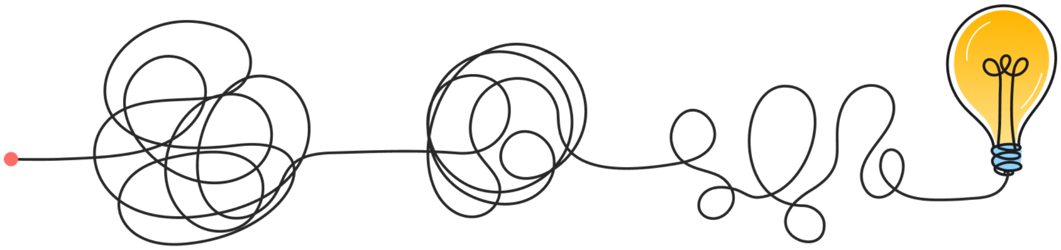
4MATIV Resource Hub

Read this article online

Assess the Magnitude of Your Own Inefficiency

Back of the envelope calculations to see what efficiencies are possible and learn how far a system is from optimal.



Recognize that Efficiency is Contextual

Efficiency typically connotes cost savings, which is why, when asked, most schools and transportation professionals would say they're trying to—or would love to—achieve a more efficient system. But efficiency is determined by context: by the system's goals and the features of the system that dictate what level of efficiency is possible. The question schools should ask is: How efficient can I be given what I have to/want to achieve? This article outlines some of the simple calculations that can help determine a system's efficiency.

A number of key factors frame up a system's level of possible efficiency:

- **Geography:**
  The geography a system serves (e.g. square miles)
- **Population:**
  The legal requirements for who needs to be served (e.g. Special Education and Homeless High Mobility populations, general populations) and population/enrollment density in the area to be served

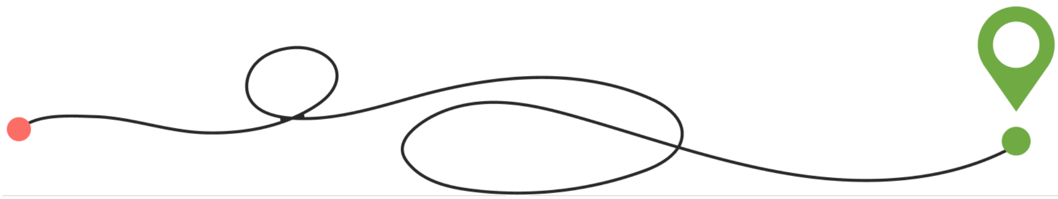
- **Allowances:**
  The school mobility tools and allowances afforded in each state or locale, such as permissible vehicle options, modes of transport, and driver qualifications

- **Service Requirements:**
  Other terms and requirements for the service to be provided

Many factors (all essentially constraints) are school- or district-based policies and design choices, such as transportation eligibility rules, school choice policies, school/program schedules, and promised service levels. These policies constitute the base of 4MATIV's efficiency pyramid.

Schools may also have specific goals or a mission (but not necessarily a requirement) to serve specific geographies or certain student populations. Likewise, schools may set differentiated service levels to accommodate specific programs or for other reasons that are meaningful, such as offering citywide choice with transportation from hub-stops for career and technical (CTE) programs or magnet schools. Rural schools might prioritize door-to-door service even for far-flung students due to safety concerns and lack of sidewalks on rural roads. These priorities must be accounted for when evaluating a transportation system's efficiency.

Sustainability is yet another factor, and one that won't be addressed here in detail. Still, it should be noted that "efficient systems" as discussed here may not necessarily be operationally or environmentally sustainable. An efficient system may be prohibitively complex to manage or require relying on modes with high carbon emissions footprint in the nearterm. Nonetheless, making the best use of existing assets or reducing the number of vehicles required or miles driven to serve a student population necessarily helps the environment relative to a less efficient version of a system trying to transport the same students.



How to Measure System Efficiency

In student mobility, efficiency can be measured based on the following:

- **Filling available seats:**
  increase seat utilization and reduce cost per student
- **Choosing the fastest/optimal route path:**
  reduce time/miles per route or per student
- **Serving a targeted geography:**
  reduce transport cost per student-mile
- **Maximizing use of assets:**
  increase trip/vehicle utilization, decrease cost per routed trip
- **Meeting compliance mandates:**
  reduce transport cost per Special Education and Homeless High Mobility student
- **Serving programmatic goals:**
  improve attendance/access for specific students in specific programs
- **Keeping students safe:**
  minimize overall cost while meeting programmatic and safety imperatives

So given a system's mission, its various constraints, and system features as outlined above, it's nonetheless still useful to benchmark against some standard of efficiency. **4MATIV's recommended back-of-the-envelope way to do this is by evaluating seat utilization on a bus trip against a theoretical maximum that considering the configuration of bell tiers.**

1 Calculate Seat Utilization

A typical Type C bus (a standard yellow bus) has a stated "manufactured capacity" of 68-77 passengers. That assumes students sit three-per-seat, which is impracticable for older students and often unrealistic even with the smallest students. So a better guidepost – and one that makes the math simple – is to assume most full-sized buses can fit 50 students. This is about two per seat and results in a very full bus (especially according to most drivers).

For each increment of 50 students in a school or school system, the most efficient way to transport those students would be to run one bus. Assuming just one bell tier, 100 students would require two buses, 150 students would require three buses, and so on. If a system transports 50,000 students with one bell tier, then the back-of-the-envelope calculation would indicate a need for 1,000 buses. If a system is currently running more than that, then that system can be made more efficient.

Unfortunately, that calculation doesn't indicate anything about how long the trips might be or how far students have to walk to bus stops. For example, if a district has widely disparate geographies that it's trying to serve and adopts a (reasonable and sometimes non-negotiable) restriction on how long students should ride on a bus, then picking up 50 students within even a loosely "reasonable" but still long bus ride time (say, 90 minutes or less) may not be possible, even if "community" or "hub stops" are used.

2

Include Bell Times

Another enormous lever whose impact can be calculated fairly simply in tandem with the above seat utilization calculation are bell times. For instance, in a district with two schools that each need to transport 50 students, two buses will be required if their bell times are the same. If the bell times are staggered (to allow at least, say, 60 minutes in between), then one bus (with the max of 50 students on each trip) could be “stacked” or “tiered” and serve all 100 students. A three tiered system could similarly serve 150 students with one bus if school schedules were staggered with 60 minutes (sometimes in smaller geographies this doesn’t have to be such a tight window).

3

Find the Theoretical Maximum

In this way, a school system can quickly calculate the theoretical minimum number of buses needed to serve their system if they could freely adjust the bell times, set reasonable or defensible walk-to-stop distances, and pick up 50 students on each trip within the time allotted. The “theoretical” maximum efficiency calculated might not practically be achievable for reasons of geography (not enough time to traverse an area), neighborhood safety, or socioeconomic reasons (parents can’t or won’t get to or have students walk to far-flung bus stops), but it’s still a useful guidepost.

4

Evaluate System Fidelity

Another way to think about and assess efficiency is assessing a system’s fidelity and adherence to existing published walk zones, eligibility boundaries, and walk-to-stop distance guidelines. In theory, a maximally efficient system would adhere to these policies without exception. Exceptions that are left should be understood, codified, and systematically reevaluated periodically. Walk-to-stop efficiency and stop consolidation specifically as a strategy to enhance efficiency is the subject of another paper.