (ASCE-ULI-NAHB, 1974). Overtaking in this situation would increase the possibility of accident to occur. Tan

and Ogden (1981) found that fleet-articulated trucks were about 12 times as likely as a car to involve in fatal accidents, while long-distance travelled articulated truck were 3 times of that (See also Polus and Mahalel, 1985). Alfa and Allam (1988), indicated that the number of accidents per vehicle-kilometre is likely to decline with the inclination of GVW for both single and double trailer combinations. It seems that the larger the truck is, the possibility it causes fatal accidents is higher and increasing exposures of heavy-slow trucks to the traffic would increase the possibility of fatal accident to occur.

Impact upon Traffic Characteristics

The presence of heavy trucks in traffic is considered to be an impediment that may impact traffic characteristics including, volume, density and speed. Most of HGV travelled fairly slower than other vehicles. Overload Heavy Goods Vehicles are even worse. A big truck, in some situation, can block visibility of drivers of smaller vehicles which causes those drivers to follow the truck closely. In a situation of no opportunity for overtaking, the truck impedes those vehicles. Another bad situation occurs in parts of urban road network. In urbanised areas, trucks usually avoid to travel at the left lanes due to enormous disturbances caused by other activities at these areas. This behaviour certainly reduces the level of service of carriageways. These are some examples how the presence of HGVs in road network might reduce traffic volume of the road for a certain period.

The impediment attributed to truck can change the density of the traffic. Increasing in number of trucks may significantly increase density due to tailgating. The presence of HGVs can result in reduction of average speed and the difference of speed between vehicles. Since there is a possibility for overtaking, the drivers of smaller vehicles tend to overtake the slow truck that causes a great difference between speed of vehicles preceding the truck and those are following.

A numbers of measures, propose to tackle these problems including the provision of slow lanes for overtaking which are added at sections of the road links and changes the geometry of intersections, and providing specific lane for truck in urbanised areas. TRB (2002) highlighted the need in improving carriageways and intersection capacity when larger vehicles are allowed to operate in US federal highways. Since most of highways were designated for certain type of trucks, the tendency to use the larger one would definitely change many of the design parameters of the road.

For many road authorities, these are costly and difficult to apply, especially in urban areas. Also, in many cases, there is no adequate

evidence can be used in proposing such measures due to lack of research supporting the inefficiency caused by overloading upon road services. Information in this area appears to be quite rare. It is still required to carry out extensive exploration to formulate effect of overload upon level of service of the road.

Impact on the environment

Effects of the presence of large and heavy trucks upon the environment focus on three issues, namely noise disturbance, air pollution, and vibrations. A number of information have been found concerning effects of truck operation within the traffic stream upon environmental noise, including OECD (1995), EPA (1999), Krause and Brown (1994) and Transportation Research Board (TRB; 1976). Whilst information concerning impact of trucks upon air quality also appears to be enormous (ATRI-WHI, 2004; Janssen et al, 2003; TRB, 1995), effects trucks in traffic on vibrations are less likely addressed.

Issues upon noise disturbance associated with the presence of trucks in the traffic mainly concern about the significant gap between noise resulted from trucks and the standard quality of environmental noise. This related to 2 sources of noise. Noise generated by vehicle, which include noise resulted from engine and other parts of the vehicles, and that generated from the interaction between tyres and road surfaces. In a free flowing traffic, noise generated from interaction of tyres with road surfaces plays dominant role in determining noise accepted by receptors at the side of the road. In a situation of non-free flowing traffic, noise generated by engines, including that resulted from transmission and exhaust system, dominates the environmental noise attributed to traffic. Since heavy trucks utilise large numbers of tyres, which each puts great pressures on road surface, and large engine size with engine breaking features, then noise problems in relation to the operation of heavy trucks on road network appears to be unavoidable.

Generally, environmental loss attributed to traffic-air pollution is calculated on the basis of the amount of pollutants (Kgs) emitted by vehicles to the atmosphere per Kilometre travel or in a specified period (daily, monthly, or annually). This is also utilized by TRB (1995) as basic approach in analysing reviewing large number of researches in relation to traffic air pollution. TRB highlighted that concerns about pollutants emitted by trucks are different from those emitted by passenger vehicles. Whilst most passengers-vehicles result in large concentration of Carbon Monoxide (CO), followed by much smaller emissions of Volatile Organic Compounds (VOCs) and Oxides of Nitrogen (NO_x), heavy-duty diesel vehicles-combination trucks and buses-primarily emitted NO_x, followed

by smaller emissions of CO, Particulates (PM-10), sulfur gases (SO_2), and VOCs (Figure 2).

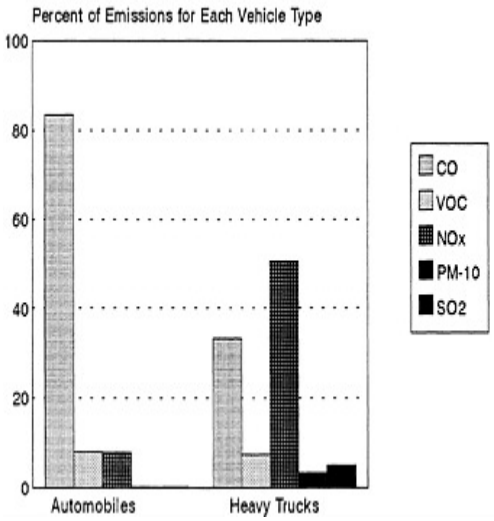

Figure 2 Comparison of national emission estimates (measured in short tons) for gasoline-powered, light-duty automobiles and diesel-powered heavy-duty vehicles (Nizich et al., 1994 in TRB, 1995).

Heavy-duty diesel vehicles result in about 5 percent of total emissions from all highway vehicles, approximately proportional to their share of highway travel but much smaller than the emissions of gasoline-powered passenger vehicles, which correspond to nearly two-thirds of total emissions from highway vehicles.

An overloading truck might run in overload engine. Thus, exhaust gasses emitted by this truck per kilometre would be greater than that travel with a normal load. This might cause a problem for infrastructure providers because they face a risk in reducing the infrastructure emission.

CONTROLLING LOAD

Deterring overloading from road network requires a strong weight enforcement practice. This would include policy and enforcement activities. To make an effective deterrence, an enforcement activity requires deploying measuring devices and punishment instrument. There are numbers of instruments deployed to enforce weight limit. Complimentary with the deployment of load control devices, significant fine is generally imposed for overloading offence. In addition to this, some countries adopt the overloading permit scheme for flexibility in transporting goods which because of its nature should be hauled in excessive weight.

As any other enforcement, the effectiveness of weight enforcement is largely depended upon a number of factors, including levels of enforcement activities, levels of limit tolerance, action taken toward violators, fine structures, and court actions. To ensure an effective deterrence in overloading enforcement, The NCHRP Synthesis of Highway Practice 68 (TRB, 1995) suggested the following approach:

1) Deploying all size and weight enforcement activity in a specific unit that is adequately staffed. This unit would establish a comprehensive program of

various scale to ensure reasonable coverage and high level in perceived of apprehension among offender.

2) Establish and take effective action against violators along with appropriate fine structures. A coordinated legislative and regulatory action would be required.
3) Coordinate programs and develop model with the assistance of FHWA, AASHTO, and the association of National Government.
4) Review and study of differences in permit issuance, which fails to support overloading deterrence from the network.

From the above suggestion, it is clear that overload control should deploy a comprehensive approach and affect any levels of government. An effective concept in load control should be a focus of a specific authority which is able to establish and carry out the enforcement strategy and tactics, appropriate fines structure, and supporting permit scheme which are wrapped in a comprehensive program under assistance of a right authority and expertise.

Overloading Enforcement Activity and Load Control Devices

There are two common methods in measuring weight of a truck, namely stationary and dynamic methods. The stationary method utilises a plate axle weighbridge, while the dynamic one makes use of the weight in motion (WIM) device. In a stationary method, the weighed vehicle is required to stop on the weighing beam, while in the dynamic method, the weighed vehicle is not required to do a complete stop. Indonesia has adopted the stationary measuring method in the Weigh Bridge Station (WBS) since 1975 (Aly, 1985). In the US, most states collect tuck classification and weight data using WIM device as it is required by the Traffic Monitoring Guide (TRC, 1998). In addition to those two methods, the UK has also employed the portable weigh pads (Hodges, 2005). For enforcement purposes, the deployment of these instruments should comply with codes of practice published by the Department of Transport or relevant authority that is responsible to weight enforcement program (see FHWA, 1995).

The degree of weight enforcement influences trucker compliance level upon weight limit. A Canadian study (cited in TRB, 1998)

recorded that increasing inspection rate of a permanent weigh scale to about 5 % from its normal operation would reduce number of weight violation rapidly. While improving enforcement activity which generates apprehension probability beyond 5% had little impact on violation rate. The study has also found that there was significant difference in effect between various enforcement levels. The level of violation within the long-haul intercity truck was 2.8% lower at continuous enforcement than at normal enforcement. At areas, where the enforcement were relaxed from normal to zero (closing WBS), the violation level increased by 18.6%.

Strathman (2001) observed the effect of four enforcement regimes in association with penalty and enforcement levels upon overloading i.e. a combination of low penalty and low enforcement, low penalty and high enforcement, high penalty and low enforcement, and high penalty and high enforcement levels. He correlated numbers of citation issued by traffic police against weighing methods, levels of fines, Vehicle-Mile Travels (VMT), and transport price per ton. As a result, strathman found that increases in level of enforcement would significantly reduce the number of overloading offences. It is also obvious that fixed –location weighing practice was much less effective than weighing at variable locations with portable scales. Meanwhile, it seems that overweight fine structures were well below the marginal revenues the truckers gained from overloading.

Besides physical measurement, a number of states in the US, such as Minnesota, Montana, and Texas, and the Province of Alberta in Canada deploy a Relevant Evidence Enforcement (TRB, 1999). This involves inspection of relevant documents, such as receipt or bill of lading, which inform the origin, destination, weight, and composition of shipments. The advantage of such system includes enabling the initial suits for violators, easy to monitor habitual violators, unobtrusive procedures and not route specific, reducing the on-enforcement activity. However, this system would increase the administration costs and sensitive to gross weight violation only. Also, specific policy on document keeping is required to ensure all truckers completed with necessary document to enable the enforcement underway.

Overloading Fines

The magnitude of overloading fines varies widely across countries. In the UK, a maximum penalty for overloading offence is £ 5000. For a more serious offence, such as in which the overloading potentially create a danger or injury to any person, then the driver or truck operator could be charged with the offence of using a vehicle in a dangerous condition (Hodge, 2005). In accordance with the Traffic and Road Transportation Act, UU no. 14 year 1992, the maximum fines for

overload in Indonesia is Rp. 3 Millions (Approximately USD 330). Compared to other traffic offences, the magnitude of fines for overloading is considerably higher. It is obvious that overloading is considered to be a serious offence in many countries. Large fines imposed for overloading offences is expected to generate a deterrent effect for offenders.

The operationalisation of overloading fines in Indonesia is authorised to the district court. Even though the regulation entitled the district court to exercise large amount of fine but there is no record showing that the effective fines has been practiced for overloading offenders. For around 400 offences, local courts fine offenders around Rp 40 thousand to Rp 300 thousand per violation captured (DGLC, 1999). This situation is less likely to discourage drivers to break the overload limit than if the maximum fines are deployed. A number of considerations have been involved in judge decisions, including the rate of offence out of the statutory weigh limit and economic ability of drivers. It appears that other considerations including, lost in infrastructure life, road capacity, environment, and safety have not been optimally taken into account in structure of overloading fines.

The effect of fines magnitude upon overloading has somehow been explored in New Brunswick and Manitoba study by Prentice and Hildebrand (1988). The study used a game theory to model the decision of truckers either to comply with statutory weight limit or to overload their truck in association with the enforcer choice either to open or close the scaling point. The solution to the theory model can be interpreted as an equilibrium value which indicates the percentage of time scales should remain open, and the incentive for truckers to take the risks of overloading with reference to the penalties for overloading. By determining the penalty structure, Prentice and Hildebrand thus could establish the equilibrium point in which neither the truck operator nor the government, has any incentive to modify their actions irrespective of the other party's actions.

Prentice and Hildebrand (1988) defined the equilibrium level of enforcement, $^{-Y}$, as the trucker potential gain from overloading divided by his/her potential cost if apprehended.

$$^{-Y} = \frac{C + G}{P} \qquad (6)$$

Where,

C = costs of compliance imposed to road authority, monetary units
G = overload revenue, ton
P = magnitude of penalty, monetary units

The equilibrium figures that truckers tend to overload their trucks if the magnitude of penalty to be paid, when they are apprehended, is lower

than the sum of compliance costs and overload revenue. From the above relationship, it is evident that as the penalty for overloading increases, the required level of enforcement decreases. Since the enforcement effort brings in considerable costs in association with labour and capital, and then raising the magnitude of penalty would be an effective deterrence for overloading.

Establishing an optimum magnitude of fines for overloading might be less expensive than conducting an extensive enforcement, but it would not be easy. Extensive efforts are needed to enable good estimation of trucker revenue from overloading due to large variation in size, locations, and operating areas of the trucking company. In addition, since lots of parties have also been benefited by overloading, it is required strong evidences to be taken before legislative people to support the large fines. Prentice and Hildebrand (1988) recorded that the expected deterrence of penalty would not be achieved if truckers can internalise the magnitude of penalty in their costs of doing business. A successful deterrent effect of overloading enforcement can be achieved only when truckers perceive the probability of apprehension multiplied by the applicable fines are greater than truckers' gain from overloading.

Overloading Permit

Many countries establish an overloading permit system. This system allows for the accommodation of vehicle that is unable to avoid overloading due to the nature of the transported goods which could not be divided, dismantled, reduced, or rearranged to conform to legal weight as provided by law. Type of overweight permit issued can comprise of single, multiple, continuous, area, or linked permit. Terms and conditions apply for each permit proposal (Hodges, 2005; TNZ, 2002). To ensure that the overweight permit would not create any dispute with a number of difference road authorities, this policy is usually implemented on the basis of agreement between national and local road authorities. The agreement would allow single authority to issue weight permit which applies for the working area of other authority or vice versa.

The utilisation of weight permit system does not necessarily relax the overweight control. The scheme is designated to control the movement of unavoidable-excessive haul weight within the network. TRB (1998) reported that around USD 84 Millions out of USD 261 Millions (approximately 32.2%) additional cost required for infrastructure investment has been earned by the Federal Government from the permit and penalty scheme. This was well

below the required funding. Nevertheless, on one hand, such system has provided potential way out to funding road infrastructure as long as appropriate permit structures can be established. On other hand, permit system would give solution to truckers who could not avoid taking the risk of overweight due to the nature of the load or other reason.

Critics upon permit policy rise around little effects of this policy in deterring overload offences. Overload Permit can be a revenue collection instrument as well as an escape alley for intentionally-overloading operator, but Permit Policy would not significantly contribute to the reduction of overloading offences. Information regarding the effect of such policy upon operators' intention to take the risk of overloading is very poor. Nevertheless, taking an assumption that overloading permit would help truckers to avoid offences due to the nature of hauled goods, the existence of permit scheme would certainly reduce the intention of truckers to violate weight limit.

RECENT PROPOSALS IN DETERING OVERLOADING (CASE OF INDONESIA)

Overloading has been a serious problem for both road authority (Ditjen Bina Marga; DGH) of the Ministry of Public Works and land transport authority (DGLC) of the Ministry of Communication since the end of 90s. A series of meeting involving both agency followed by a number of projects have been conducted to overcome overloading problem in Indonesia. The progress seems leading to 3 different approaches in encountering overloading, namely the privatisation of Weigh Bridge Station, Restrictions for overloaded truck passing through freeways, and improvement in truck dimension standard.

Privatisation of WBS

One of the largest challenges in operating weight enforcement is the difficulties in ensuring a good management practice and maintaining consistent policy within the WBS. Since the introduction of Weigh Bridge Station (WBS) for weight enforcement purposes in Indonesia in 1975, the operation of the WBS then has been on and off (DGLC, 1999B). Despite large number of WBSs had spread over the country, in mid 80s all WBS were closed. One major reason for stopping the operation of WBS was corruption that occurred at the WBS (DGLC, 1999A). During the closure of WBS, the control for load weight limit was also relaxed. The consequence of this relaxation was premature damage of most primary arterial roads in the network.

In 1995, the DGLC declared to re-operate the WBSs. Bulk trucks, including 1.2, 1.22, and all 1.2-2.2 trucks except for containers or tanks, are liable to be weighed. The change

in policy failed to deter overload offenders from the network. The policy to compulsorily weigh bulk trucks is likely based on the fact that overload offences were majority committed by these trucks. The policy has been underway up to this moment. The problem, however, stays behind. Government fails to sweep corruptions out from WBSs.

There was no apparent result attributed to the change in enforcement policy. The poor management of WBSs was found to be a major contributing factor for overloading offences. Dealing with this situation, the DGLC, through the Sumatra Region Road Project (SRRP), suggested a pilot project for privatisation of WBSs. This year (2007) this project is going to expand to Java.

Privatising the WBS is aiming at improving independency of the WBS unit which is expected to increase the deterrent effect of the enforcement. Using this concept, the DGLC optimistically improve management of the WBSs. However the replication of this approach in other areas without thorough and accurate understanding in the nature of overloading and concept of privatisation would mislead the outcome.

As it is understood, main objectives to setup the WBS is controlling the most frequent axle load reducing overloading offences in the road network. The WBS is therefore functioned as a law enforcement unit for overloading which issues citations or tickets for offenders. Privatising such unit might cause great problem for long run operation. It would face 2 possibilities. First the new management succeed in deterring load limit offender and the second the new management changes function of the unit to be a gate to collect revenue. If the first possibility happens then WBS management would have to be paid by government expenses which might be regarded as a contractor. Other way around, to sustain the operation of WBS a new revenue policy might be developed. This might relax the load limit enforcement. When truck operators can internalise expenses to be paid in the WBS then they would consider the fine as part of the business expenses. In both possibilities there is no warranty for sustainable outcome.

Restricted Overloaded Truck in Specific Link

Another thought which has been discussed recently is implementing the ***no-go*** policy for overloaded trucks in the tol-way. It seems that road operator has just pushed a ***panic button*** in deterring load limit offenders. This policy might be effective for the specific link and give hallo effects to other parts of the network. However, it is necessary to consider the inclination of expenses due to equipment investment and its

operation. Also, if the corresponding link is not long enough, truckers might consider using other alternatives which leads to a rapid deterioration of other parts of the network. Deeper understanding in truckers decision making will be required to see the outcomes and impacts of this idea.

Standardisation of Truck Dimension

In 2006, the DGLC has drafted the technical guidelines for truck dimension which is based on the maximum dimension of goods vehicle cited in the Government Regulation (PP) no 44 year 1993. The guidelines elaborate the size of trucks relating to class of road the corresponding truck can travel on for safety purposes. Even though there is no changes in the maximum truck dimension, this road code has managed to restrict inappropriate size of truck to utilise the poor road structure. The idea was reasonable, however, this unlikely to address the bandit in overloading cases. Most of overloading problems occur within the strategic road network. Overloading is mostly committed by the 1.2 or 1.2.2 HGVs. The dimension of these HGVs are free to travel on the first and second class.

CONCLUSION REMARKS

From the initial review, a number of conclusions can be drawn. These include:

1) Overloading appears to relate to a number of travel-related situations, including the distance of travel, the presence of ferry ports, types of load, level enforcement, and magnitude of fines for overloading. This is likely to be a strong indication only. There is no statistical support to the statement. Extensive works upon this relationship, especially to disclosure the relationship between overloading behaviour, enforcement levels, and magnitude of fines would be the primary focus of this study.
2) As well as understanding the above relationships, properly knowing rational reasons behind overloading and other factors that contribute to overload behaviour is deemed necessary. This would help in identifying factors which are utilised by overloading agent in taking the risk of overloading.
3) There is a gap found in determining the effect of driver's characteristics on overloading behaviour. Psychological attribute might not be the most relevant determinant for overloading behaviour but can be supporting evidence in establishing measures for weight offences. A study using psychological approach is needed to discover the importance of driver personal attributes to overloading.
4) Impacts of overloading upon road structure appear to be properly

explored. A number of advance and recent research are available. On the other hands, impacts of overloading on other aspects, such as traffic characteristics, safety, and the environment, are less likely to be explained than that on road structure. Including these aspects in the analysis would require extensive explorations on potential information and previous research.

5) In addition to necessary research focussing upon overloading, research on pricing and methodological approach in determining penalty for unlawful behaviour, such as overloading, is crucial. This would provide great information on the relationships between magnitude of penalty and overloading.
6) Since overloading is considered to be a way out in solving the transport cost problems, it would be relevant to approach the decision making of overloading from transport costs structure. While many overloading researcher based their analysis from transport authority perspectives, it appears that the policy recommended from the study did not effectively deter overloading from the system. A novel approach involving truck operator perspectives might provide a better answer. It is, therefore, important to figure out the structure of transport costs from truck operators' view as a balance for road authority's perspective. An optimisation from both parties' views upon overloading would provide an appropriate strategy indication in deterring overloading from the system.

List of References

Alfa, A.S, and Allam, S., 1988, *Safety Records of Trucks Used for Long Haul Heavy Goods Movement*, Texas, Transport Institute-University of Manitoba.

Aly, Moh. Anas, 1990, *Truck Overload Problems in Indonesia*, Proceedings of 6th Road Engineering association of Asia nad Australasia Conference, Kualalumpur, REAAA.

American Transport Research Institute (ATRI) and Western Highway Institute (WHI), 2004, *Energy and Emmission Impact of Operating Higher Productivity Vehicles*, California, Cummins Inc.

Beaty, Anthony N.S, 1988, *Axle Loading of Road Freight Vehicles on the Highlands Highway in Papua New Guinea.* Proceedings 14th ARRB Conference, Part 6, Canberra, Australian Capital Territory, ARRB.

Button, K.J., 1982, *Transport Economics*, London, Heinemann, p. 74-162.

Direktorat Jenderal Perhubungan Darat, 1999 A, *Solusi Strategis Muatan Lebih di Jalan. SRRP*,

Jakarta, Departemen Perhubungan.

1999 B, *Kebijakan mengenai keselamatan Lalu Lintas Jalan dan Pembatasan Berat Kendaraan SRRP*, Palembang, Departemen Perhubungan.

1999 C, *Program Penanggulangan Muatan Lebih kendaraan Bermotor SRRP*, Jakarta, Departemen Perhubungan.

Imam Santoso, Doni J Widiantono, Husin Rivai and Syukur Wahyono, 2000, *Karakteristik Baban Lalu Lintas pada jaringan Prasarana Jalan Antar Kota*. Laporan Penelitian, Bandung, Pusat Litbang Teknologi Prasarana Jalan, Balitbang Kimpraswil.

Jørgensen, F. and Polak, J., 1993, *The Effect of Personal Characteristics on Driver's Speed Selection, Journal of Transport Economics and Policy,* Sept. 1993, p.237-252.

Kolozsi, G., Szilassy, A., Agardy, G., and Gaspar, L., 1998, *Permit Vehicle Routing System in Hungary: Protecting Bridges from Highly Loaded Vehicles,* Transportation Research Circular 498, pp. K4/1 –K4/9.

Litman, Todd, 2005, *Transportation Costs and Benefit Analysis*, Victoria-Canada, Vistoria Transport Policy Institute, 2-1 – 2-15.

Lou Dan, 2003, *Overloading and Anti-overloading,* Economic Observer, Dec-2003, Beijing, Downloaded from HYPERLINK "http://www.observer.com"

Manulang, G.Dairi, and Gultom, A.H., 2005, *Kompensasi Muatan Lebih Terhadap Kerusakan Jalan, Prosiding Konferensi Nasional Teknik Jalan*, Batam, Himpunan Pengembangan Jalan Indonesia (HPJI)

Pantja Dharma Oetojo, et.al, 2000, *Studi Penelitian Karakteristik Beban Lalu Lintas Jalan Antar Kota.* Laporan Penelitian, Bandung, Pusat Litbang Teknologi Prasarana Jalan, Balitbang Kimbangwil.

Pattulo, Scott, 2004, *Take control over fleet costs*, NAFA Management Institute, Atlanta G.A.

Prentice, B, and Hildebrand, M.D., 1988, *An Economic Approach to Truck Weight Regulation Enforcement*, Research Bulletin no.4, Texas, The University of Manitoba Research Institute.

Ruenkrairergsa, Teeracharti, 1990, *Problem of Truck Overloading in Thailand*, Report no. MR. 123, Department of Highways, Ministry of Transport and Communication, Bangkok. P.4-37

The US Department of Transportation (USDOT), 2000, *Comprehensive Truck Size and Weight Study*, FHWA Report no. FHWA-PL-00-029, FHWA, Washington.