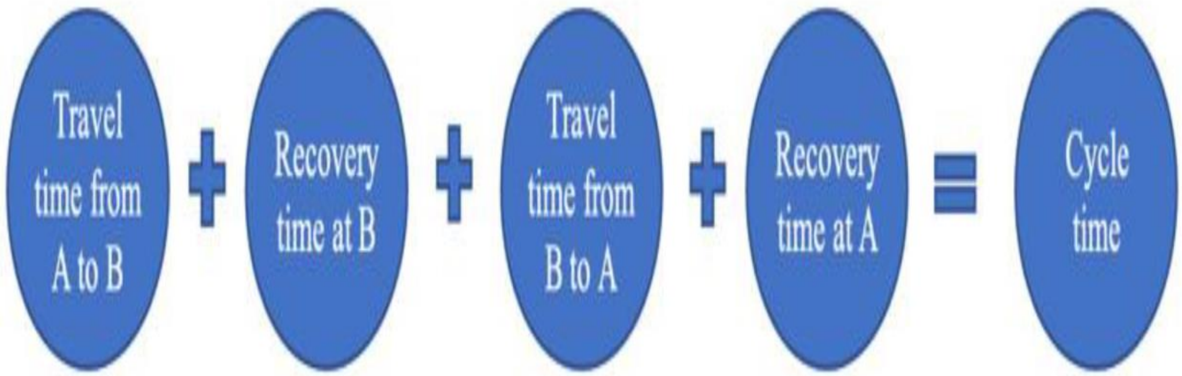
INTERNET OF THINGS_PHASE 2

Public transportation is one of the principal components of any urban transportation system. It plays a key role in providing mobility for a considerable share of the population in any society in a sustainable manner. If public transportation does not satisfy the population's needs in a comfortable and suitable manner, transportation system problems may occur. Therefore, transportation engineers and city planners develop action plans to achieve efficient public transportation
and sustainable urban systems.

Figure 1. Cycle time concept.



We introduce a simple yet efficient approach to optimize the modal fleet size of urban public transportation services, considering both user- and operator-oriented factors. This is envisaged to enhance the potential for achieving sustainable urban transportation systems and, eventually, opportunities to create sustainable cities. The presented constraint optimization approach can be described as follows. First, the expected passenger demand and the cycle time for the public transportation service are estimated. Next, the desired constraints and parameters, such as those related to the headway and seat supply, are determined. Finally, the optimal combination of different vehicle classes and the number of trips satisfying all the defined constraints are determined. The case of an urban area in a developing country is considered. The resulting solution determines the optimal numbers of public transportation trips and vehicles, by mode, required to meet the expected passenger demand, provide a high-quality service with acceptable headways for passengers, and, at the same time, reduce the service providers' costs as well as the environmental impacts. It is also concluded that a fleet composed of different modes can better facilitate the achievement of the optimal solution for passengers and service providers compared with the one-mode fleet.

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Input: Passenger demand (D), initial cycle time (CT_i), and capacity (C_i) for each vehicle class i
Output: Optimal number of trips (T_i) and other dependent variables for each vehicle class i
Initialization of variables and setting upper and lower bounds: T_i, number of vehicles (V_i),
and headway (H_i) for each vehicle class i
Introducing constraints: H_{i+1} ≥ H_i, i and C_{i+1} > C_i  ∀∈{1...n–1}
                              H_avg <= H_max
                              S >= S_min
                              S <= S_max
While (ΣT_i is not optimal or all constraints are not satisfied)
    For (i in 1...n)
        T_i = t_i                 // assign a new value to number of trips
        H_i = 60/T_i              // update headway
        V_i = CT_i/H_i            // update number of vehicles
    End for
    S = Σ(T_i * C_i)              // update seat supply
    H_avg = Σ(T_i * Hi) / ΣT_i    // update average headway
    ΣT_i = T_i + T_{i+1} + … + T_n  // update total number of trips
End while
Return Ti, Vi, and Hi             // return optimal variables for each class
End
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