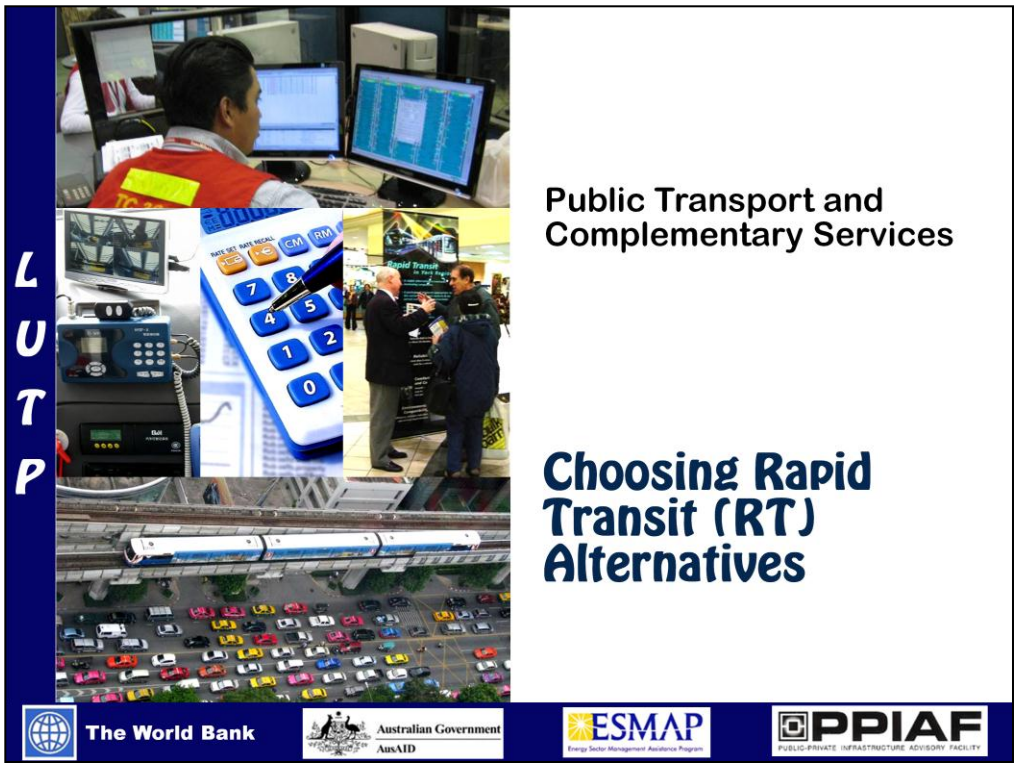

Cluster #4Module 1 (C4/M1): Choosing Rapid Transit Alternatives.

This presentation is one of the support materials prepared for the capacity building program ***Building Leaders in Urban Transport Planning (LUTP).***

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- The World Bank,
- Australian Agency for International Development Aid,
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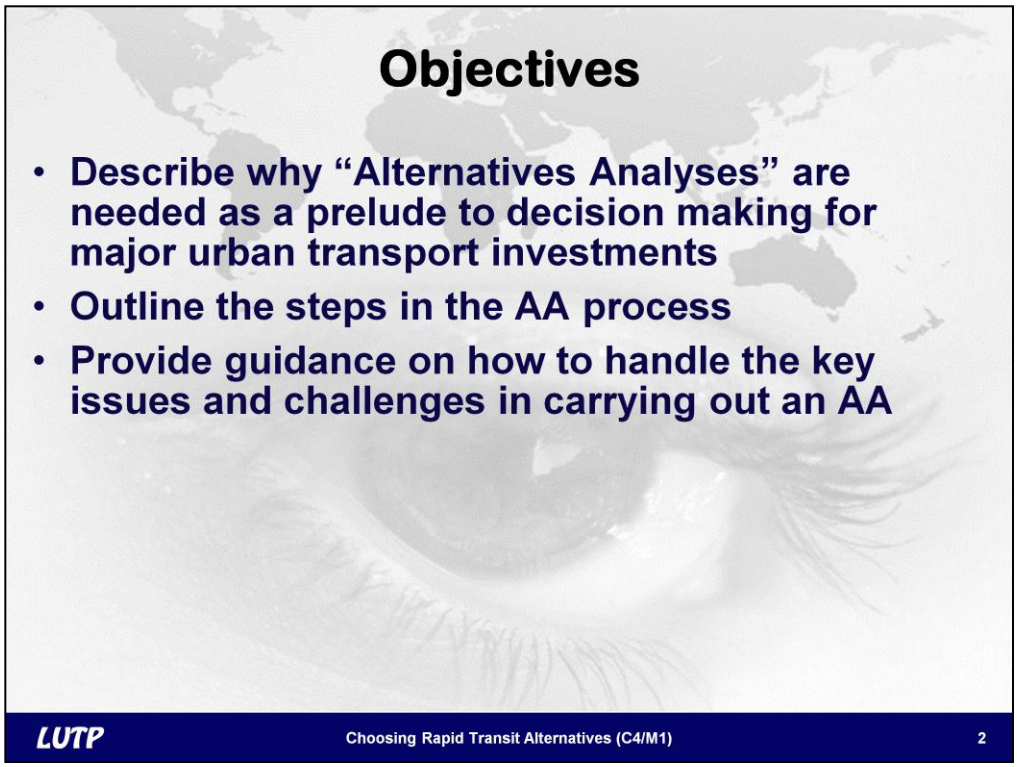


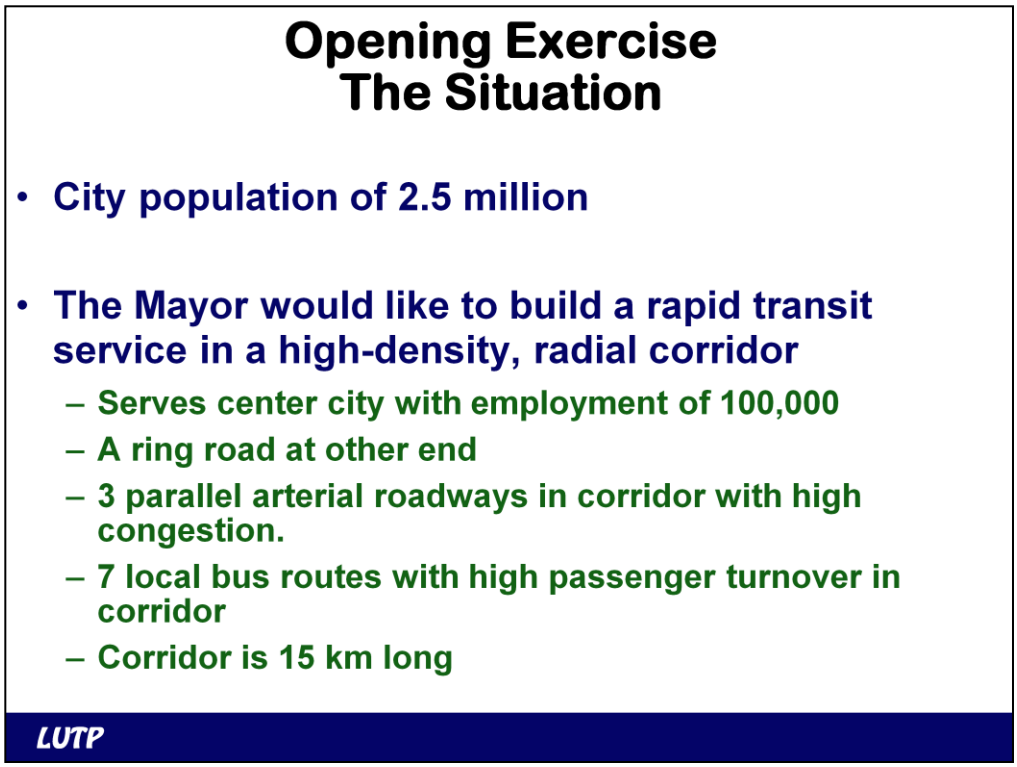
There are two main objectives for this presentation. The first objective is to present the rationale for an "Alternatives Analysis" project identification step. This step bridges the gap between broad, policy-oriented strategic planning and the preparation of specific investments in new rapid transit capacity.

The second objective is to outline the steps in the process and provide guidelines on how to address the key challenges and issues in successfully carrying out an Alternatives Analysis. The presentation will make the point that these challenges are not only technical but also relate to communications. The information that is produced during an Alternatives Analysis is impacted both by the general public and how the information is used in decision making.

Opening Exercise
Choosing A Rapid Transit Mode

LUTP

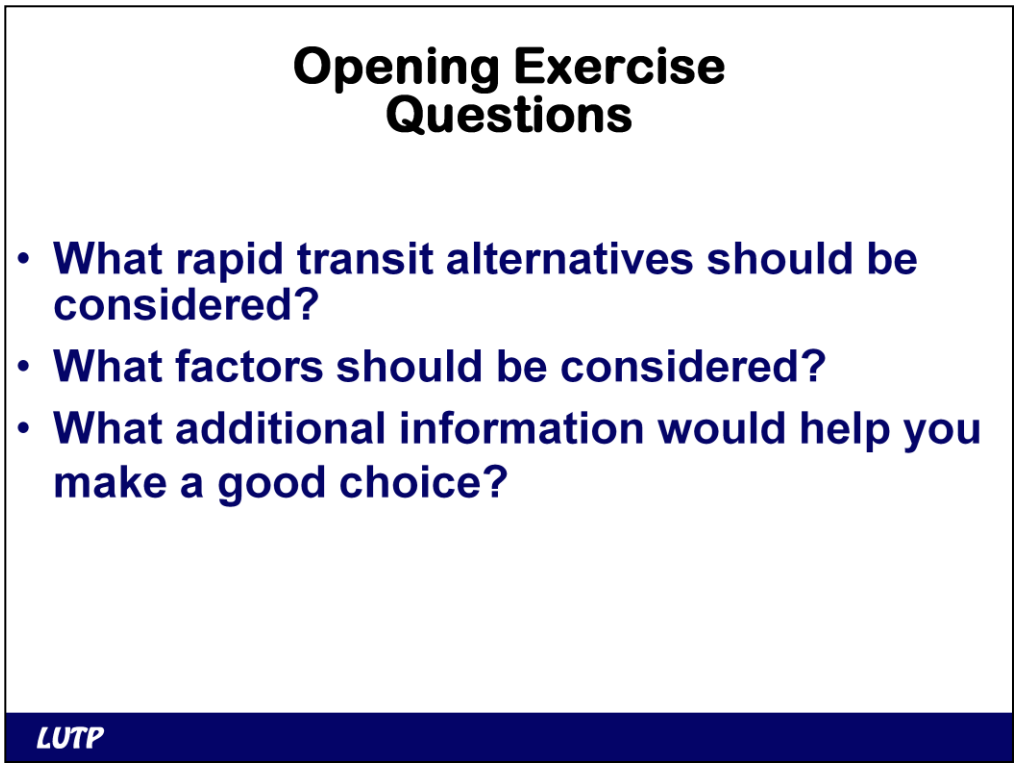
Worldwide experience has shown that there are a number of different ways of providing high performance, high capacity rapid transit service. The purpose of this exercise is to get you thinking about how to choose the right mode for your city.



You work in a city with a population of 2.5 million residents.

The Mayor would like to build a rapid transit service in a high density radial corridor with the following characteristics:

- The corridor serves the center city which has an employment of 100,000 jobs. The center city is one end of the corridor.
- The other end of the corridor is a ring road at the outskirts of the city.
- There are 3 parallel arterial roadways in corridor. These roadways are congested during most times of the day.
- There are 7 local bus routes in the corridor. These routes have high turnover with many users making trips that do not start or end in the center city.
- The length of the corridor is 15 km l fron the ring road to the center city.

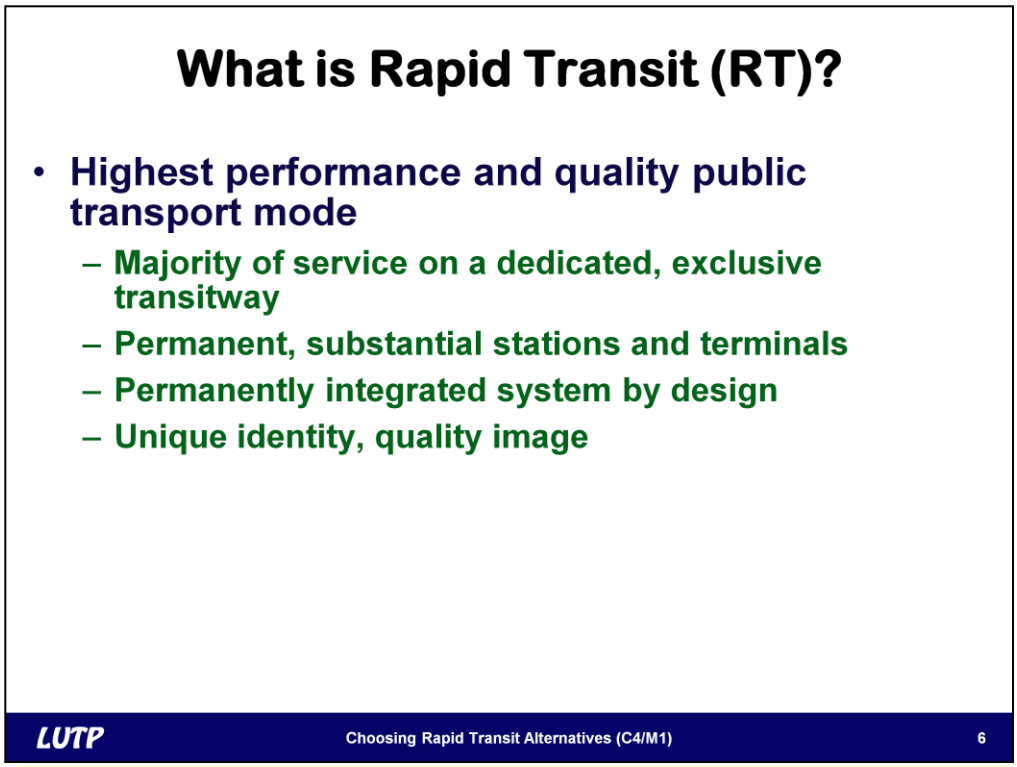


We would like you to answer three questions.

Based on the information that we gave you, what rapid transit alternatives do you think should be considered?

The Mayor also would like you to recommend the best alternative for the corridor. What factors do you think should be considered to help you make this choice?

Finally, we may not have provided you with all of the information that you think is necessary to make a good choice. What additional information would help you make a good choice?



Rapid transit is the highest quality, highest performance and highest capacity public transport mode. Irrespective of whether it is road or rail based, its defining characteristic is that the majority of its service uses an exclusive, dedicated right of way. This dedicated right of way contributes to its relatively high speed, reliability and safety. Rapid transit stations are more than stops. They provide a permanent, safe, secure and attractive place for boarding and alighting. These stops are integrated into the surrounding urban fabric and can serve as focal points for development.

Rapid transit systems are comprised of a number of elements: services, stations, vehicles, running ways, fare collection, ITS applications, branding and other passenger information. These elements are planned and designed as a permanently integrated system in which each element works with the others to provide high, cost-effective performance.

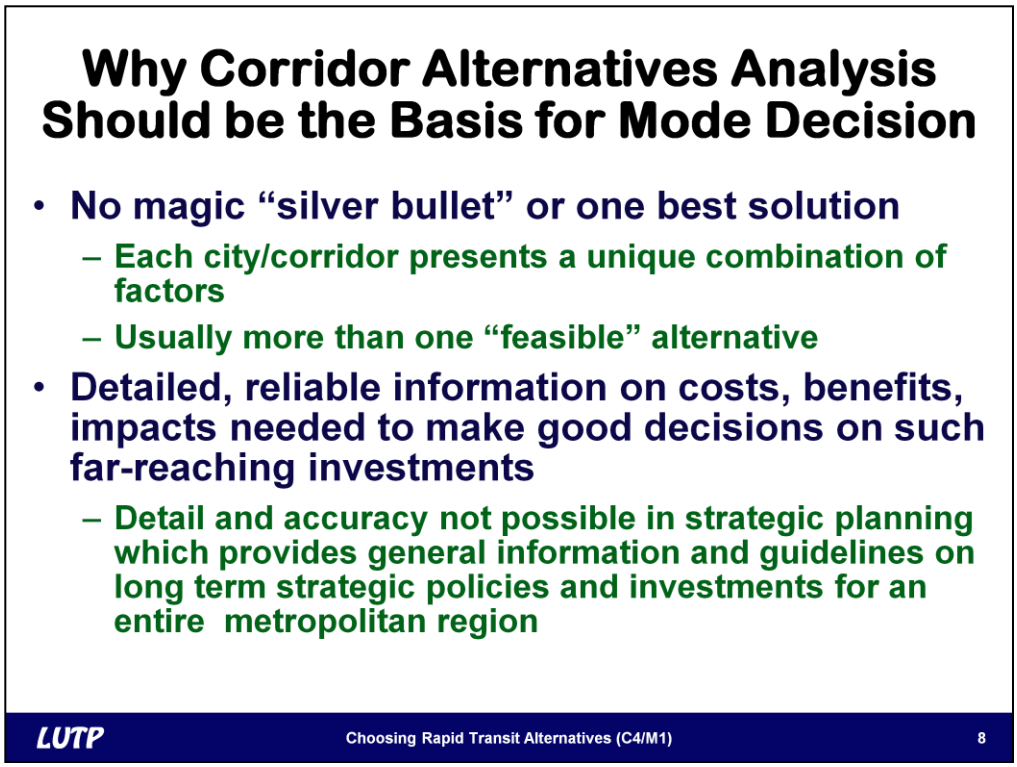
Branding and other passenger information is used to convey the integrated nature of rapid transit systems as well as “how to use” to customers.

Factors Impacting Selection of a Specific Rapid Transit Mode

- Strategic goals, objectives
  - Transport
  - Land use
  - Social, environment, economic
  - Other
- Current and future general travel and RT market
- Current, future multi-modal transport network size, condition, performance
- Current and future land use patterns
- Available rights-of-way
- Costs, benefits, impacts
- Financial resources, current and future needs

As with any major transport infrastructure capacity expansion, there are many factors which should impact the selection of the most appropriate investment. This includes the strategic policy framework passed from the strategic planning process. It also includes the nature of the specific market: its operational, physical and financial environment, both current and future. Investments in rapid transit are also heavily impacted by the extent, condition and performance of the entire transport network of an area. The entire transport network includes the highway and roadway network and the entirety of the public transport system, as well as intercity passenger and freight transport.

Though we are dealing with rapid transit in this discussion, the same factors apply in planning and decision making for any major urban transport investment.

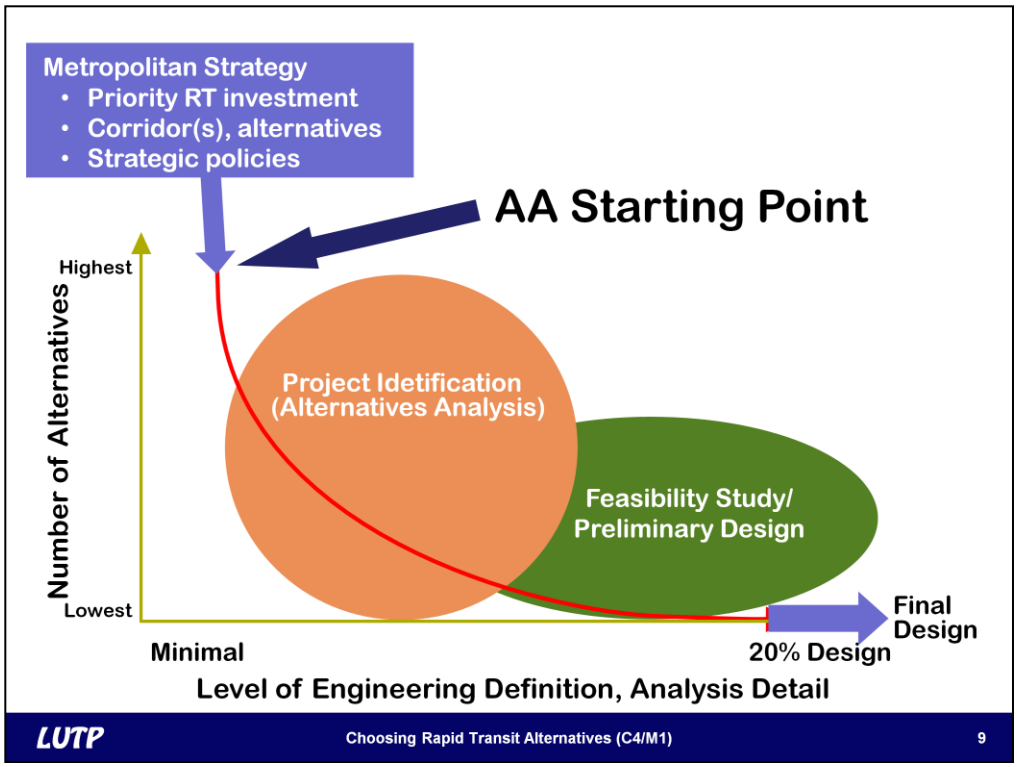


The specific factors that affect the potential costs, benefits and impact of a rapid transit investment vary between cities and even within a city. Each city is different as are each corridor and/or sub-area within a city. Investment in any project is driven by many factors--its cost, its projected benefits and its projected impact on land use, society and the environment.

Though consideration should be given to system- or network-wide issues during strategic planning, specific decisions on major transport infrastructure investments requires the detailed focus of corridor level planning. Alignments cannot be studied in detail at the regional network level where combinations and permutations of different investments in all corridors must be considered. A relatively minor change in an alignment assumed during strategic regional planning may result in a major change in the costs, effectiveness and impacts so important to decision making in any kind of political environment.

At the same time, technological advances have significantly increased the number of alternatives that can be feasibly applied in most corridors. This means that decisions on major transport investments, especially those for rapid transit, have the benefit of a detailed Alternatives Analysis done at the corridor level.

Slide 9



The starting point for Alternatives Analyses is a strategic transport policy and investment framework produced during strategic planning. This will include adopted policies on issues such as land use, transport user charges, the role of public and non-motorized transport, parking and traffic management, and institutional functions and organization.

The strategic framework adopted after strategic planning will also include a list of corridors requiring major capacity expansion in priority order and a very broad definition of mode (roadway, rapid transit or both). It may also include a “screened” list of physically and operationally feasible alternatives.

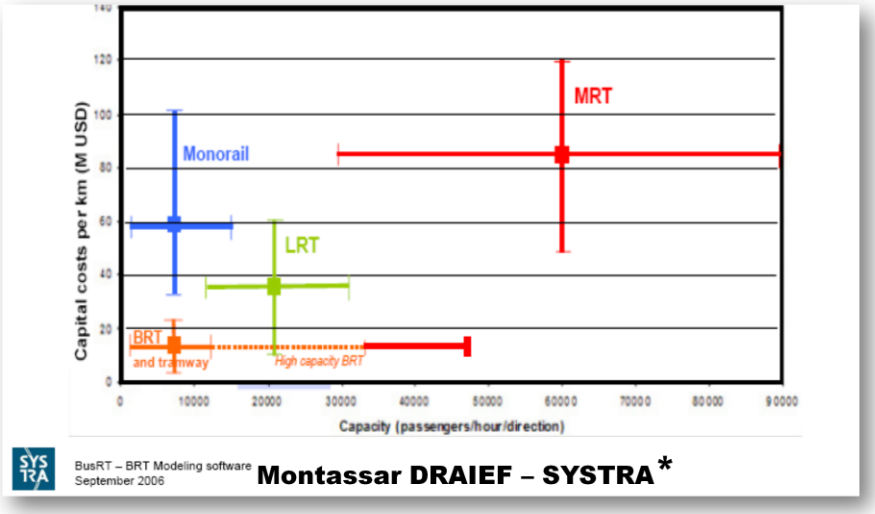
The level of detail at which strategic planning is undertaken prevents closure on a specific rapid transit mode, roadway type or specific alignments (station, interchange locations, etc.) because so little is known with any confidence. Costs, benefits and impacts can not be evaluated in detail because of the city-wide or regional scale of strategic planning and its long range time frame (usually 20 years).

Alternatives Analysis involves a much more focused, detailed look and are typified by the following:

- A smaller number of capacity expansion investment options in a single corridor or sub-area (e.g., the urban core)
- In a shorter time frame, usually under 15 years
- In much more detail.

No Dominant, Magic "Silver Bullet"

Capital Cost, Capacity Comparisons

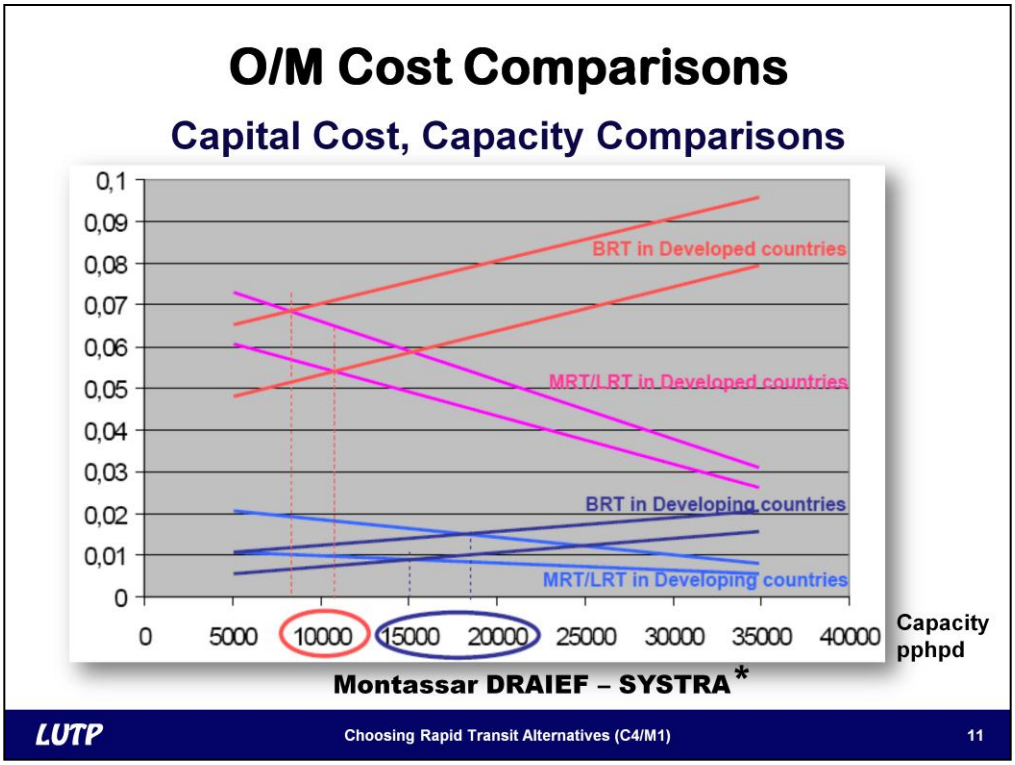


The purpose of this exhibit (produced by the French Planning and Engineering Company, SYSTRA) is to show that there is a large overlap in the capacity of rapid transit modes — light rail (LRT), BRT, monorail, and full grade separated metros (MRT). For example, BRT, LRT (trams on dedicated rights of way), and MRT (metros) all can provide a capacity of 30,000 passengers per hour in one direction.

However, there is a wide range of capital costs for providing the same amounts of capacity. To provide a capacity of 30,000 passengers per hour in one direction, it costs $16 million per km (US dollars) to provide BRT service. This cost is much lower than the costs to provide LRT service ($37 million per km) and metro (MRT) service ($84 million per km).

There are several options for providing passenger capacity up to 50,000 passengers per hour in one direction. Only when passenger demand exceeds 50,000 passengers per hour in one direction is there only one option and that is metro (MRT). However, this is a demand that is well beyond that found in the busiest corridors of most developing cities.

Since there will be several options in most developing cities, choices must be made. These choices should consider more factors than the construction or capital costs and capacity. Let us look at some other factors such as operating and maintenance costs.



This exhibit, also from a SYSTRA presentation, illustrates the relative range of operating and maintenance costs as a function of demand past the maximum load point on a rapid transit line in the peak direction. The higher the volume, the lower the O/M costs of rail based modes becomes because savings in drivers offset their higher fixed maintenance costs relative to BRT. Conversely, the higher proportion of bus variable costs (i.e., drivers) means that BRT O/M costs go up with volume, though relatively slowly in developing cities.

The envelope is different in developing and developed cities because of the effects of wage rates.

Again, the range at which the rail based modes becomes dominant in developing cities, between 15,000 and 20,000 trips/hour at the maximum load point in the peak direction is only achieved in the biggest developing cities.

Both exhibits illustrate the fact that in the demand range found in most developing cities, there are few corridors where any one option (e.g., rail-based) will be dominant in either capacity or operating or maintenance cost terms.

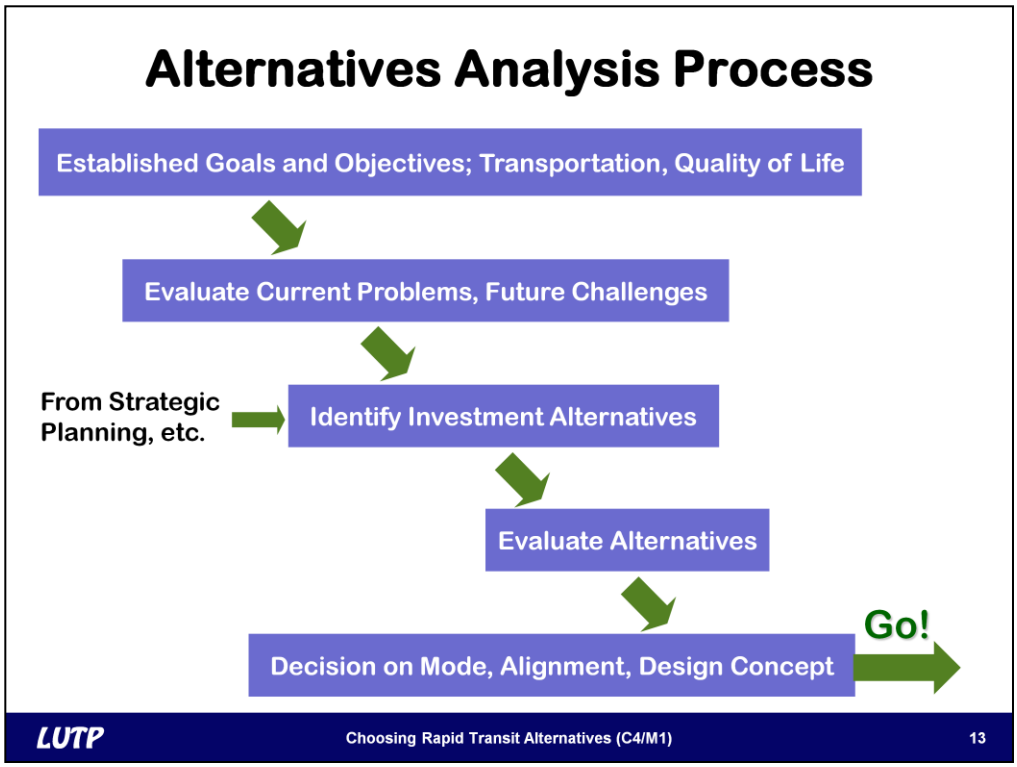
What AA is Not!

- A feasibility study where
  - A single, pre-determined solution is assessed
    - Physical and operational ability to implement
    - Absolute economic return based on optimistic "guess-timates"
  - Other, potentially more cost-effective, affordable and desirable options are ignored

The key message here is that Alternatives Analysis is not the same as a typical feasibility study where a single, pre-determined "solution" is usually found to be feasible from an economic return perspective, and no option other than doing nothing is analyzed.

The key difference is that other potential investment alternatives are objectively evaluated in a transparent, balanced Alternatives Analysis process. The facts as best as they can be estimated during AA serve as the basis for an open decision on the rapid transit mode and general alignment to take into detailed project preparation.

This does not mean that the decision will be a "technical" one, but that a corridor level Alternatives Analysis must be done to provide elected or appointed political leaders with the information they need in order to make their decision.



This exhibit shows the sequential steps that should be taken in an Alternatives Analysis of a specific corridor.

1. Goals and objectives should be set that define the quality of life and corresponding mobility that is desired for the community. These are based on the goals and objectives developed in the strategic plan.
2. Evaluate the current problems and future challenges in the corridor. The objectives from the previous step are used to define these problems and challenges.
3. Identify the transportation alternatives for meeting these challenges. Often, the strategic plan will include a "screened" list of physically and operationally feasible, potential desirable alternatives.
4. Evaluate the alternatives against the objectives defined in #1. This effort should rely on quantitative analysis as much as possible to ensure that all alternatives are evaluated fairly.
5. Based on the results of the evaluation analysis, a decision is made on mode, alignment, and design concept.

Alternatives Analysis Guidelines

1. Develop and Implement a Formal Communications Process
2. Establish Goals, Objectives, and Evaluation Criteria
3. Understand the Process and Causes of Problems
4. Consider the Right Alternatives
5. Develop Decision Support Information
6. "Make the case" for the selected alternative

The steps in the Alternatives Analysis process are straightforward. There are six broad guidelines that should govern the Alternatives Analysis process so that it generates the best transport alternative for the corridor. We will now discuss each of these guidelines

1. Develop and Implement a Formal Communications Process

- From the beginning, make sure all stakeholders, decision makers, general public, private sector understand the AA process
- Provide for two-way communications process leading up to, as well as after, key decision points
  - Use a variety of communications tools

One of the first steps in an Alternatives Analysis is development of a formal communication plan. This will establish a process of two-way information exchange from the very beginning of the study. The target audiences for the plan will include all stakeholders, such as government agencies at all levels of government, the private sector, and citizens. There must be an early understanding of the Alternatives Analysis's purpose and how it differs from a "feasibility study." An aggressive communications program is also needed to help avoid the public relations problems that can delay or even "derail" almost any type of major transport infrastructure or facility when important decisions are conveyed to the public "after the fact."

The plan will cover more than post- or even pre-decision point milestones such as goals, objectives, and criteria; the range of alternatives to be addressed; and the selection of an alternative to take into preparation. A continuous communications process will keep all stakeholders aware of the study's progress and, after milestone decisions are made, help "sell" them to the largest number of people.

Communications processes for urban transport have traditionally used a small number of media (formal public "hearings", newspaper announcements, a static website) that had limited purposes (to inform, not necessarily to receive direction and feedback).

Increasingly, communications plans will include advanced technologies such as web-casts and the use of smart phones to receive citizen feedback and perform opinion surveys on specific issues.

2. Establish Goals, Objectives, and Evaluation Criteria

- **Address more than traditional transport concerns like congestion**
  - **Environmental issues**
  - **Social equity**
  - **Health and safety**
  - **Economic**
  - **Land use**
  - **Logistics**
  - **Finance, affordability**

Often, we think of congestion and cost as the only important factors in transport. But there are many other concerns to consider, as noted above. In a general sense, alternatives should be judged in terms of how well they help the given corridor achieve the strategic vision for the city. This vision should include an emphasis on quality of life as well as access and mobility.

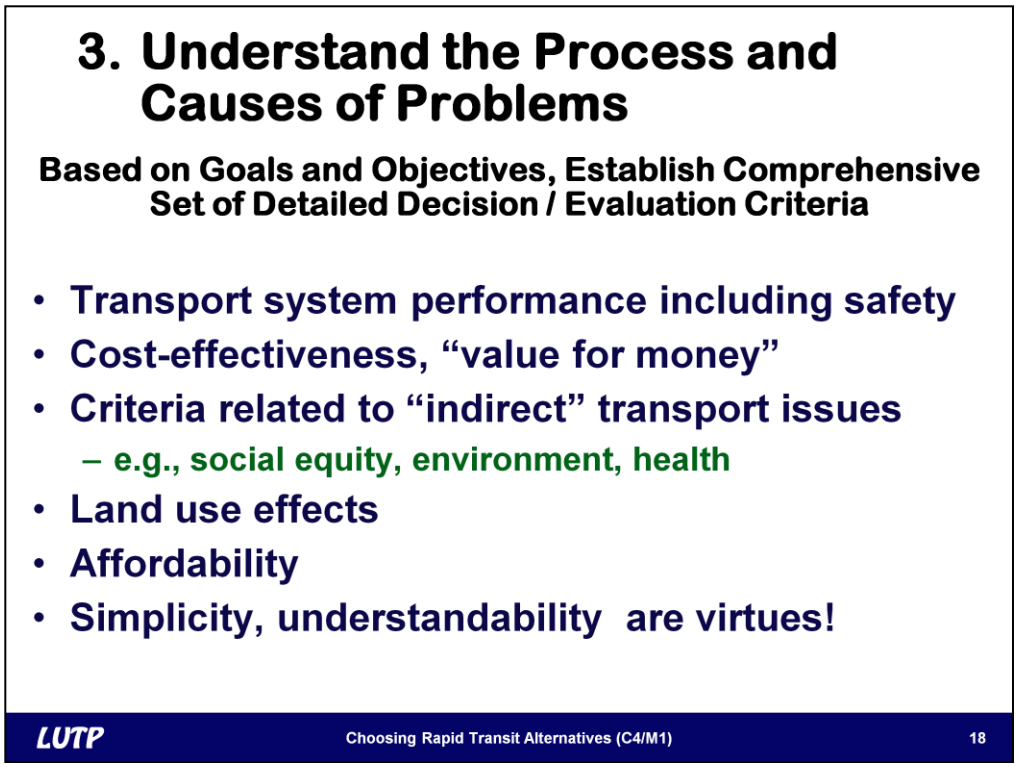
Broadly defined, cost effectiveness and affordability are very important in developing cities. The focus of cost effectiveness and affordability is not the ability to produce financing for the initial implementation. But rather, cost effectiveness and affordability must include the ability to build, operate, and maintain the investment in question. It also includes the other public and general transport services and facilities necessary to produce promised benefits. In addition, affordability references the ability to sustain the entire transport system in an acceptable state of good repair over the long term, including periodic rehabilitation and major overhauls.

3. Understand the Process and Causes of Problems

- Analyze current and expected future "no project" conditions
- Identify underlying causes, not just symptoms
  - Congestion, global emissions, traffic accidents, and poor air quality are symptoms, not causes

Another important Alternatives Analysis step is to understand the causal factors influencing the issues and challenges any potential transport investment is meant to address. It is particularly important to understand the underlying causes of inordinately high private vehicle use and the pathologies such use causes, such as congestion, traffic accidents, local and global emissions, and noise. The causes of high vehicle use include:

- Rising incomes and motorization
- Private vehicle-oriented land use at both macro and site levels
- Auto use incentives ("free" on street and sidewalk parking, low vehicle ownership fees, low gasoline prices, etc) which do not reflect the true costs of private vehicle ownership and use
- Poor public transport services and infrastructure
- Insufficient, unsafe, poorly maintained non-motorized transport infrastructure
- Lack of a complete secondary road network
- Poorly planned, designed, and maintained highway infrastructure
- Inadequate traffic management, including enforcement of traffic/parking rules



The evaluation process should produce quantitative and qualitative decision criteria related to the goals and objectives for the investment. As noted above, in developing cities, the list of criteria should include more than congestion relief. The list should include information related to the environmental, social, and economic objectives held for the transport system in general, and for the specific investment in question.

They should be comprehensive, straightforward to estimate, unbiased and easy to understand by decision makers and the general public.

Finally, cost effectiveness and affordability (both of the initial capital investment and operations and maintenance over time) are perhaps most critical in developing cities with limited financial resources.

3. Understand the Process and Causes of Problems

Identify, Collect, Analyze, Forecast Information to Produce Criteria

- **Detailed data on current and future land use, demographic, transport conditions**
- **Analytical tools**
  - **Network and travel**
  - **Costing and finance**
  - **Environmental impacts and equity**

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Many if not most important decision criteria will be quantitative. In order to prepare data in a credible way, it will need to be collected and evaluation methodologies or tools updated or developed. Perhaps the most important data deal with usage (public transport ridership, highway traffic, etc) and the accessibility provided by the multi-modal network. The criteria are produced by travel and network models and are needed to produce the complete range of social, environmental, financial, and economic criteria that are crucial to informed decision making.

There is no one single best form for travel demand models that should be used in every situation. The key is to develop travel models that can satisfactorily estimate the numbers of travelers by mode for each alternative in the given application situation, currently and over the forecasting horizon. This may mean something as simple as using information from an on-board or road side survey to consider the following:

- Applying travel time and cost elasticities to current travel (e.g., public transport)
- Applying growth and diversion factors to current travel
- Applying volumes by origin to destination market
- This approach is simpler and less costly to develop and apply than developing a totally new multi-step conventional demand model from a home interview survey.

The tendency to overly complicate travel modeling while ignoring differential accessibility impacts on the poor and over simplifying capital and operating cost and overall financial

modeling should be avoided.

4. Consider the Right Alternatives

- Should be multi-modal, including roadway TDM and investment
- There is more than one RT mode
  - BRT
  - LRT (tramway)
  - Metro
- System integration is critical
- Make each alternative as competitive as possible

Another critical issue in Alternatives Analysis is to identify and study the right alternatives. In some situations, these will be identified as operationally and physically feasible, potentially desirable alternatives during strategic planning. In others, strategic planning will identify the need for a high performance, high capacity rapid transit and/or a substantial roadway enhancement in a corridor but leave open the range of alternatives to be studied in depth. These are all part of an initial, sketch planning" Alternatives Analysis phase.

The key premise is that only in unusual situations will only one alternative be physically and operationally "feasible" or dominant in all important criteria. This means that a range of options should be studied, differing in factors such as initial and ongoing costs, technology, and basic horizontal and vertical alignments. Each alternative should be developed to produce the maximum benefit from the given technology, taking care to avoid purposely setting up "straw-men" likely to fail by definition, not performance.

Irrespective of the nature of the rapid transit alternatives brought into detailed analysis, each should be assessed as part of an integrated public transport, roadway, and operations management system in the given corridor designed to produce the maximum benefit for the given cost.

5. Develop Decision Support Information

- Information should be complete, objective, and reliable
- Be transparent
  - Fully disclose an honest, objective assessment of benefits, costs, impacts and risks
- Address risks
  - Sensitivity analyses (what happens if everything goes wrong?)
  - Independent assessment of technical methods, assumptions and cost and benefit results can mitigate risk and build credibility

As noted above, a formal communications plan is the key to mitigating risk that opposition to any project at all or to the specific project selected at the conclusion of Alternatives Analysis will prevent implementation.

Where there are uncertainties regarding important evaluation criteria such as construction schedules, performance, costs and ridership, the risk associated with not achieving forecasts should be accounted for, as a minimum, with explicit sensitivity analyses on the key uncertain input parameters.

A truly independent assessment of technical procedures, input assumptions, and resulting decision criteria by experts with no stake in the project can also be an excellent way of mitigating risk and gaining the confidence of all stakeholders.

5. Develop Decision Support Information

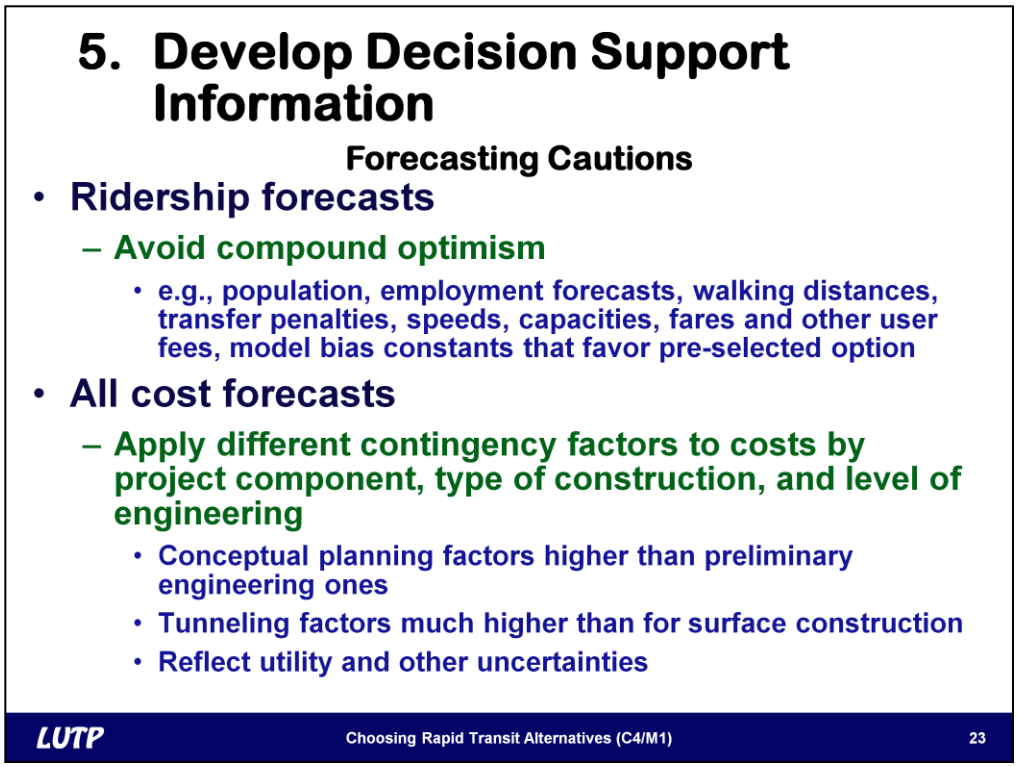
Do Not Slant Analysis to Favor Pre-determined Solutions!

- **Biased assumptions**
  - **e.g., fares, capacity standards**
- **Non-competitive alternatives**
  - **"Straw-men"**
- **Under-estimated costs**
- **Inflated benefits**
- **Ignored risk**

A problem with "feasibility" studies is that they evaluate the "feasibility" of a pre-selected project, irrespective of whether there are other, potentially better ways of addressing the same issues and challenges. It is well know that feasibility studies of pre-selected projects that have powerful interests behind them rarely show them to be "infeasible."

Care should be taken during Alternatives Analysis to avoid this kind of bias. All alternatives should be identified and prepared to reflect the best application of the particular technologies or modes, and all assumptions (e.g., capacity of a rapid transit vehicle in terms of number of allowable standees per square meter) used as inputs to the evaluation process should be fair and consistent.

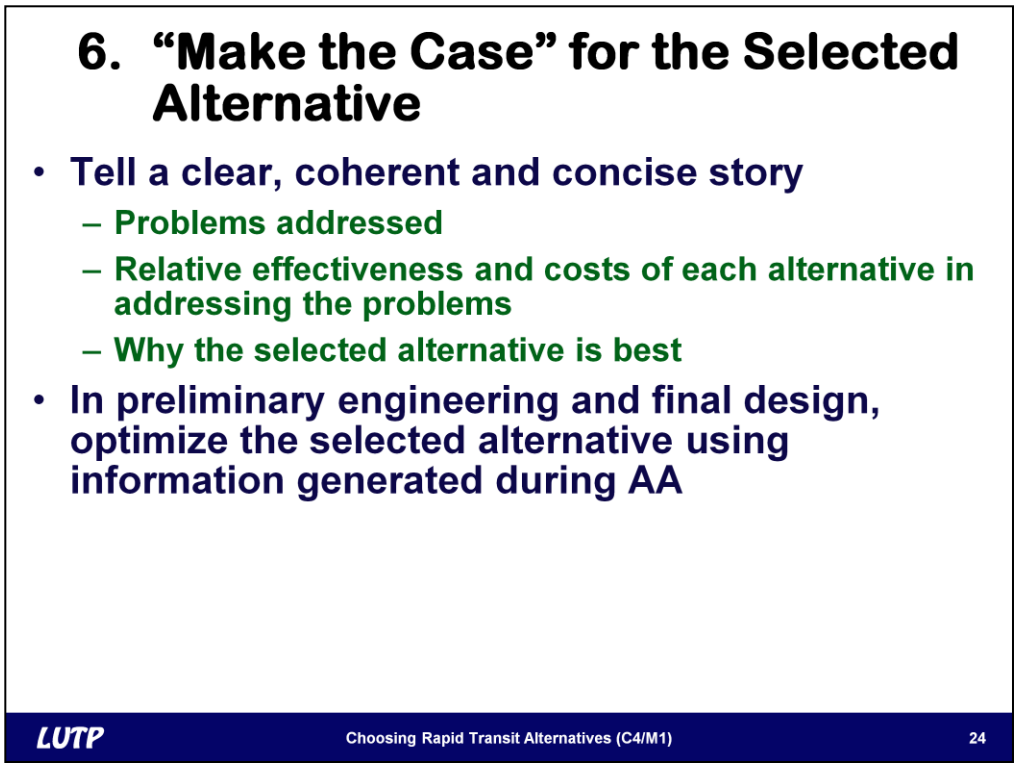
If costs are underestimated and benefits overstated for a particular investment to push decisions toward a particular outcome, not only will money be wasted, but other more effective and needed investments in transport and other sectors might not be made because of a lack of funds.



It is important to recognize that forecasting involves making predictions based on certain assumptions about the future. A common failure in many forecasts is to be too optimistic about the future. This often results in unreasonably high estimates of ridership and revenue and unreasonably low estimates of construction and operating costs

Caution should be taken to avoid compound optimism in the ridership forecasts by assuming the “best” future for key assumptions such as population, employment, and fare levels. You also should avoid “bias” assumptions that state that users favor one mode more than another based on just belief, e.g., “ Rail always attracts 30% more users than bus.”

Caution is also needed for cost estimates. A good way to guard against under-estimation is to apply contingency factors to each level of the project development. These contingency factors reflect uncertainty. For example, tunneling costs from a recent construction project may be inflated by a contingency factor of 20% to reflect uncertainty.

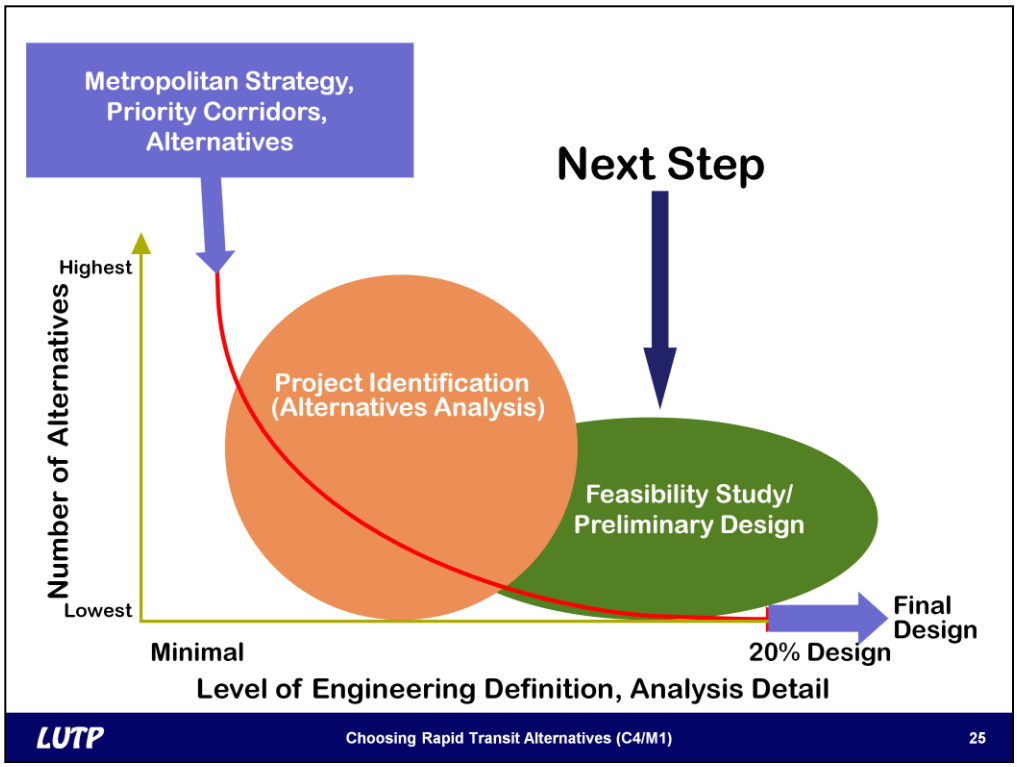


Another important guideline is to "make the case" for the selected alternative. A clear and concise story is needed that describes:

- Problems addressed
- Relative effectiveness and costs of each alternative in addressing the problems
- Why the selected alternative is best

This story-writing effort often helps planners recommend the best alternative. If a compelling story cannot be developed, it may raise questions about how the preferred alternative was selected and suggest that the evaluation process be reviewed.

Once the story is developed and is compelling, it should be used as the project advances. Sometimes, project support waivers and it is important to remind decision makers and the public why the selected alternative is a valuable investment.



After a project advances through Alternatives Analysis, it enters the engineering phases of feasibility analysis and preliminary design. In these phases, it is important to optimize the selected alternative using information generated during Alternatives Analysis.

Summary

- **Many factors need to be considered in rapid transit investment decision making**
  - **Each corridor or small area presents a unique combination of these factors**
- **There is no single, dominant RT mode**
- **A detailed, objective Alternatives Analysis following strategic planning is the only way to identify the best alternative**
- **Effective AA's include a strong, extensive communications process as well solid technical procedures**

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Deciding any major transport investment should be based on a broad array of factors, including:

- Life cycle costs
- Financial affordability
- Transport system performance
- Access and mobility
- Environmental/social/economic/land use effects
- Cost effectiveness in all the above

No one rapid transit mode is dominant in all of these factors in all situations, making detailed, corridor-level Alternatives Analyses critical to urban transport planning and project development.

Alternatives Analysis provides technical information to what are most often decisions made in a political arena, making transparency through two-way aggressive communications an important part of the process.