



SWOT Analysis of Transport in Cambodia Identifying Paths to Higher Efficiency and Sustainability

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ABSTRACT

Traffic demand and motor traffic in Cambodia and its capital Phnom Penh are growing steadily, while the performance of the transport infrastructure is lagging behind due to lack of funds for investment and maintenance, absence of design standards and lack of knowledge on sustainable strategies for the development of the transport infrastructure. Engineering Master students from the Netherlands performed together with students from the Royal University of Fine Arts in Phnom Penh a quick scan of the current transport and traffic problems in Cambodia and Phnom Penh in order to develop measures for improving capacity and safety of rural road traffic and to implement a pedestrian mall in the city center of Phnom Penh. The analysis includes recommendations for administrative and transport policy reforms, innovation of professional transport education, introduction of sustainable road design standards and implementation of a traffic calming plan in the centre of the capital city.

La demande de transport en Cambodge et dans sa capitale Phnom Penh a cru constamment, tandis que la capacité de transport est restée en arrière à cause des moyens financiers de l'investissement et de l'entretien insuffisants, l'absence des normes de plans de constructions standard des types différents de routes et un manque des plans de l'infrastructure de transport. Des étudiants Master de l'ingénieur civile des Pays Bas ont fait des recherches rapides en collaboration avec des étudiants de l'Université Royale des Beaux Arts de Phnom Penh des problèmes de transport en Cambodge et la capitale afin de rédiger des mesures pour augmenter la capacité et la sécurité de trafic routier rurale et pour construire une zone piétonnière dans le centre de Phnom Penh. L'analyse a mené aux recommandations pour la réorganisation de l'administration publique et des reformes du secteur de transport, de l'innovation du système de l'éducation professionnelle en transport, de l'introduction des standards des plans des routes et de la réalisation du plan de réduction du trafic routier motorisé dans le centre de la ville capitale.

CONTENTS



1. Introduction

During the dictatorship of the Khmer Rouge the existing knowledge, legal documents, plans and data about transport in Cambodia were devastated and most of the academically educated people and professionals were eliminated. Since the overthrow of the Khmer Rouge in 1979 the country was hardly able to redevelop some parts of the severely damaged transport infrastructure due to the lack of national funds and knowledge except from aids by international development agencies and a few bilateral international cooperation projects.

The fast growing number of inhabitants, economic activities and motorized traffic in the capital city Phnom Penh leads to an increase of congestion, air pollution and traffic accidents, which endangers the access to historic cultural buildings, further development of trade, safety and security of people in city center markets. More and more sidewalks are occupied by simple street market stands, parked pick-ups, cars, motor cycles or carts that force pedestrians to walk on the streets and to mix with dangerous motorized vehicles.

The Faculty of Architecture and Urbanism of the Royal University of Arts in Phnom Penh was developing in 2006/2007 a plan for a pedestrian area along the main commercial market street # 13 and redesigning the market buildings. As the Royal University does not have a Faculty of Engineering and there is not any professional knowledge available in the area of traffic and transport, the department of Transport & Planning of the Delft University of Technology offered its expertise for supporting the staff and students from the Faculty of Architecture and Urbanism in Phnom Penh in their urban development project.

Growing transport and traffic problems, however, are not limited to the capital city of Phnom Penh but can be found, too, in other cities and in other than urban networks, as they are common for developing countries, which lack of a sufficient national and regional transport infrastructure and policy. For that reason, the analysis of the existing transport and traffic problems in the capital city Phnom Penh has been extended to the national transport infrastructure and public administration in Cambodia.

In the following section of the paper the research goals and method are described. Then, the principal characteristics of the Cambodian transport sector are analyzed in order to present a sustainable strategy for solving some of the main problems of the national network. Next, the feasibility of implementation of a pedestrian area in the city center of Phnom is investigated. Finally, the main elements of a short term sustainable safe transport strategy in Cambodia are described.

2. Goals and method of research

The goals of research are threefold: (i) to identify the main transport infrastructure and traffic problems in Cambodia and to analyze the possibilities for sustainable and safe transport networks, (ii) to investigate the feasibility for implementation of a pedestrian area in the main market street of Phnom Penh, and (iii) to develop a general strategy of short-term low-cost transfer of sustainable transport knowledge to developing countries with a lack of national economic and human resources.

The chosen approach is characterized by a Strengths-Weaknesses-Opportunities-Threats (SWOT) analysis of the existing transport sector in Cambodia and by a feasibility study of the redistribution of public road space and traffic flows in the city center of Phnom Penh. The research is performed in collaboration between Master students of Transport, Planning and Policy



Analysis from Delft University of Technology on the one hand and Master students of Architecture and Urbanism of the Royal University of Fine Arts in Phnom Penh on the other hand.

The activities consist of:

- data compilation and review,
- traffic measurements and interviews,
- traffic analysis and road network design,
- impact assessment of redevelopment plans, and
- discussion of findings with Cambodian counterparts.

3. Quick scan of the Cambodian transport sector

3.1 Road infrastructure

The Cambodian government focuses in its strategic infrastructure plans on the road and waterway networks. After years of intentional destruction and lack of maintenance, the transport sector in Cambodia, which provides both the country's lifeline to the outside world and its crucial internal distribution system, fell into a serious state of disrepair. Despite lack of technical capability to restore it or to make needed improvements and shortage of funds considerable progress has been made in the last few years in reviving the transport operations, using the minimal resources that could be obtained.

A sizable amount of donor funding has already been mobilized for transport infrastructure rehabilitation, and implementation of some projects was started in 1992-93. A great deal of repair and rehabilitative work undertaken directly or was financed by donors, including Australia, Japan, Sweden, Thailand, the United States, ILO, ODA, UNDP, ADB and UNHCR¹. These efforts have generally been focused on the immediate necessity of returning the roads to a traversable condition and carrying out repairs to damaged or destroyed bridges.

Table 1: Road characteristics in Cambodia

Type of Roads	Length		Asphalt or DBST Pavement		Gravel, Laterite or Earth Pavement		Trafficable		Untrafficable	
	Km.	%	Km.	%	Km.	%	Km.	%	Km.	%
National Roads (A, Primary Roads 1-7)	1,988	5.59	1,345	67	643	33	1,988	100	0	0
National Roads (B, Primary Roads-2 digit)	2,165	6.10	255	11.7	1,910	88.3	2,165	100	0	0
Provincial Roads (PR, Secondary Roads)	3,555	9.91			1,224	3.4	1,224	34.4	2,331	65.6
Rural Roads (Rural, Tertiary Roads)	28,000	78.40			11,580	41.5	11,580	41.5	16,420	58.5
Total	35,708		1,600		15,357		16,957		18,751	



The capital of Cambodia serves as a central hub. The city has grown from 50.000 inhabitants in 1977 to 1 million in 2005. The most important traffic destinations in Cambodia are Sihanoukville, a harbour and tourist city, Seam Reab, the city of Angkor Wat situated along the national route heading to Thailand. The national roads # 1, 5 and 7 connect Cambodia to the neighbor countries Vietnam, Laos and Thailand. The total length of the road network is around 36000 km (Table 1).

Most of the national A roads are paved with asphalt, while the national B roads mostly have only gravel or earth pavement. All national A and B roads are trafficable. However, piping is a serious problem during the rainy season. Due to poor drainage, the substructure regularly is eroded and big bursts occur in the pavement. After the rainy season road sections need to be closed for maintenance. The third category are provincial roads, which only contain gravel and earth pavement. Most of all the roads are rural roads, which are not trafficable by motor vehicles.

The big differences in speed and mass between light and heavy vehicles are the main obstacles for increasing road capacity and traffic safety. The most dangerous road is road # 4 from Phnom Penh to Sihanoukville due to the high number of lorries.

3.2 Railway network

The Royal Cambodian Railway comprises two single-track main lines of one metre gauge which carries passenger and freight transport. There are also some special- purpose sidings and small branches for freight or serving ballast quarries. There exists no signalling system at all. The northern or "old" line was constructed from 1929 to 1943 and runs from Phnom Penh for 385 km to the Thai border at Poipet. The last 48 km from Sisophon to the Thai border has been disused since the early 1970s. The southern line was built between 1960 and 1969, takes off at a bifurcation 9 km from Phnom Penh station and continues for 254 km to the port of Sihanoukville.

The trains consist of very old locomotive hauled passenger coaches and cargo wagons operated by the Royal Cambodian Railway. A total of 12 main line diesel locomotives, 10 steam engines and 4 diesel shunting locomotives exist. Until recently 12 very old passenger coaches are used. The trains are rather poorly occupied because of their low reliability, speed and frequency. So called "bamboo trains" illegally use some tracks as the railway trains only pass once a day. They consist of a wooden frame, bamboo planking, a four-stroke, upright engine from a lawn mover and reused military tank wheels and axles. These "bamboo trains" haul passengers and freight between Battambang and the spur lines of Phnom Penh.

The Cambodian government gets funding from the ADB for modernisation of the railway infrastructure and wants to privatize the railway service. A tender is underway. The government will be responsible for the rehabilitation of the railway track, locomotives and wagons.

3.3. Inland waterways

Historically, inland water transport is the most reliable and conventional form of transport in Kampuchea and still remains the most important traditional and, during the rainy season, most useful, mode of transport. The system consists of the Mekong river and the Bassac tributary, the Tonle Sap lake, the Tonle Sap river and its tributaries and the Bassac River.

The Cambodia National Mekong Committee (CNMC) monitors the daily operations on the Mekong River. The 102 km long section between the border and Phnom Penh is only navigable



for vessels shorter than 110 m limiting the weight to about 7,000 dwt. The draft of the Tonle Sap river is only about 1 m in the dry season but can reach up to 4 m in the rainy season.

The Sihanoukville Autonomous Port (SAP) is the only deep sea port in Cambodia and handles almost 90 percent of imports, which are dominated by building materials. Phnom Penh Port is located in the capital of Phnom Penh, along the Tonle Sap River. The most important cargo are containers, cement, steel, machinery, bitumen, fuel, and wood. Besides cargo passengers are transported by boat, especially during the rainy season.

3.4 Identified problems

A major administrative problem of the transport infrastructure is the concentration of political power. The Prime Minister of Cambodia needs to approve any major investment project. The employees of the government still lack basic transport knowledge concerning the compilation, analysis and use of data as there still does not exist an academic or professional institute for education of civil engineers in Cambodia. The government of Cambodia still depends on the knowledge of international organizations.

The lack of money is often the start of the other problems. The lack of money is the general problem of developing countries. Due to the lack of money the salaries are too low and there is no money to invest in infrastructure and education.

How to improve the capabilities of lower public administration?

An improvement of the administrative effectiveness would be a decentralization of power and responsibilities. The municipalities and the provinces should be able to make decisions about projects on their level without asking higher levels. More power for lower administrative levels is better for the democratic control of the higher levels and thus better for the poverty reduction. This means that the people working at the lower administrative levels should be better educated and receive a certain part of the tax income, so that they are able to decide on local projects on their own.

How to improve the professional knowledge of the government of Cambodia?

To keep knowledge at the government, employees should be able to work a part of the year at a firm to earn more money and another part of the year for the government in order to enable brain circulation. Developing countries should provide their employees better work and career conditions and the industrialized countries could support the transfer of transport knowledge more efficiently.

How to improve the knowledge of the government and the commitment of the government?

There is no experience with educating students about infrastructure related topics, because there is not sufficient knowledge available at the universities and the government of Cambodia seems not to know the economic benefits of implementing a professional institute where infrastructure related topics are educated. First of all the government needs to realize that knowledge about infrastructure is very important. The government needs to be motivated to invest in knowledge of infrastructure. But without the help of foreign countries this isn't possible. Foreign countries and companies have to clarify the importance of knowledge about infrastructure in the future to the government of Cambodia and needs to help Cambodia developing with good educational institutes in cooperation with educational institutes in foreign countries. Those institutes have to cooperate with universities or other schools to share their knowledge about infrastructure related topics.

How to improve the safety on the national routes and in the city on administrative level?



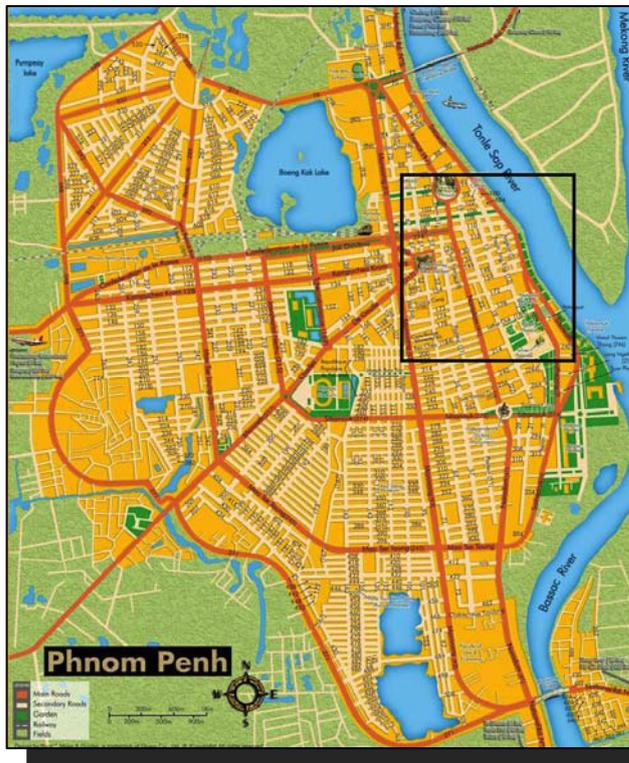
To improve the road safety the government of Cambodia has in cooperation with Handicap International Belgium implemented a new traffic law in 2006. Due to this new law the amount of accidents has decreased slightly. But the people are still not used to live by rules. The new traffic law needs to be educated more and better to improve the understanding by the inhabitants and policemen of Cambodia. The control on the observance of the traffic law needs to be improved. Due to low salaries the motivation of some policemen is low and the corruption is high. An independent traffic safety agency could be founded to supervise, monitor and analyze illegal and bad road user behavior and traffic accidents.

How to deal with the lack of money?

To decrease the lack of money, the government of Cambodia can ask international development agencies and foreign governments for technical support, transport policy and business advices, as well as investment loans. Cambodia needs to develop further its infrastructure, tourism, transport industry, professional education. The introduction/increase of taxes on the sale of motor vehicles and fuel may generate more public funds that could be earmarked for the improvement of transport infrastructure.

4. Feasibility of pedestrian mall in Phnom Penh

Since there are only very few parks and public spaces in Phnom Penh and most of the sidewalks in the city center are not accessible for pedestrians it is crucial for the development of the city to provide more open space for the inhabitants and tourists. Until now there are still many sidewalks lining the streets of Phnom Penh, but there are plans to widen more and more of the streets and narrowing the sidewalks to serve the motorised traffic, especially cars. There is a need to emphasize the possibilities of sustainable urban development for all road users.



Master students of the Faculty of Architecture and Urbanism (FAU) presented a redign of the Kharn Daun Penh district, Phnom Penh (Fig. 1), which is enclosed by the Old Market (Psar Cha) in the north, street No. 178 in the south, Norodom Boulevard in the west and the Tonle Sap (River) in the east. It is a very busy area with many small shops and stalls and two markets. Since it is right next to the National Museum and the Royal Palace the area is frequented by many tourists as well as inhabitants of Phnom Penh. The area contains a variety of very interesting architectural buildings from different periods of Phnom Penh's history. The main shopping street # 13 (Fig. 2) is intended to become a pedestrian zone including a new Kandal Market building (Fig. 3).

Figure 1: Map of Phnom Penh



Figure 2: Street # 13 Phnom Penh (2007)

This area would attract Cambodians as well as tourists to discover the architectural heritage of Cambodia's Capital and provide public spaces and recreation zones. Possibly the pedestrian zone might be extended up to the Royal Palace in order to connect the Palace and the National Museum to that "heritage lane".

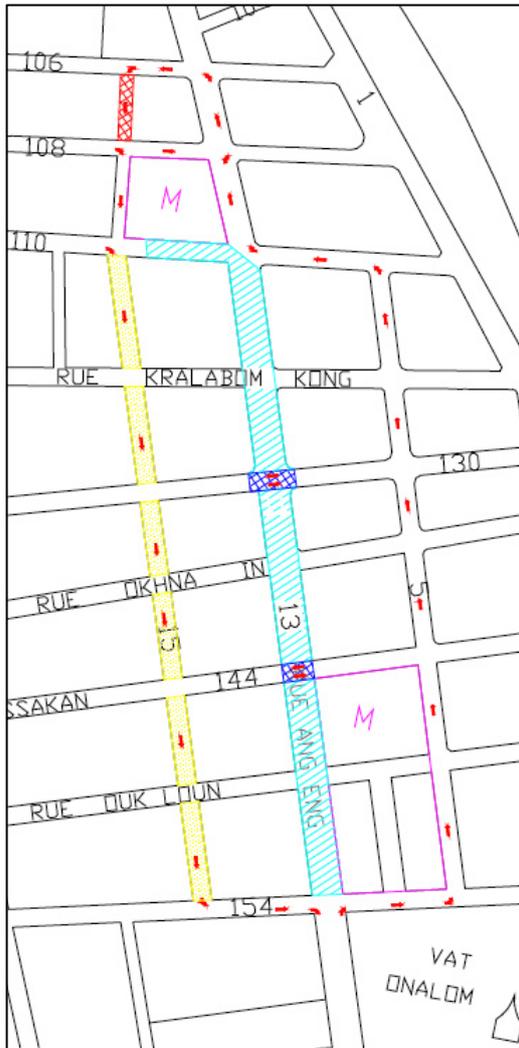
The Dutch Master students from TU Delft focused on traffic issues in the project area including:

- Analysis of existing land use, road network and traffic flows,
- Traffic counts at cross sections and major intersections,
- Development of traffic management strategy for implementation of a pedestrian zone,
- Design of standard road cross-sections,
- Design of access for loading/unloading of goods and car park,
- Rerouting urban traffic in the city centre.



Figure 3: Psar Kandal Market building (source: S. Ratana, 2007)

Traffic counts on main urban roads during peak hours revealed busy, but still not congested flows with a maximum of 2000 motorcycles and 650 cars/hour per lane, which corresponds to about 900 passenger car equivalents (pce) based on a rate of 0.1 pce/motorcycle. Assuming yearly traffic growth rates of 4 to 7 % for motorcycles and 7 to 13 % for cars until 2020 the future traffic volume is estimated to increase up to a maximum of 3500 motor vehicles/h and 1100 pce/h and direction respectively on street #13. This would mean a volume/capacity ratio of more than 1.0 leading to permanent congestion during peak hours.



In case street # 13 was closed for motor cycles and cars (Fig. 4), traffic would shift to parallel and perpendicular streets in the vicinity, which might be congested in future. The main shopping street # 13 would become a pedestrian area with restricted access for shop owners and delivery by car during the early morning hours. Access of motor vehicles would be controlled by means of gates. Suppliers of the shops in the new market building would need to use additional parking lots within the building or in a nearby parking garage and transport the goods manually or by handcarts to the shop entrances. Up to 900 parking lots for customers and visitors of the pedestrian area could be created in most of the parallel and perpendicular streets by introducing one-way single lane traffic. Through traffic in north-south direction would be shifted to the main boulevards having two lanes per direction and offering shorter trip times, while through traffic in west-east direction would be forced to go around the pedestrian area. Capacity on the main boulevards can be increased by:

- separating physically the lanes per direction,
- creating dedicated lanes for (motor)cycles and carts,
- closing some minor intersections,
- introducing small roundabouts and installing traffic lights respectively.

Figure 4: Traffic circulation around pedestrian mall of street # 13

The proposed sustainable redesign of the main shopping street in Phnom Penh into a pedestrian mall would generate much economic benefits, attract significantly more visitors and customers, improve safety and health due to the elimination of traffic noise and air pollution, and stimulate the preservation of historical buildings and cultural heritage. The costs of construction are limited to reconstruction of street # 13 into a pedestrian mall and repaving the neighbouring streets, while the return on investment into the new market building will be high due to the increased property value and high attractiveness of the modern shopping center.

5. Implementation of a sustainable safe transport strategy

It is said that Khmers don't like to walk. They prefer to travel from door to door. Everyone wants to own a moped, motorbike or car. This desire is not realistic because the economy and welfare in Cambodia are still underdeveloped, while the capacity of the road infrastructure is insufficient. Rapid growth of car ownership would lead to a big extension of suburban areas and require much more road space, which is scarce in urban areas. The example of other big cities in south-east Asia like Bangkok or Jakarta shows that individual car traffic cannot solve the mobility needs of people in bigger cities, but leads to increased traffic congestion, accidents, air pollution, noise, fossil energy consumption and climate change. For that reason, a sustainable safe transport strategy is needed.



Sustainable safe transport means, first, preference to environmentally friendly transport modes and, second, to safety in infrastructure design, vehicle operation and traffic rules. This strategy is characterised by the following safety principles [Wegman et al., 2005]:

- Functionality,
- Homogeneity,
- Predictability.

The functionality requires a matching of intended and actual use of roads according to the three categories (connector, distributor and access roads), while each road may have only one function. Homogeneity does not tolerate significant differences in speeds, driving directions and mass, which can be achieved by segregating incompatible traffic types or forcing motor vehicles to drive slowly. Finally, road users must be familiar with the behaviour demanded by the different types of roads and what they may expect from other road users. A prerequisite is a good recognisability of the infrastructure and of the other road users.

The big majority of daily trips in any country do not last longer than about 30 minutes and have a rather short distance of less than 5 to 10 km depending on the density of settlement and motorization of people. Many trips for school, work, administration, shopping and leisure can be made by walking or cycling provided that the distances between housing and destinations are short, comfortable and safe. Only a minority of daily passenger trips are medium or long distance trips requiring a motor vehicle and higher speed levels.

Thus, sustainable land-use policy must assure a mix of functions and accessibility of origins and destinations in first instance by networks of as direct as possible links and sufficiently wide sidewalks, bicycle tracks and local roads including parking facilities. Conflicts between the modes and local traffic flows are to be minimised by physical separation and marking of different lanes, speed limitation of motor vehicles at 30 km/h, easy recognisable traffic guidance and simple priority rules at intersections.

Through traffic must be concentrated on main arterials surrounding and linking the traffic calmed areas within a city, while the cities are connected by rural roads and/or railways permitting a higher speed. The collection/distribution roads within cities and suburbs should be designed for a vehicle speed of 50 to 70 km/h, while access to slower vehicles must be forbidden or restricted to parallel roads separated from the main road by a median. The intersections are at-grade and traffic flows are controlled by road signs and possibly traffic lights indicating the priority direction of flow. Preferably, the intersections in urban and suburban road networks are to be designed as roundabouts, which combine a maximum of capacity and safety due to the minimum number of conflict points and the obliged speed reduction.

The connector roads (motorways) between cities serve for long distance transport and are designed for a maximum speed of about 100 to 120 km/h. The most important national road links have a minimum of 2 lanes per direction, shoulder lanes for emergencies and physical separation between opposite traffic directions, while the on-/off-ramps and interchanges are grade-separated.

In Cambodia there are still no motorways, but the national roads # 1 and 4 to Vietnam and Sihanoukville respectively would be the prime candidates for upgrading during the next decade in order to improve the efficiency of goods transport and traffic safety. A preliminary design of the alignment of these motorways should be made in order to enable the required legal reservation of land. The national roads A and B need to be redesigned such that faster through traffic is separated from local and slow traffic by introduction of at least a shoulder lane on both sides and



clear road marking and signs. Where national roads cross cities and villages, the construction of bypasses and design of safer intersections with local roads are of prime importance.

The urban traffic in Phnom Penh would need to be redirected such that the main north-south corridors along the Monivong Blvd., Norodom Blvd. and Sisowath Quay together with the main east-west and circumferential streets form a clear collector/distributor road network, where the central lanes may be used by cars, buses and trucks only at a maximum speed of 50 km/h. Left turns at intersections from the main roads need to be facilitated by dedicated lanes or impeded where the additional space is unavailable and straight traffic would be hampered. Slow vehicles should be channelled on marked grade crossings at redesigned intersections. The right and safe use of urban and rural roads in general is to be specified in a code, which needs to be published by public media, teaching courses and supervised by the traffic police.

The redesign and transformation of the main shopping street # 13 into a pedestrian mall should be combined with the creation of a clearly signed network of a number of dedicated transversal pedestrian and cycle tracks connecting the main housing quarters to the city center and the markets in order to stimulate walking and cycling of inhabitants and tourists. Illegal parking of carts, cars and trucks or erection of commercial stalls on these sustainable mobility friendly tracks must be avoided through supervision and fines.

6. Conclusions

The development and introduction of a sustainable safe transport strategy in Cambodia depends on the international transfer of transport and traffic know-how, education of Cambodian professionals and cooperation between researchers and students from both, Royal University of Fine Arts and foreign universities. The collaboration between Master students of the Faculty of Architecture and Urbanism in Phnom Penh and the Faculties of Civil Engineering and Policy Analysis of Delft University of Technology for the analysis of transport problems and the design of sustainable traffic management measures is a good example how to develop short-term low-cost concepts for urban redevelopment project in Phnom Penh and the improvement of efficiency and safety of road traffic in general. It demonstrates the high potential and practical benefits of non-governmental international cooperation between universities, academic staff and students from developing and developed countries.

Acknowledgement

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References

- Luipen, O., Sengers, P. (2007), Traffic in Cambodia. An analysis of the problems in Cambodia on infrastructure and administrative level and their solutions, MSc project, TU Delft
- Konings, J., Van Rossum, J. (2007) Traffic planning in Phnom Penh. Effects of a pedestrian areain a motor-minded society, MSc project, TU Delft
- Ratana, S. (2007), Psar Kandal Market, Royal University of Fine Arts, Phnom Penh
- Wegman, F., Dijkstra, A., Schermers, G., Van Vliet, P. (2005), Sustainable Safety in the Netherlands: the vision, the implementation and the safety effects, SWOV R-2005-5