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TITLE: **Towards a Transport Infrastructure Management System (TIMS)**

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Abstract

The Cambodian rural infrastructure sector is facing a number of problems. Among these are: a not fully defined legal framework; unclear definition of responsibilities; lack of updated road inventories; limited local implementation capacity; inadequate design standards, insufficient and inadequate and slow maintenance funding and disbursement mechanism. There is thus a need for the development of an efficient, cost-effective and locally applicable maintenance management system.

The paper briefs on the status of the institutionalization and mainstreaming of the Ministry's of Rural Development (MRD) planning tool: Integrated Rural Accessibility Planning (IRAP) and focuses on the application of the Transport Infrastructure Inventory (TII) as an appropriate tool to develop a rural road inventory and prioritization of maintenance and rehabilitation at district level. It is proposed that TII can form the basis of a more comprehensive Transport Infrastructure Management Tool (TIMS) by including design standards, budgeting and financial forecasting. It is argued that such a TIMS will guarantee local community involvement in prioritization of rural infrastructure; that a rational decision is made between roads or service infrastructure that are local-resource based; that local communities, government and others mobilize resources and provides a transparent and cost-effective monitoring mechanism that would increase the confidence of stakeholders in administration of rural roads.

The paper then concludes by laying out the steps needed to be taken to create an enabling environment for the development of TIMS.

1. The Cambodian Rural Transport Context

The Royal Government of Cambodia (RGC) is implementing the "Rectangular Strategy" which based upon the National Poverty Reduction Strategy (NPRS) and the Millennium Development Goals (MDG).

The current Rectangular Strategy consists of four pillars grouped around one main objective: Good Governance. Three of the four pillars are relevant for the Provincial and Rural Infrastructure Project (PRIP): the Rehabilitation and Maintenance of Physical Infrastructure; Private Sector Development and Employment Generation; and the Capacity Building and Human Resource Development.

Central to the Rectangular Strategy is decentralization and de-concentration.

The road network in Cambodia is managed by two Ministries; the Ministry of Ministry of Public Works and Transport (MPW&T) and the Ministry of Rural Development (MRD).

Table 1: Road Management Responsibility in Cambodia

	MPWT	**MRD**
Road Classification	National	Tertiary
	Sub-national	Sub-Tertiary -1
	Provincial	Sub-Tertiary - 2
		Sub-Tertiary - 3

The MRD is responsible for the coordination of rural development activities among all stakeholders involved, charged with the responsibility for construction, operation and maintenance of a rural road network of approximately 28,000 kilometres. Since 1993, the MRD and its partner projects have rehabilitated and constructed approximately 7,600 kilometres in 20 provinces nationwide, of which 1,039 have been maintained. With a number of big infrastructure projects ongoing and others in the pipeline, it is clear that the MRD faces huge challenges to plan, implement and manage its rural infrastructure assets. The challenges include a lack of accurate information on rural infrastructure, the geographical spread of the road network and limited funds to address rural road maintenance.

Concerning the planning, the MRD needs to target limited funds to maximum efficiency while promoting transparent decision-making by involving local communities and co-ordinating among different agencies and institutions with different requirements.

MRD has therefore adopted IRAP as standard planning tool as mentioned in the Second Five Year Socio-Economic Development Plan (SEDP II). Special mention of IRAP was made by Prime Minister Hun Sen. He stated that the MRD has: "the responsibility to prepare local plans aimed at addressing the delivery and management of rural infrastructure through improved accessibility using the methodology of integrated rural accessibility planning as a survey instrument.". (Closing speech of the annual conference at MRD, February 28 2001) There is a need to continue to build capacity at provincial level and further strengthen institutionalization processes at national level.

Concerning the road maintenance, the main challenge for MRD is to be able to produce realistic road maintenance budgets to obtain funding from central government and mechanisms to spend limited budgets in efficient and transparent manners. MRD started to collect information on the rural roads in the provinces and tested different RMMS in different areas of the country under different projects; Rural Infrastructure Improvement project (RIIP), Tertiary Road Improvement Project (TRIP), Flood Relief Projects, The Upstream Project and the North-western Rural Development Project (NRDP) and Provincial and Rural Infrastructure Project (PRIP) There is now an urgent need to evaluate those piloted management systems and develop a tailor made Transport Infrastructure Management System (TIMS) for the MRD that provides quality road network analysis and accurate budget estimations at provincial and national level.

2 Current Transport Infrastructure Management Problems

The first bottleneck that Cambodia encounters is a not yet full developed legal framework for road management. The (MPW&T) developed a Transport Strategy and for the rural roads the Ministry developed a Policy for Rural Roads, which is anchored in a sub-decree. However an overarching Road Law that would bind these policies and strategies together has been drafted but not yet approved.

This perpetuates the unclear definition for road ownership between the three main actors: MPWT, MRD and Municipalities. There is especially a need for clarification at the level of provincial, tertiary and sub-tertiary roads.

This situation is exacerbated by the lack of classification of roads at the tertiary and sub-tertiary levels and the absence of recent inventories at the provincial offices.

A reason is that there is a limited capacity at the provincial and district levels because graduated engineers and technicians prefer to be employed in the capital rather than be stationed at a provincial office where career opportunities are limited and the remuneration does not compensate for the harsh conditions under which one has to work.

Another problem lies in the lack of appropriate design standards and implementation methods. Most standards that are used for roads and bridges are imported from abroad where the road network is well developed and thus not applicable. Furthermore there is a conventional focus on the higher end of the road network with the assumption that the majority of traffic is motorized. This leaves a gap at the lower end of the network, which opens the door for inappropriate practices in terms of under-design. There is also a lack of knowledge among practitioners on local resource based standards and methods.

Maybe the most pressing problem is the lack of maintenance funding. The Government Agencies prefer to invest in rehabilitation which is also true for the donor community preferring to make capital investments, leading to a sub-optimal allocation of resources.

The existing fund flow mechanism is centralized and slow in disbursement. The approval of maintenance budgets is based on requests made for specific roads. Once this information is brought up to the national level, these requests need to be combined and submitted by the MRD to the Ministry of Economy and Finance (MEF). Once the MEF releases the funds it is often much later than anticipated resulting in the selected roads being already deteriorated

because of lack of maintenance that more funds are needed to repair those roads. Moreover the funds available from the national level are insufficient, in 2005 covering only 50% provision of the needs.

3 Current Status of Transport Infrastructure Planning: Integrated Rural Accessibility Planning (IRAP)

This section will focus on the developments in the area of infrastructure planning and monitoring: IRAP, focussing on the element of Transport Infrastructure Inventory (TII) which specifically focuses on the rural road network.

IRAP is a local-level area planning tool that approaches the issue of poverty based on the concept that the lack of access of rural people to goods and services is one of the fundamental constraints to development and that improving access is a necessary step towards poverty alleviation.

IRAP works with three elements that are intimately linked:

1. The household or village;
2. The location of social and economic services
3. The transport network linking the first with the second.

Accessibility improvements may therefore involve the improvement of the road network, increased personal mobility or the improvement of the distribution and location of services. Providing the population with access to a range of goods and services and local employment creates the platform for economic and social development.

IRAP is a bottom-up planning tool that involves local population in each stage of the planning process. It is demand driven; it takes the access needs of households as a starting point; it is integrated in nature because it considers all aspects of a household's need for access and is participatory at every level so that investment priorities incorporate community perceptions. This makes IRAP both comprehensive and sustainable.

IRAP is flexible in its local application. While the concept of IRAP always will remain "accessibility", the application might differ from country to country, either in terms of sectors; administrative levels involved in the planning process or applied technology.

3.1 IRAP application in Cambodia

For eight consecutive years the ILO has been working in Cambodia constructing and maintaining roads using Labour Based Appropriate Technology (LBAT). The activities served two important goals: employment generation to stimulate the local economy that had been devastated after thirty years of war and violence and to rehabilitate and maintain needed roads and canals. Through these activities hundreds of kilometres of roads have been reconstructed and maintained and also hundreds of engineers have been trained in LBAT infrastructure and maintenance.

In the now completed ILO Upstream Project, attention was shifted towards institutional strengthening and capacity building in the Ministry of Rural Development (MRD). One of

these activities was to strengthen the planning and prioritisation of maintenance and construction of rural roads.

As part of that, IRAP was introduced in 1999 and piloted in Siem Reap and later extended to neighbouring Bantaey Meanchey Province.

The MRD has adopted IRAP as a standard planning tool in 2001 and major donors became interested in the planning tool and currently IRAP is being applied in 4 north-western provinces through the NRDP, financed by the Asian Development Bank (ADB) and executed by MRD, and is projected to be used in the World Bank funded PRIP. The Seth Koma programme, funded by UNICEF is piloting IRAP in the south-east of the country for water and sanitation planning. Planning results are being by other major programmes such as the Tonle Sap Sustainable Livelihood project (TSSLP), the North-west Irrigation Project and ECOSORN.

The IRAP/GIS component of the NRDP assists MRD in institutionalizing IRAP at the central and district levels as a rural infrastructure planning tool. The IRAP/GIS Office has established, as a part of the overall support (human resources, equipment, hardware, software and procedures), the mechanism to attain project objectives.

The IRAP/GIS office also reinforces the Planning Department and the Rural Roads Department (RRD) and its respective provincial offices for the planning and monitoring of rural road networks. The Project supports provincial planning activities of the Provincial Department for Rural Development (PDRD) and is well established in the 4 project provinces.

Up until now, the IRAP has been effectively used at the district level. Districts produce their Accessibility Improvement Plans for review and approval by district executives. So far, this scheme works well as government agencies, NGOs and donors select and finance priority projects from a list of rural infrastructure investments that IRAP has identified.

With the evolving framework for decentralization and de-concentration an inter-ministerial process has been started to integrate IRAP into the local level planning process at district and provincial level to ensure institutional sustainability in participatory and transparent prioritization in infrastructure decision making.

The Planning Process

The IRAP planning cycle can be divided into four steps:

1. Data gathering
2. Data analysis
3. Investment or Project Identification,
4. Monitoring and evaluation/impact assessment

During the whole process maps play a very important role. The planning process consists of a number of steps:

1. **Preparation**. Preparation of base maps of the target districts indicating administrative boundaries, villages, commune and district centres, roads, schools, health facilities, markets, cultural heritage sites and protected areas.

2. **Asset Assessment and TII**. A situation analysis is made of the district. This process starts with an assessment of the condition and the location of the rural road network Transport Infrastructure Inventory (TII), other public infrastructure assets, Rural Infrastructure Asset Inventory (RIAI) and the location of all villages, commune centres and natural resources. After the inventory is completed, village level information is collected on access, using secondary sources and data supplied by key informants at commune workshops. Most of the information is collected making use of manual maps and Global Positioning System (GPS) receivers. This serves as a basis to update the GIS maps.
3. **Accessibility Assessment, Indicator Building and Mapping** The data is processed and analysed for each settlement and accessibility indicators are calculated at the village and the commune levels. The difficulty of access to specific goods and services is quantified, in terms of travel time, travel cost and frequency. Based on these indicators, villages and communes are ranked according to their levels of access to basic minimum needs and services. Manual maps and GIS maps are produced to show the spatial distribution of the accessibility ranking. Poor accessibility rankings can then be used to highlight areas most in need of development. The collected information is compiled into a document referred to as the District Accessibility Profile (DAP).
4. **Identification and Prioritisation.** The accessibility indicators for all of the settlements are compared during a district workshop using manual thematic maps. The stakeholders identify and prioritise areas and locations, like transport routes, schools, health centres for possible interventions. A target village or area with the poorest accessibility in a particular sector gets the highest priority for access interventions in that sector.
5. **Investment Planning of Appropriate Interventions.** The stakeholders at the district and commune levels define the sector objectives for access interventions. These interventions attempt to meet the basic minimum needs (BMN) standards that the MRD uses to monitor poverty. Using the BMN thresholds and other planning criteria, like buffer zones and service areas, the sector priorities are compared with each other and integrated into an investment framework. Maintenance of existing assets is considered first before identifying rehabilitation and new construction.
6. **Evaluation of Appropriate Interventions.** A more detailed survey is then undertaken to determine technology choice and feasibility, including a budget estimation for the proposed transport infrastructure works.
7. **Submission of the Accessibility Action Plan (AAP).** During a final planning workshop the stakeholders study the investment framework and the cost estimation and agree upon the final version of the district plan. Then the AAP is prepared. It is subsequently submitted to the Provincial Rural Development Committee (PRDC) for approval and integration into the provincial plan. Through the PRDC, it is presented to government departments and development agencies.

Through consultation and prioritisation, an investment framework for those most lowly ranked areas is then developed. Cross sector analysis also reveals the complementary or conflicting nature of proposed investments. The resulting Accessibility Action Plan (AAP) should not be considered in terms of individual sectors but as an integrated development plan in which the maintenance and upgrading of existing assets are considered together with the request for new assets.

Outputs

- 8 GIS maps (accessibility profile, assets, water, school, health, market, road, integrated action)
- 1 IRAP Data Book
- 1 DAP in both Khmer and English
- 1 AAP in both Khmer and in English

The AAP helps to guide planned and future investments in the District that will benefit all the population, specifically the poorest and most isolated parts of the population.

3.2 Transport Infrastructure Inventory

Given that the information on the road network in Cambodia has not been updated since pre-war times, a complete new inventory and update is required of the rural road network.

IRAP developed a Transport Infrastructure Inventory (TII) tool that is participatory and low cost approach to conduct a road inventory. The objective of TII is to obtain in a relatively short time information the extent and condition of the transport network in the district. The transport network consists of rural roads and waterways.

During the TII a combination of workshops, interviews with key persons, field verification using handheld Global Positioning System (GPS) and Geographic Information System (GIS) in the provincial offices is used to produce maps that are presented during district workshop to obtain feedback and to prioritize roads for maintenance and rehabilitation.

Over time affordable and simple GIS programmes have become available that have the capacity to combine database analysis and spatial analysis, making the mapping process easy and efficient. Experience has shown that new staff do not require all phases of manual mapping training, but can "leapfrog" to contemporary GIS and still have a strong understanding of spatial analysis theory. This makes the use of GIS more cost-effective and time-effective in the production of illustrative maps, as well as spatial analysis.

During the TII process the location of all villages are checked, as well as the location and condition of each school, health facility and market. Using standard unit rates, maps are can then be produced which illustrate the relative wealth of areas with regard to the value of their assets.

The output is a district road inventory, detailing length, condition and classification of the road network, all displayed in updated GIS based TII maps. These maps form the basis for the prioritisation phase of the process.

Roads classification follows the guidelines of the MRD Policy of Rural Roads:

Tertiary roads:	district to district
Sub-tertiary 1:	district to commune
Sub-tertiary 2:	commune to commune
Sub-tertiary 3:	commune to village

TII results are presented during feedback workshops where stakeholders can verify the updated information. Table 2 is an example of a summary table of a the district road network in Rattanak Mondol district in Battambang Province.

Table 2: ***Tertiary Road Network in Rattanak Mondol District***

Rattanak Mondol District							
Road			Road Condition				
Road Type	Identification	Total Length (Km)	All weather (km)			Dry weather (km)	
			Earth Surface	Laterite Surface	Bitumen Surface	Earth Surface	Laterite Surface
Tertiary, T							
T	Sdao to Bavel District border	31				31	
	Sdao to Banan District	14				14	
	Sub total:	**45**				**45**	
Sub-tertiary 1 (T1)							
T1	Pcheav to Dangtong (Bridge)	11		11			
	Rotonak Mondol to Thvark	6.5		6.5			
	Sub total:	**17.5**		**17.5**			
Sub-tertiary 3 (T3)							
T3	Road S10 to Serey Voan	5				5	
	Kouk Choeur to Boribour	1.5				1.5	
	Svay Chuo to Doun Miey	5		3		2	
	Reaksmey Sangha to Andeuk Dobmouy	4		4			
	Reaksmey Sangha to Nonoung	7				7	
	Prey Ampor to Kandal Stoeung	4				4	
	Banang Village to border of Andaek Heb commune	3				3	
	Chea Montrey to Pech Chenda	1.5				1.5	
	Boeng Kteng to Boribour	1.5				1.5	
	Plouv Meas to Oudar	11				11	
	Badak to Ou Daikhla	4				4	
	Sub total:	**47.5**		**7**		**40.5**	
	Grand Total:	**110**	**0**	**24.5**	**0**	**85.5**	**0**

There is one stretch of 35 kilometres of SNR # 10 crossing through the districts, this alignment is laterite and in all weather condition.

Road Transport Indicators:

Road network:	145 km	24% National 76% Tertiary
Rural Road network:	110 km	41% T 16% T1 0% T2 43% T3
Paved roads:	0 km	
Roads in good/fair condition	All roads	59.5 km (41%), mainly laterite
	Rural Roads	24.5 km (22%)
Estimated Asset Value	All roads	US$ 1,141,000
	Rural Roads	US$ 441,000
Access to the road network	12,849 people (44% of the total population) live within 2 km of an all-weather road.	

The prioritisation of maintenance and rehabilitation takes place during an investment planning workshop at the district level where district officials, commune council representatives, teachers, health care staff, market owners, NGO's working in that area and provincial line department representatives participate.

To identify the investments five criteria are used:

1. The accessibility class of villages;
2. A two and a half kilometre service area around all weather roads;
3. The routes that people take to reach an all weather road;
4. The perception of participants for which villages access to transport infrastructure is a problem;
5. The perception of participants for which villages improving access to transport infrastructure is a priority.

For both types of investments, a preliminary costing is made for the 1st, 2nd and 3rd Priority roads. Pricing is based upon locally available surface treatments (including assessment of alternative treatments if available).

Recommendations are made on the feasibility of the application of Labour Based Appropriate Technology (LBAT) based upon local labour availability and surface treatment based upon the availability of local resources. Finally a financial Cost-Effectiveness (CE) analysis is made to rank these priority investments as a first recommendation towards full Economic Analysis.

4 The Way Forward: Towards a sustainable Transport Infrastructure Management System (TIMS)

IRAP provides a key opportunity for the road sector to contribute to the decentralization and de-concentration process that the RGC initiated in order to strengthen good governance for poverty alleviation and development. The IRAP package introduces a community based participatory planning tool for rural infrastructure, creating common understanding and dialogue between actors at provincial, district and commune level on what kind of rural infrastructure investments are needed in which areas.

It creates opportunities of co-ordination between communes and across sectors to achieve an efficient resource allocation based upon maximum need, and impact and presents district authorities with a tool to gain support from provincial authorities, Non Governmental Organizations (NGO) and International Organizations (IO) for proposed infrastructure investments. It also facilitates line departments identify the most isolated areas in need for interventions, which they can compare and align with their national and provincial policies and strategies.

In a country where 80% of the population lives and works in rural areas, the rural road network forms the backbone of the Cambodian economy. Hence, with limited funds available at national and local level, preserving infrastructure through maintenance of existing roads, IRAP forms the basis for efficient asset management

Coming back to the problems of the rural infrastructure sector mentioned in the beginning of the paper TII addresses the problems of the need for an efficient planning approach, monitoring, technology and capacity.

This approach needs to be expanded upon and developed into a comprehensive Transport Infrastructure Management System (TIMS) that will integrate planning, engineering feasibility study, economics and finance.

The proposed TIMS relies on IRAP to create awareness and ownership of infrastructure assets among local stakeholders, which feeds into a comprehensive, affordable and locally managed maintenance system. TIMS provides an extension of the above-mentioned database that stores budget information and by road inventory data and generates, through a set of maintenance and budget management modules, maintenances works programmes for the local road network.

5 Rationale of TIMS

There are a number of inter-related reasons that justify the establishment of TIMS:

1. It involves rural communities in the prioritisation of rural transport and other rural infrastructure investments and provides a rational prioritisation between road and other rural infrastructure investments and services within investment and recurrent budgetary constraints;
2. It ensures that local-resource-based approaches are properly considered, to the optimum benefit of the communities and to ensure sustainability;
3. It prioritises and provides cost estimates for candidate road locations and sections for upgrading (effectively a "spot improvement" basic access approach to maximise the impact of limited resources);
4. It mobilises communities, local and central government, NGO and IO resources equitably and effectively and allocates transport infrastructure maintenance resources rationally and cost effectively to rural roads;
5. It monitors rural transport infrastructure expenditures to all stakeholders in a transparent and cost effective way that provides confidence to stakeholders that all expenditures are cost-effectively administered;
6. It monitors the impact of the investments to rural communities.

TIMS should be seen as a holistic approach to road network management differing from traditional approaches where planning, engineering and economics are applied in isolation by separate units of professionals.

6 Creating and enabling environment for TIMS

At the policy level it is necessary that follow up is given to review and finalize the draft road law and that it is submitted to parliament for approval so that the designation of legal ownership or the road network is clarified.

At the institutional level a comprehensive human resource development and institutional strengthening programme needs to be implemented to ensure that all levels involved; district,

province and national are able to manage the road network assigned under their responsibility.

As mentioned above the TII tool can be developed into TIMS through a number of sequenced steps that include:

- Review current TII tool to adapt to TIMS requirements;
- Design of financial modules to be included into TIMS, including information requirements, human resource requirements, hardware, software, infrastructure and maintenance costs;
- Introduction of TIMS at the Provincial Departments of Rural Development (PDRD);
- Training of the designated provincial staff at PDRD and Rural Roads Department (RRD) staff at national level to operate and manage TIMS;
- Definition and standardisation of TIMSD outputs in the forms of implementation plans, maps and budget proposals.

For implementation of maintenance, appropriate design standards and methods need to de developed that are appropriate to local geological and climatologically circumstances. After development they need to be widely introduced and disseminated to professionals, interns and engineering students.

TIMS will only be feasible if the process of de-centralization and de-concentration will be implemented as foreseen to devolve responsibility for maintenance to local governments and involve private sector for implementation.

These local agents will need to necessary funds to successfully implement maintenance programmes therefore a decentralized flow of adequate and stable funds to finance maintenance; needs to be established to feed TIMS.