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Purpose-driven public transport: creating a clear conversation about public transport goals

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ABSTRACT

Public transport faces an increasingly intense conflict between patronage goals and coverage goals. Broadly speaking, patronage goals seek to maximize patronage of all types, while coverage goals lead to the provision of service despite low patronage – to achieve social inclusion objectives for example. The conflict between these goals follows inevitably from the underlying structure of the public transport product, including both its costs and geometry.

The tradeoff between patronage and coverage is the type of value-judgment that elected officials are paid to make. The paper presents a means of quantifying the tradeoff, to facilitate public discussion and decisions on how to balance these priorities. These strategies are designed to ensure that the decision about how to balance social versus patronage goals is made consciously rather than inadvertently, with a clear understanding of the consequences of the choice.

0. Introduction

Public transport exists for a range of purposes, including environmental, economic, and social ones (Veeneman, 2002). However, different purposes may imply quite different kinds of service. Public transport providers and funding agencies may try to present themselves as serving all the diverse purposes of public transport, but in fact they must make hard choices between competing goals. This paper presents a language for discussing these hard choices with constituents and elected officials, one that has proven valuable in consultation and decision making.

Most of the purposes of public transport cluster around two opposing poles:

- Purposes served by *patronage*. Most environmental benefits of public transport are related to how many people use the service. Fiscally conservative goals, such as minimizing subsidy, are affected by fare revenue, which also varies with patronage.
- Purposes served by *coverage*. Social benefits of public transport, such as accessibility for persons who cannot drive, tend to be based on the severity of need among certain population groups, rather than the level of patronage to be gained by meeting this need. Demands for "equity" of public transport service among areas with different patronage potential also can yield low-patronage services that are retained for these non-patronage reasons (Hay, 1993, 1995).

This paper contends that it is possible to create a language in which to discuss those hard choices with the public, so that elected leaders can make informed and quantified decisions about those choices that reflect their constituents' values. The key idea is to use the consultation process to educate constituents and decision-makers about the patronage–coverage tradeoff, and then elicit a direction in the form of a percentage of service resources to be devoted to each of these purposes. The role of the public transport funding agency and operator, in this scheme, is to document that the service they are providing reflects the balance of values chosen by the public through their elected leaders.

A scheme of this kind was developed by the author in the course of consulting projects for several public transport agencies in North America.[1] The agencies in question ranged from larger urban operators (population over 2 million) to agencies covering free-standing small cities (population 50,000–100,000). The Regional Transportation Plan for the urban area of Reno, Nevada (Regional Transportation Authority of Washoe County Nevada, 2005), based on work for them by the author, uses the scheme most ambitiously, establishing and monitoring long-term goals for each category.[2]

[1] The author acknowledges the contributions of these US clients to this line of thinking, notably Salem Keizer Transit, Salem, Oregon; Whatcom Transportation Authority, Bellingham, Washington (2004); Regional Transportation Commission of Washoe County Nevada, Reno, Nevada (2005); the City of Fort Collins, Colorado (2002); Valley Regional Transit, Boise, Idaho; and VIA Metropolitan Transit, San Antonio, Texas.

[2] The Reno policy states: "Approximately 80% of Citifare service will be allocated to maximize productivity and 20% for coverage to provide service in less dense areas." (2005, pp. 2–7) "Productivity" in this statement corresponds to "Patronage" in this paper.

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The distinction between patronage-oriented and coverage-oriented services echoes distinctions made by Litman (2006, p. 58) and Nielsen et al. (2005), among others. The State Government of Victoria in Australia (Betts, 2007) makes a policy distinction between "mass transit" and "social transit" that roughly parallels the distinction between patronage and coverage. This paper attempts to quantify the tradeoff as precisely as possible, as a tool for public discussion and consensus-building.

The structure of this paper is as follows:

- The first two sections discuss the two categories of goals proposed – patronage goals versus coverage goals – and explain the different kinds of service design that tend to follow from each.
- Section 3 describes the range of situations in which this distinction is useful.
- Section 4, "Service Design Policies and "Equity"" shows how the language of the productivity/coverage distinction leads to policies that elected officials can understand as reflecting their values, and that public transport managers and planners can implement and measure.
- Section 5, "Consultation Process", presents an approach to consultation using the proposed tools.
- Finally, one key technical challenge in such policymaking is to define the starting point – i.e. what is the split between patronage and coverage goals in the existing service pattern. Section 6 "Analysing Existing Services by Purpose", discusses techniques developed to this end. The section is aimed at planners and managers seeking to use this tool, but a reader interested in larger questions of policy may skip this section without missing important material.

1. Patronage goals

A patronage goal is one that is achieved to the extent that people use public transport. These goals include:

- *Goals related to financial return or efficiency*. The agency or operator that receives the fare revenue are motivated to maximize patronage.
- *Goals related to vehicle trip reduction*. Most environmental purposes of public transport – including emissions reductions – are met by full public transport vehicles and not by empty ones.

The typical measure of a patronage goal is patronage per unit of cost, e.g. passengers/km or passengers/h. Where fare revenue is relatively constant per passenger, fare revenue per passenger (high) or subsidy per passenger (low) can also express achievements toward a patronage goal.

Patronage goals are not all exactly aligned with one another. For example, some emissions-related goals are related to vehicle km travelled, and are therefore met mostly in relation to passenger–kilometres. Others, especially those relating to "cold start" emissions, tend to vary with passengers more than passenger–distance, at least over the typical distance range of urban public transport operations. Meeting environmental goals may also require that public transport patronage consist of people who would otherwise have generated car trips, rather than those who otherwise would have walked, cycled, or not made the trip.

In the urban public transport context, however, these variations are small in comparison to the difference between patronage goals and their opposite, the coverage goals. The key point of patronage goals is that they all tend to lead to similar kinds of service, namely:

- *Frequent all-day service in dense and walkable areas*. For example, in a large urban area based on a core city that is at least a century old, the portion of the city built before World War II typically has higher overall densities and also a more well-connected street grid that is friendly to pedestrians, while being less friendly to the private car. Some newer centres and communities may also have these features. These areas tend to support voluntary public transport dependence, which in turn leads to high all-day patronage.
- *Frequent all-day connections between major activity centres*, where the intense activity at these centres produces high demand even though the demand at points in between may be relatively light.
- *Frequent peak-period service in commute markets*, where a high level of demand can be served over a short period. This tends to be a dominant mode of service in lower density areas.

In most urban public transport operations, the most productive services, in terms of patronage per unit of cost, are generally of these types.

It should be noted, however, that the patronage/coverage distinction is used to categorize services by the standards of a particular study area, Thus the distinction can be used by outer-suburban and rural operations where there is no dense inner city fabric, because these areas still have services that reflect a patronage goal as applied to that service area. The key to identifying patronage-oriented services is to ask: "Would this service still run when and where it does if patronage were our only purpose?" In low-density areas some markets will be *relatively* high-patronage by the standards of that study area, and would therefore pass this test.

2. Coverage goals

Coverage goals are met by the availability of service, regardless of its patronage. These values tend to include:

- *Social needs of disadvantaged populations*. When a public transport operator proposes to cut a service due to low patronage, the response is often an intense objection from small numbers of people who depend heavily on the service. A facility serving senior citizens or disabled persons, for example, will advocate for their service not based on how many people use it, but rather on the severity of the problems these people would face if the service were taken away. Whenever service is provided or retained due to such appeals, we are in the presence of a coverage goal.
- *Concepts of geographic equity*. The perception that service should be "equitable" leads to a dispersion of service to include areas with low patronage potential. In outer-suburban Sydney, for example, typical "good" performance for a bus route can be as little as 0.5 passengers/km, while in the inner city a "good" performance is 2.0 passengers/km or more. A purely patronage-based approach would focus service on the best markets and abandon unproductive markets. Services retained despite this consideration reflect the impact of the coverage goal.[3]

The typical measure of a coverage goal takes the form "___% of residents and jobs must be within ___ metres of service".

Again, there are some subtleties among coverage goals, but they are exceptions that prove the rule, showing that all coverage goals are broadly more similar than different:

[3] Alternatively, equity can be as a possible position midway between patronage and coverage goals, as discussed later in the paper.

- Severity of need and geographic equity sometimes diverge in the case of very small numbers of people with severe needs in an otherwise rural setting, but the vagueness of the concept of equity is often extended to embrace these cases.
- Low-patronage service may be provided with the intent of "leading development", where there is credible reason to believe that high patronage will be achieved at development build-out. These cases are easily dealt with by identifying the service as patronage-based but defining the patronage target in relation to development completion.

Service designed for a coverage goal is by definition low-patronage service, by the standards of a given agency or service area. As a result, these services tend to be:

- Devoted to low-density and rural areas where patronage potential is always relatively low.
- Infrequent, because services are spread over the largest possible area.
- Circuitous, often including one-way loops, because covering an area is more important than speed or directness of operations.

Demand-responsive services are usually coverage services, because compared to successful fixed route services in the same area, they tend to have lower productivity. By their nature, demand-responsive services must devote more effort to serving each passenger than fixed routes do, so they tend to reach their capacity limits at much lower levels of patronage. When a demand-response service replaces a successful patronage service at low-demand times, some special considerations apply as discussed in Section 5.

3. Uses of the patronage–coverage distinction

The question about how to divide resources between patronage and coverage services is, by design, a judgment about competing values. It obviously has no technical answer, but rather goes to the heart of each citizen's beliefs about why public transport should exist at all. Framing service design questions in these terms can quickly lead to remarkably clear conversations among constituents about what really matters to them.

This conversation can lead, in turn, to an informed decision by appropriate elected officials. The resulting policy typically takes this form:

> Devote ___% of resources to services justified by patronage, and the remaining ___% to maximizing coverage.

Service design professionals can design a network that implements this direction precisely, including documentation showing which services are intended for patronage and which are intended for coverage.

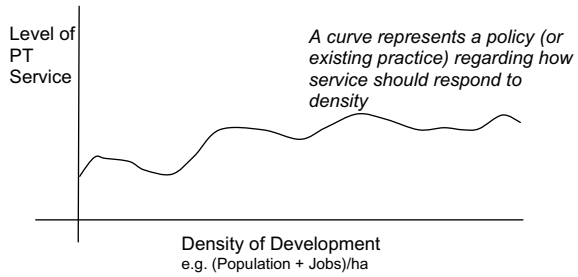
Such a policy provides a clear answer to inevitable objections that arise during consultation, by showing that the service provided is a fair implementation of a consistent policy. For example, if a resident of a low-density area complains about their low level of service, the reply is that:

- The density and/or development pattern where they live is not conducive to a high-patronage service, so any service they receive is going to be coverage service.
- The proposed service plan represents a fair distribution of the __% of service dedicated to coverage over the areas to be covered.
- If you want more service than is provided, your options are to (a) advocate for a shift of the overall policy in favor of coverage or (b) advocate for a local funding source in your council or market area to supplement your service above the policy level.

Elected officials often value this kind of policy because it spares them from accusations of favoring one area over another. It also empowers the elected official by separating service design into its two components: decisions about values – which elected officials should make – and the technical and creative aspects of designing service to implement those values – which are the province of public transport professionals. The result can be an increased level of trust between these two essential parties in the service design process.

4. Service Allocation Policies and "Equity

To understand the effect of the productivity and coverage goals on service design, consider a service allocation graph where the *x*-axis represents density, and the *y*-axis represents the service provided. Different service allocation policies can be represented by different curves. If a hypothetical community had equal amounts of each density, then the area under the curve would be proportional to the overall quantity of service provided:

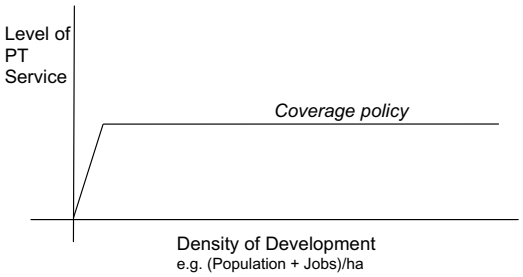


Density here should be understood as a shorthand term for "aspects of a built environment that directly affect public transport patronage." As Cervero (1998, pp. 72–74) and others note, density is indeed the overwhelmingly dominant indicator, but other aspects of design, such as the continuity of the pedestrian network, are also relevant. Density indicates the size of the market located within a fixed air distance (such as the common 400 m standard) of a transit stop, but the pedestrian network determines how much of that market is within a fixed walking distance (Ewing, 1996, p. 13). Densities (and hence air distances) are commonly used as shorthand because density information (by small travel zones) is usually available. A more subtle and accurate measure would consider walking distance rather than air distance, but this calculation requires levels of detail about the pedestrian network, and exact locations of destinations within travel zones, that are not available from most jurisdictions.[4]

By the same principle, density must be understood as combining both population and activity density. The measure (Population + Jobs)/ha is a reasonable approximation that is easy to calculate, though subtler and more complex measures are possible.

A coverage approach is responsive to need rather than density. Even coverage-oriented service falls away at the very lowest densities, but apart from this coverage service is about making a little service available everywhere, regardless of density. For example, a typical small-city coverage system consists of one-way loop routes all running at the same frequency, converging on a centre for the purposes of connections but otherwise offering the same level of service everywhere. A coverage policy, then, would be a horizontal line, falling away only where the level of activity is so close to zero that the community expresses no need for public transport even as a social service or lifeline:

[4] For fast-growing or fast-changing areas, of course, it is often a challenge for jurisdictions to keep population and employment data current. Public transport planners are often accused of "planning for the past" even when they are using the most current data available.



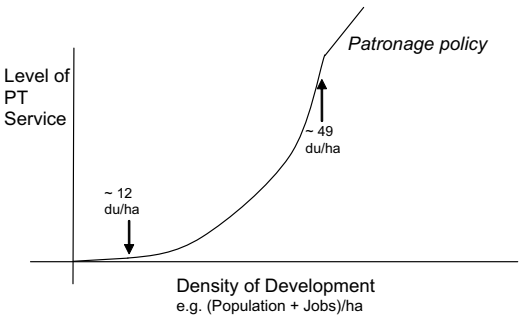
A deployment based on patronage is more complex, because the relationship between density and patronage has several different phases. Spillar and Rutherford (1998), for example, looked at cities in the Western US and found these relationships:

- In rural development up to about 12 dwelling units per hectare[5] (du/ha), demand is at a very low level, rising slowly in direct proportion to density. (Demand at this level is actually highly dependent on the presence of demographic categories with high public transport needs, such as senior citizens, the disabled, and youth below driving age.)
- From 12 du/ha to about 49 du/ha[6] demand rises faster than density, in an upward and roughly parabolic curve. This is the range in which most urban development in Australia and North America occurs, outside of the densest urban cores.
- Above 49 du/ha demand is again linear with density, but at a much higher rate than in rural areas. At these high urban densities, people live so close to so many of their daily needs that walk trips begin to take a large mode share at the expense of public transport.

Given these relationships, a service pattern devoted to maximizing patronage would follow these phases with service. The goal of the patronage policy is to deploy all service where it will carry the most passengers overall. Thus:

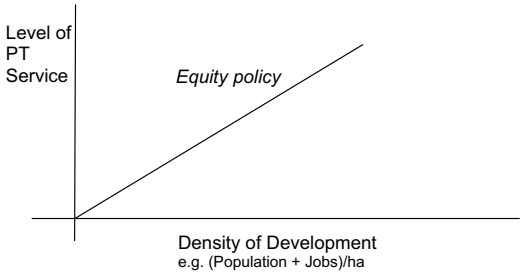
- At densities below 12 du/ha, patronage potential is low except for the occasional school trip. Thus, a strict patronage policy would provide no service apart from those school trips.
- At densities of 12–49 du/ha, patronage potential rises faster than density, so a patronage policy would follow this rising curve. (Spillar and Rutherford note that the rate of public transport use per household rises in an upward curve. The service allocation strategy, then, would be an even steeper curve, reflecting this rate of use times the number of households.)
- Above 49 du/ha, the curve becomes a steep straight line, as patronage continues to grow with population density, but not faster.

So a patronage policy would look something like this:



[5] 5 du/acre in Spillar and Rutherford.
[6] 20 du/acre in Spillar and Rutherford.

Graphing the policies in this way suggests a possible "compromise" between the two policies, namely one in which the service is directly proportional to the density throughout the range. This could be called an "equity policy", although it is not always what advocates of "equity" intend:



In regions or states where there is a wide range of development types, the equity policy has obvious appeal. Something like an equity policy is usually at work if an agency tolerates a much lower patronage/km in a low-density area than in a high-density area. In very dense cities, however, the equity policy provides far less service than the patronage policy does. A common outcome may be overcrowding in dense inner city portions of a network, while in outer-suburban areas public transport may run largely empty outside of school peak periods.

In practice, every consistent system of service allocation will be some compromise between a patronage policy and a coverage policy. The equity policy is one possible compromise, so long as policymakers are comfortable with having empty public transport vehicles in outer suburbs and overcrowded ones in the inner city. A simpler form of compromise, however, is simply to allocate resources between patronage and coverage goals, and allow the resources on each side of the divide to be used unequivocally for that end.

5. Consultation Process

Once an existing system is understood in terms of how it divides resources between patronage and coverage – and other purposes if relevant – elected officials are presented with a clear question that only they can answer: How should this balance between competing goods be shifted, if at all? This section briefly describes how this question can be applied both to short range service design decisions and long-term planning of policy networks. The discussions are obviously different in each case, but the underlying question is the same.

5.1. Short range service changes

When doing a short range service design where the strain between productivity and coverage goals is an issue, the best approach is often to draft two or more service designs that illustrate different points on a spectrum. For example, in a strategic plan project for the Whatcom Transportation Authority in Bellingham, Washington, USA (WTA, 2004) two service designs were prepared, one emphasising patronage and the other emphasising coverage. Both designs were taken to the public in consultation. Only then was a final recommendation developed striking a balance between the two. This approach had several benefits.

First, a common complaint about public consultations – that the plan has already been decided on and consultation is just a show – was refuted by the presentation of two options. All public transport management staff participating in the consultation were instructed to show no preference between the options in their comments to the public.

Second, participants readily understood the philosophical choice underlying the difference between the two options. For participants who were not comfortable discussing patronage and coverage as abstractions, the contrast between the proposed networks made the tradeoff clear.

Finally, all participants could express an opinion that could be translated into a quantifiable 'vote'. For example, if one scenario was, say 60% patronage and 40% coverage,[7] while the other was the opposite, then participants could easily vote for one of these, or to say that they would be comfortable halfway between them (a 50–50 split), or that they feel the split should be like one scenario but even more extreme (a 70–30 split or more). These votes could be readily tallied to quantify the position of any consultation group, thus providing clear guidance to the elected official(s) making the final decision.

In short, the analysis and discussion of a service plan in terms of a patronage–coverage tradeoff yielded a clear discussion in which all participants could have a valid opinion regardless of their level of technical expertise or ability to think abstractly. Nobody needed to master technical details of a proposal in order to discuss it. Instead, participants understood that they were being asked a real and consequential question, and that their response would have a measurable effect on the outcome. This clear conversation, and the clear and implementable policy resulting from it, is the ultimate purpose of the analysis.

5.2. Long-range network planning

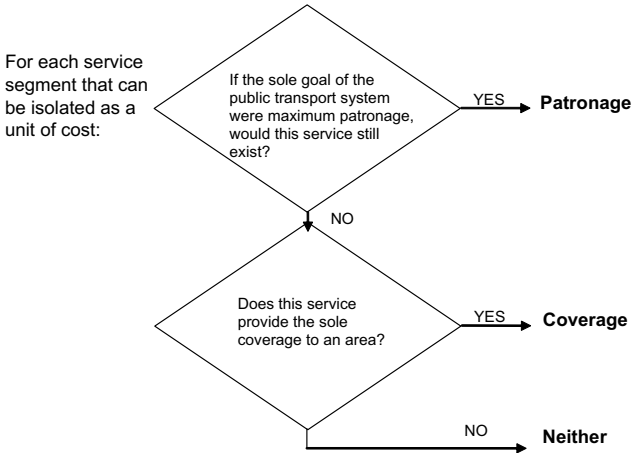
In long-range network planning, the patronage/coverage distinction is easier to talk about theoretically, and can be linked to other policy issues that are in play. For example, in the development of the Regional Transportation Plan for Washoe County, Nevada (the Reno area) a key concern has been the high non-auto mode share target – planned to rise from under 3% currently to 6% in 2030 (Regional Transportation Authority of Washoe County Nevada, 2005, pp. 2–7). The network at the time was split roughly 60% patronage, 40% coverage. When policymakers understood that patronage services were contributing substantially toward the mode share goal, but that coverage services were not, they authorised a gradual shift from the current 60–40 split to a target of 80–20 in favor of patronage. This target means that most new resources are assigned to patronage services, and the policy is cited as a reason why the agency cannot always meet the service expectations of new low-density, car-oriented outer suburbs. Service planning proposals are all assessed to see how they contribute toward reaching this goal.

It is important to stress that the "success" here is not the specific decision they reached, one with which the reader may disagree. Instead, it was that they reached a decision expressed in terms that their staff knew how to implement and measure. The elected officials also understood that they could revisit their decision, and that doing so would affect the patronage outcomes. For example, if they decided to shift resources from patronage service to coverage service, they should expect total system patronage to fall.

6. Analysing existing services by purpose

A consultation process on the patronage–coverage tradeoff typically begins with an analysis of existing public transport services in these terms. This analysis categorizes services according to the purposes they seem to be serving. The analysis typically looks both at the current performance of each route or service, as well as features of its design and the degree to which its existence supports other services. This section develops a basic methodology for this analysis. A reader more interested in the main concepts of the paper may wish to skip over this section.

The decision process for this analysis is as follows:



The sequence of steps has an impact on the outcome. If a service is justified by both patronage and coverage, it is assigned to patronage. This could have been thought of the other way: We could have first identified a system wide network of coverage, and then assigned to patronage only the frequency increments above that level. Both methodologies are valid, but get different answers, so the point is to be consistent in which methodology is used. The reason to assign to patronage first is a practical one: Many routes fall entirely into, or out of, the patronage category, so analysing the service this way means that fewer routes need to be divided between categories, and that routes can be divided by segment rather than by increments of frequency. The result is a simpler calculation and one that is easier to represent on maps.

The analysis is done primarily in terms of geographical segments, rather than temporal segments such as span of service or increments of frequency. Temporal segments are much more interdependent than geographical segments are, and therefore harder to divide by purpose. Every customer's round trip requires service at two times of day, or more, and every trip is sensitive to wait time and hence frequency. Therefore, cutting any temporal piece of service – e.g. by cutting off evening service earlier, starting morning service later, or reducing frequencies between the peaks – will have effects on patronage on other times of day. For this reason, it is usually misleading to say that a certain part of a service span, or a certain increment of frequency, is attributable to patronage while the rest is not. By contrast, a geographical increment is much easier to analyse in isolation, because it represents a discrete market.[8]

It would be easy to say, then, that the purposes of patronage or coverage are features of an entire route. However, it is quite common for an inner segment of a route to be justified by patronage, while outer tails or branches are clearly not. For this reason, some segmentation of routes may be essential for the analysis.

6.1. Assigning segments to patronage

The first question in the flowchart above may need some further explanation, because it is conditional and therefore requires considerable judgment. How do we know that a certain segment

[7] Given obvious roughness in the way services are allocated to categories, participants are encouraged to think about the patronage–coverage split in 10% increments.

[8] This issue is discussed further in subsection 6.3 below.

would be part of a maximum-patronage system, if that system were created and optimized?

The assignment is made based on the convergence of two factors:

- *Existing patronage*. Segments assigned to patronage generally have an existing productivity (patronage per unit of service) that exceeds the system average. This assessment must be based on the average load through the segment, not the boardings in the segment, since a non-stop segment where the bus is full is clearly patronage-justified.
- *Physical evidence of patronage potential.* For segments where the existing load is not decisive either way, we consider whether the segment's physical features lend themselves to further patronage growth, based on industry experience. Thus, positive indications for patronage would be if a route is:
  - Straight and direct (as opposed to circuitous and looping).
  - Operating on arterial streets that permit reasonable speed.
  - Serving continuous high-density development (i.e. a high population/employment level within 400 m).
  - Serving an area whose street network provides good pedestrian access from 400 m to either side.
  - Serving major patronage sources at the end of the corridor or segment, indicating demand to the end of the line.
  - A necessary part of a coherent connective network linking other high-patronage segments.

The "physical evidence" criteria tend to correlate with high patronage throughout the developed world. We include them because existing patronage on a particular local segment may be affected by other factors that are extraneous to this analysis. Where that is the case, it is important to consider whether the segment has the potential to be a high-patronage segment, and these factors are the definition of that potential.

6.2. Assigning segments to coverage, or to some other purpose

If a segment is clearly not justified by patronage, then we ask whether it has a unique function in providing the sole service to some neighbourhood or community. A good way to quantify this is: "If this service did not exist, would a significant number of residents and/or jobs no longer be within 400 m of service?"

The answer is usually yes, but the test is important because if the answer is no, the segment may have some other justification, usually but not always a weaker one. Examples may include:

- *Overlap*. A segment may exist overlapping other segments. This often occurs where service from several unique coverage areas converges on one path into a CBD or interchange. If these segments combine to form a high-frequency spine that supports high patronage, then the routes should be segmented to isolate this section. Small segments of this overlap may be acceptable in coverage services, since there is no more efficient route structure. Where a long overlap exists that does not combine to form a patronage service, it is sometimes appropriate to identify the service as "Overlap", and assign this category its own percentage. For example, when this analysis was done at Salem-Keizer Transit in Salem, Oregon, the quantification of an Overlap category helped the policy board understand the costs of offering a service pattern that required nobody to change to reach the CBD, as opposed to structures that would require more interchange but reduce duplication, thus allowing for better frequencies from the existing operating budget.
- *Political discretion*. Sometimes a service exists to satisfy a political demand, though it does not rise to the standards of either patronage or coverage. This is not necessarily a problem. Some applications of this scheme create a separate but usually small "Discretionary" category for these cases.

Where these categories exist, it is helpful to isolate them because they suggest other solutions.

6.3. Patronage and coverage services in integrated networks

Public transport planning is rightly concerned with creating integrated networks, where different kinds of service work together to meet a range of mobility needs. Often, a coverage service is described as 'complementary' to a patronage service. For example, demand-responsive services are often designed to complement a fixed route network. Commonly, they may serve areas that are physically unsuited to fixed route service, but bring people from those areas to a fixed route. They have broad application to evening and especially late-night service needs, where they can replace fixed route services that are unproductive at these hours, and provide a "guaranteed ride home." Considerable innovation is occurring in this area.

However, one service may complement another but still not be grounded in the same underlying purpose. Where a low-patronage service is integrated with a high-patronage one, the key question is whether the former is making the decisive difference to the performance of the latter.

The key question for our analysis is: "If our only purpose were maximum patronage per unit of service, would this service still exist?" For example, if it can be shown that certain demand responsive services are essential to the high performance of a fixed route, then and only then a case could be made for treating those demand-responsive services as patronage services. In many cases, however, a successful fixed route continues to perform well with or without these complements, because of the intrinsic strength of the markets it serves directly.

To understand the purposes of integrated or "complementary" services, it is important to distinguish between several things that these terms can mean. When Service A and Service B are described as complementary or integrated, it usually means one of the following:

- *Service B connects with Service A, but serves a different area*. In this case, Service A and Service B can still have different purposes.
- *Service B serves the same area as Service A, but runs at different times of day and/or days of week*. Many successful high-patronage services run late into the evening. These late evening trips are often low patronage, but their existence helps support patronage earlier in the day, as passengers are more comfortable using a service that gives them the option of returning home later than planned. For this reason, when considering an all-day fixed route, we do not assign different purposes to different trips based on their patronage, because part of what makes the service attractive is its entire span of service and the resulting simplicity. It follows that if Service A runs throughout the daytime but Service B replaces it in the evening to serve the same area, the two could be thought of as having the same purpose, based on their combined performance as a unit. This is an area where further research is needed, to determine the extent to which these evening services are essential to the success of the daytime route.
- *Service B serves the same area as service A, but provides specialised service for passengers who cannot use Service B for reasons of disability*. "Paratransit" services for the disabled do not fit cleanly into the patronage–coverage distinction. Where the cost of these services is assigned to fixed route operators by law, e.g. under the United States Americans with Disabilities Act, these services

become part of the cost of running a productive fixed route system, so there is no point in assigning them a separate purpose. Specialised service provided in excess of the legal requirement, or where there is no legal requirement, are best treated as a separate purpose outside of the proposed scheme, though they are similar to coverage services in that they do not aim for high patronage but rather to meet identified needs.

7. Conclusion and suggestions for further research

Public transport must serve the competing demands of patronage and coverage, because the two values push service design in opposite directions. If this distinction is made explicit, and discussed as such, the result can be a clearer conversation and, in the end, a more confident decision by the elected policymaker(s). These concepts have been used successfully to facilitate both short-term service design decisions and long-range network planning, and can be used as a way to judge short-term decisions against the long-range vision.

The core analytical question proposed is, for each public transport route or service: "Would this service still exist if maximizing patronage were our only purpose?" The paper provides a detailed methodology for answering this question, but there is certainly room for further research and thought. These include:

- How can we more precisely quantify the effects of integration between different services? What are the cases in which two or more "complementary" services should be judged only as a unit?
- Can the concept be extended fruitfully to a discussion of services for the disabled?
- How often should datasets describing existing population and employment by traffic zone be updated, and are there ways to make this updating process continuous so that current data is always available?
- Many practical refinements to the patronage/coverage tool would emerge from a large-scale application of the analysis, e.g. by using it for all of the local planning within a state, province, or nation. This paper is currently founded largely on the author's successful experience in using the tool in a range of planning projects, but these results do not lend themselves to easy summation because each agency used the tool in a different way for a different local need. A more systematic application would certainly help to refine the methodology and perhaps broaden the range of decisions in which it is useful.

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