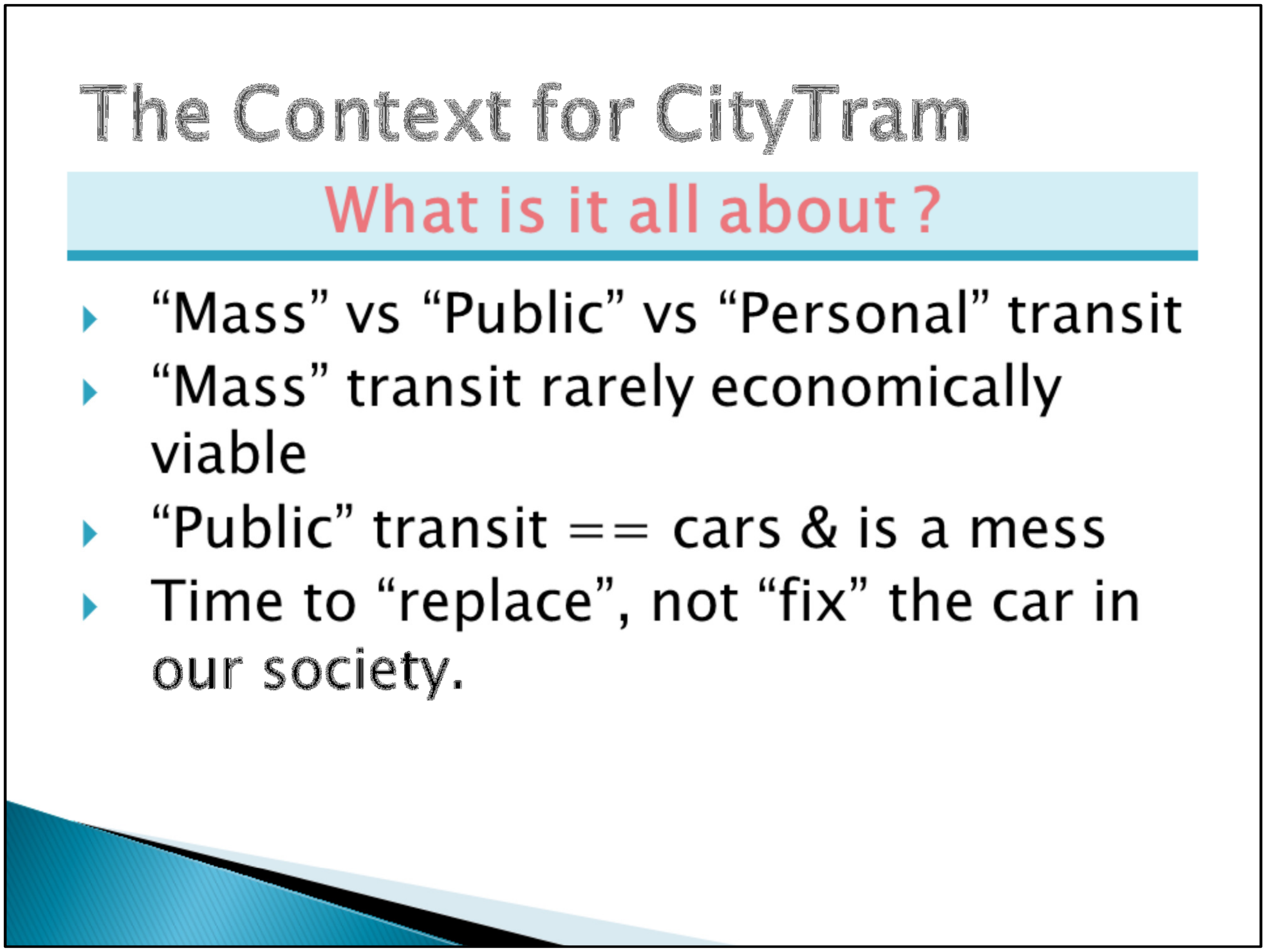
Commuters' Decision Model

City Tram

A New Vision for Urban Commuting

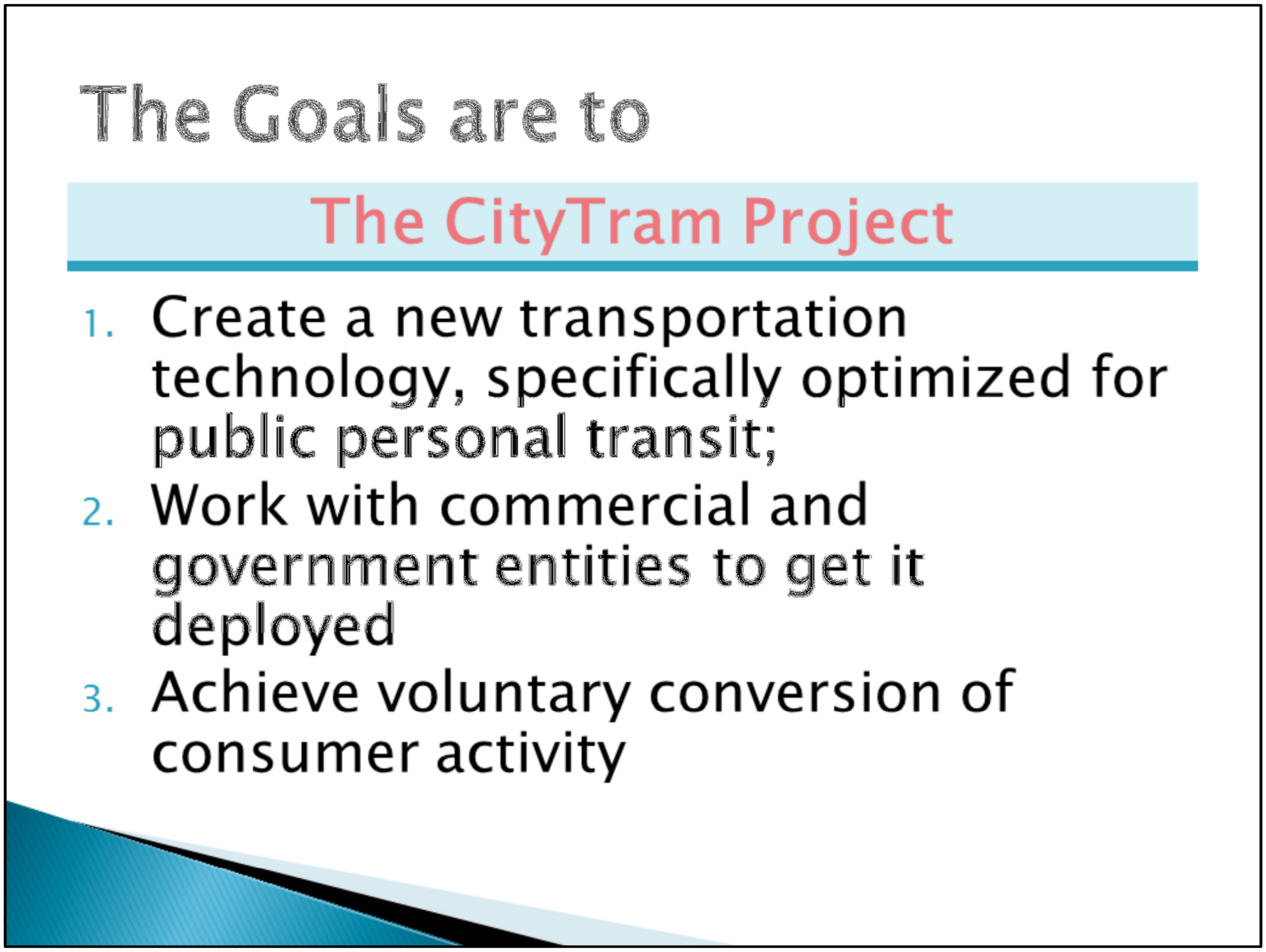


As the title of this presentation says, CityTram is a new vision for urban commuting. So let me very quickly build a frame of reference around the effort.

There is a distinction between “mass transit” and “personal transit”. The purpose of mass transit is to move a large **concentrated** volume of people. This concentration is the distinction. They are concentrated by the fact that they have a common destination or origin, and travel at a common time. The purpose of personal transit is just to move a possibly large volume of people; without the need for concentration; in fact without the expectation of concentration. The daily urban commute is my prototypical example of “personal transit”. In that commute we see people living in different houses, and working at different job sites, and twice daily commuting between the two locations. These homes and job sites are spread out across the city, so while the commuting volume may be large, there is no concentration.

I think this distinction is important. “Public transit” is just that – transit systems provided by and for the public use. American transit districts have for the most part failed economically – and therefore have required significant subsidization. In my opinion a big reason they have failed is because they have attempted to deploy mass transit technologies as solutions for personal transit problems. A bus designed to carry 40 people simply is not an economical enough way to move a group of 3 people. You can't really blame the transit districts for trying to use the only hammer available to them. To date, the only suitable technology for personal transit is the automobile. Our society has chosen deployment of this technology as a fleet of personally owned and operated automobiles. This has resulted in an expensive, unsafe, slow, and fuel in-efficient mess.

All of this is covered in some depth in a white paper I authored. But I've also gone beyond that to look for solutions. After examining the problems with cars, I have concluded that a revolution, rather than evolution, is needed. So the CityTram project is an attempt to create that revolution.



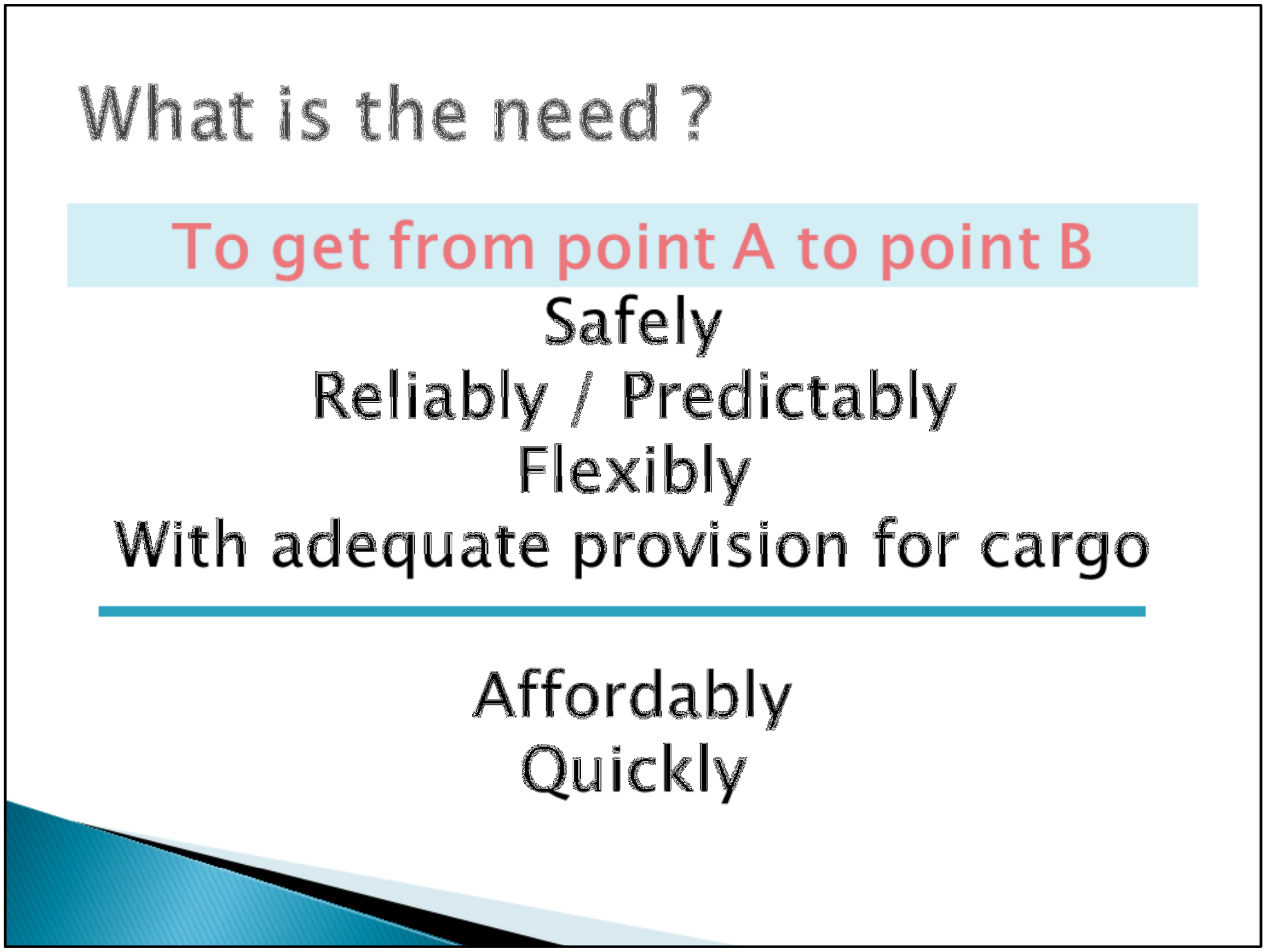
The strategy to foment this revolution is a three step process:

Step 1 is to design a new transportation technology whose design is specifically optimized for the personal transit need.
Step 2 is to work with commercial entities and government entities in order to get this technology adopted and deployed as a service to the public.
Step 3 is where success gets measured. I want CityTram not only to be successfully deployed, but to actually be used by people because it works for them.

It does our society no good to build more “bridges to nowhere”, or “trains to nowhere” to steal a UC Berkeley researcher’s title for this context. A largely political approach might be considered for steps 1 and 2. While there is serious question whether a political decision in favor of this solution is achievable, even if achieved it cannot guarantee all of these objectives. Specifically, politics cannot guarantee we actually improve people’s lives. So I believe we must seek a market based win. We have to offer a competitively superior alternative. When consumers voluntarily decide to use CityTram, then we will know that it works for them, and that the benefits it offers to all of mankind will be sustained.

So clearly understanding what the market demands is absolutely critical ! This understanding is a requirement to achieve the optimization called for in step 1. If done correctly it will make others much easier to persuade in step 2. And unless done correctly there is almost no chance of achieving the significant voluntary conversion which is the goal of step 3. To mangle metaphors, we simply must know what a better mousetrap looks like, otherwise the horses will not drink when we bring the water to them.

This presentation outlines our analysis of the market demands. It identifies what consumers in the commuting marketplace are looking for, and defines a "decision model" each consumer uses to chose between available options. We believe this decision model adequately explains the relative levels of success achieved by existing transit alternatives. This model is the basis by which the set of design requirements for the new technology were identified.



So what is the need we are attempting to fulfill ?
It is simply to enable members of the community to get from point A to point B within the city and surrounding area.
The consumers will judge our success in fulfilling the need by a set of criteria. These criteria will determine if our solution is successful in the marketplace.

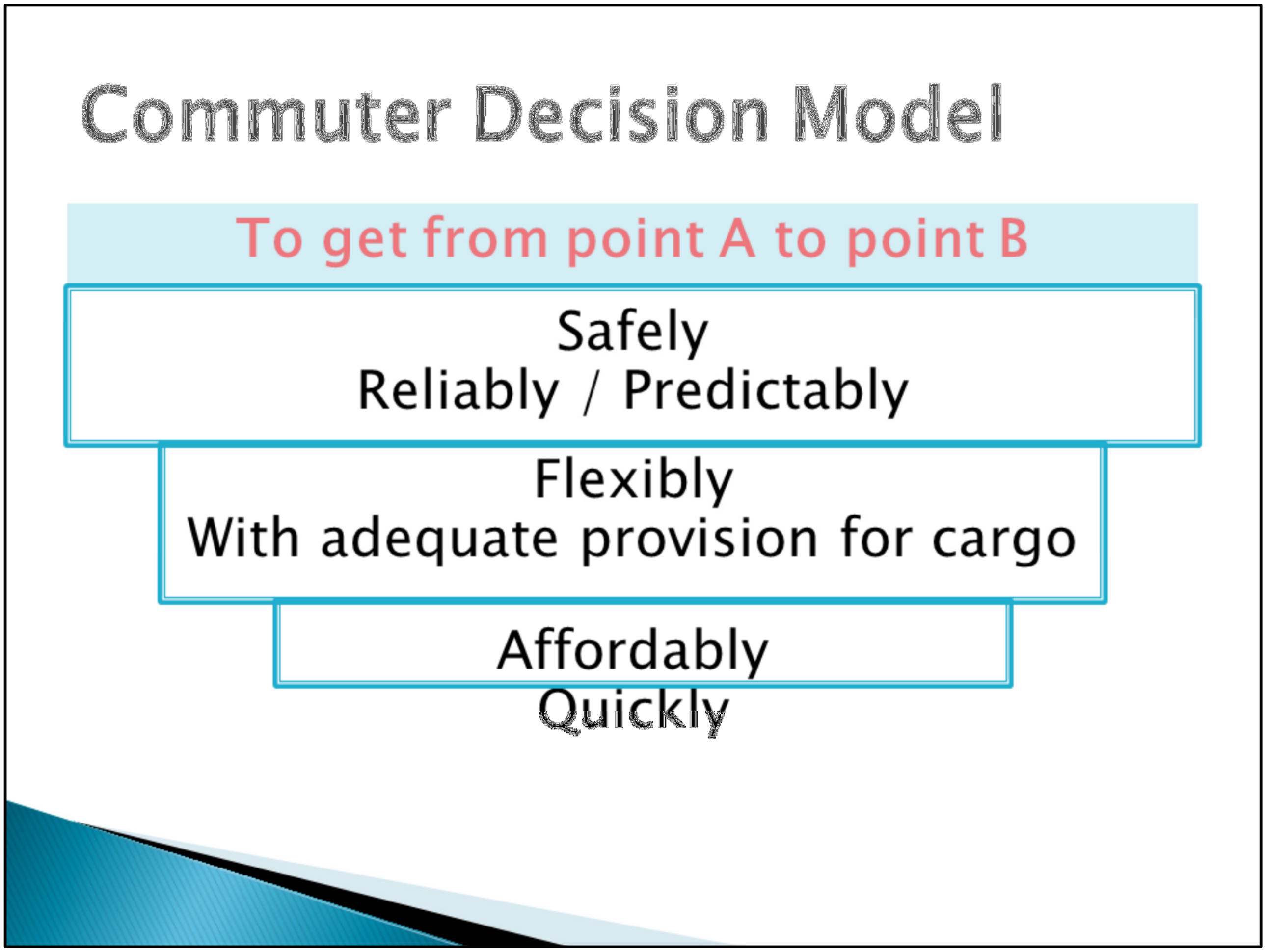
There are certain "above the line", or "anti up" criteria. These are checkbox requirements which must be met to even be considered as a commuting choice.
First, we MUST be able to move the people safely. No system can be perfectly safe. But if the commuting public does not perceive the system as basically safe, then they simply will not use it. In this context, safety includes not only the risk of injury during transit, but also the aspect of personal security while in public.

Second, the system needs to be reliable, and by that I mean predictable. Commuters must plan their day. If I have to be at work at 8 AM, then what time must I leave my house ? A small transit time is good. But if the transit time varies wildly that becomes a problem. So to get into the competition, predictable is more important than fast.

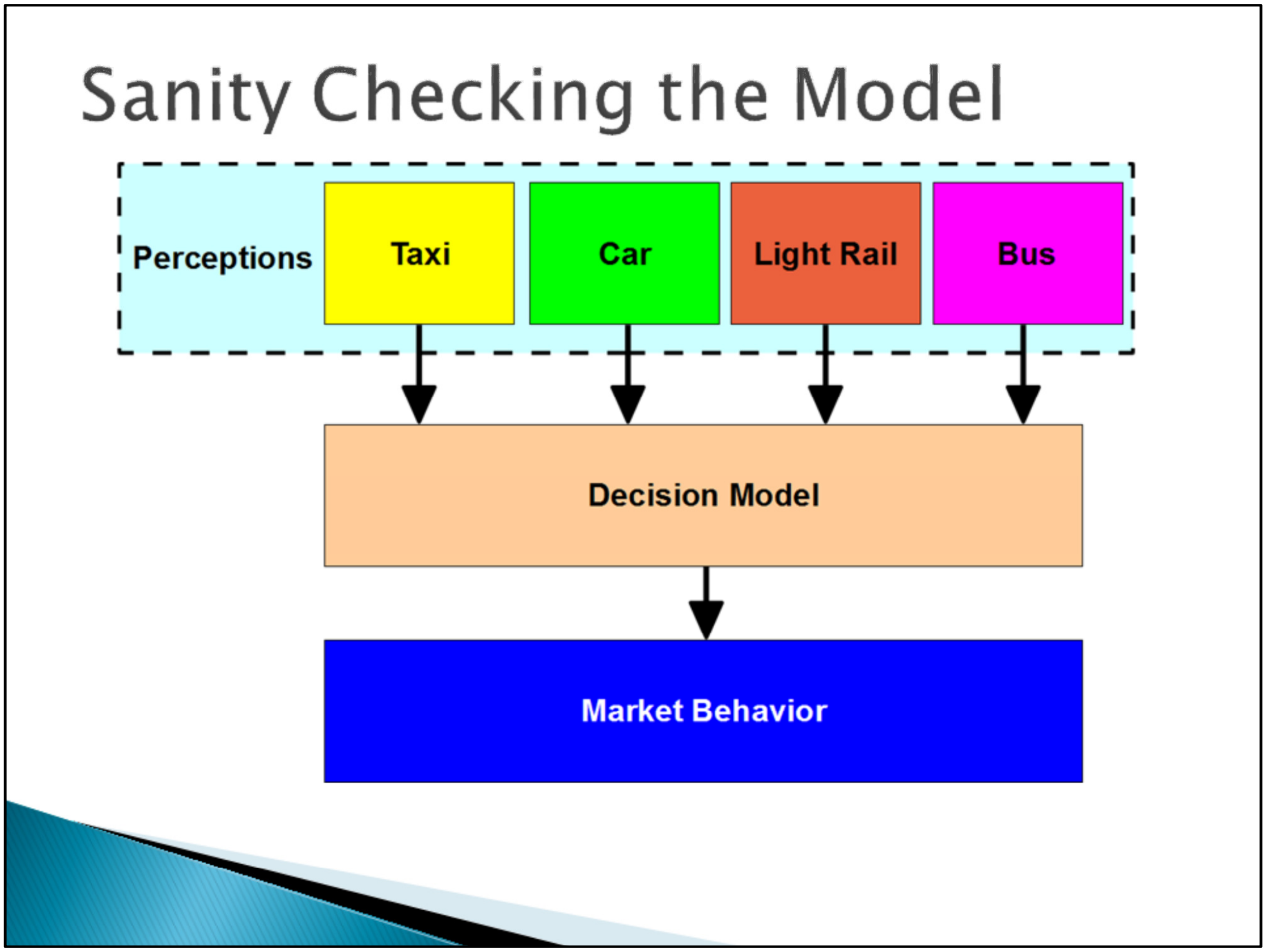
The third “above the line” criteria relates to how flexible the transit is. Let me describe flexibility with an example. Dad heads home from work to have dinner with his family. Half way home he gets a call from his wife. She got delayed at the doctor’s office and can he pick up the daughter from band practice ? He re-routes his trip. Flexibility matters to commuters. Some need it more often than others, but pretty much all of them value it some of the time.

The final “above the line” criteria splits the potential market into 2 or 3 sub-markets. Commuters may need to take something with them. Most often this is just what they can carry while walking. However, some commuters need to carry a bit more, and may need to link several trips together with some way to store the carried items between trips. A simple example is a shopping excursion. A less common but more difficult example is a traveling salesman who carries some sample inventory. If the transit solution does not adequately provide for this cargo handling need, then it is not really a viable option for the commuter. So various portions of the commuting market are included or excluded from service by transit based upon what cargo the transit can carry – a brief case; a bag of groceries; a suitcase; a bicycle, a new couch.

Once these basic criteria are met, the consumer will choose based upon the competitive criteria - how affordable is the system; and how fast is the system. These “below the line” criteria should be self explanatory.



In America consumers are accustomed to free markets that "price to value". So if one commuting approach is "better" – that is quicker in this case - it is natural that it would also be more expensive to use. Therefore, our decision model of the commuting consumer is one who filters options he will use based upon safety, and reliability/predictability; then filters again for use for a specific day or trip based upon flexibility and cargo provision needs; and then chooses by picking the fastest solution that he can afford.



We will know our decision model is good when we can use it to explain the current market behavior. This requires us to look at the competitive landscape for commuting. What are the alternative commute solutions offered, what do the consumers think of them, and what quantitative data do we have about how much market share each alternative has and the demographics of that market share ?

A significant number of studies have been performed regarding who uses mass transit and why, how it performs for them, and what they think of it. I believe this decision model explains those study findings relatively well. Demographically use of public mass transit is dominated by the less affluent, who simply cannot afford to operate a private automobile. These riders typically live in more remote and less dense neighborhoods, where mass transit operates in the red. Mass transit operates in the black, and succeeds outside of that dominant demographic, in the densest urban areas. In these areas automotive congestion is so bad that mass transit has competitive transit speeds, which attracts other riders.

So with this model in mind, lets look at the competitive landscape for commuting.

In America the car is king. It is clearly the preferred choice for most urban commuters. There is a lot of romanticism attributed to that choice, especially among the baby boomer generation – having to do with personal freedom, individualism, the adventure of the open road. But I think all of that is mostly bunk, and denies the fundamental competitive reality that the car is a very effective and very convenient means of transportation. Today it is probably the fastest way to get from point A to point B in and around a city, and it is affordable enough for the vast middle class. It is also an extremely flexible and versatile transit technology. Because it was the preferred choice by so many it has now become very much integrated into our society. Look at all the ways we subsidize the use of personal automobiles – with investments in roads, parking lots, garages, traffic lights, fueling stations, cops and courts. Use of personal cars would not be nearly so convenient without these subsidies.

But it is not un-thinkable to dethrone this king! The car is not a perfect commuting choice. As detailed in the “Trouble with Cars” white paper, it is a relatively expensive solution. Because it relies so much on amateur operators and traffic lights, it is in-efficient enough to be at least matchable, or maybe beatable, on commute speed. And as we continue to scale the system with more and more cars, its predictability is facing severe challenges. So matching its predictability is possible also.

According to our consumer model, if we offer a cheaper solution that is equally fast and predictable, a significant number of commuters should choose to use it. The more flexible it is, the more commuters should convert.

Current transit (perceptions)

To get from point A to point B		
Safely	–	Fear of violence
Predictably	–	Distrust in adherence to schedule
Flexibly	---	Goes where I need ? When ?
Quickly	---	A lot slower
Affordably	+	Cheaper than the car

Since we intend to offer a new competitive alternative, we should try to learn from the successes and failures of the old competitive alternatives. So how do commuters view the existing mass transit offerings on the criteria we identified ?

As I said, a large number of transit districts have commissioned surveys of their ridership and published the results. I've read quite a few of them. I find some variation from district to district, but also some consistent themes. I have also conducted a more personal and far less formal survey by talking to a large number of acquaintances, most of whom are not transit users. From this an "image in the market place" emerges.

Most people believe that mass transit is affordably priced – that is that it is cheaper than driving a car. Surveys consistently show that it is the less affluent among us who use mass transit most often, so this is consistent with our consumer model.

There is some minor negative perception of the safety of mass transit use. This has less to do with the safety of transit itself than it does to do with their personal safety. The public nature of mass transit puts the commuter in contact with a group of others over which the commuter has no control. It may also have him waiting alone in remote locations while being spot lit out of the surrounding darkness – a situation that promotes the feeling of being exposed.

There is also some minor negative perception of the predictability of mass transit use. This is primarily a concern that actual transit performance will not match published schedules. In many districts statistical reality belies this – you are more likely to be delayed in a traffic jam than you are due to a broken down train. But there is a perception of having more control of these situations when driving than while riding.

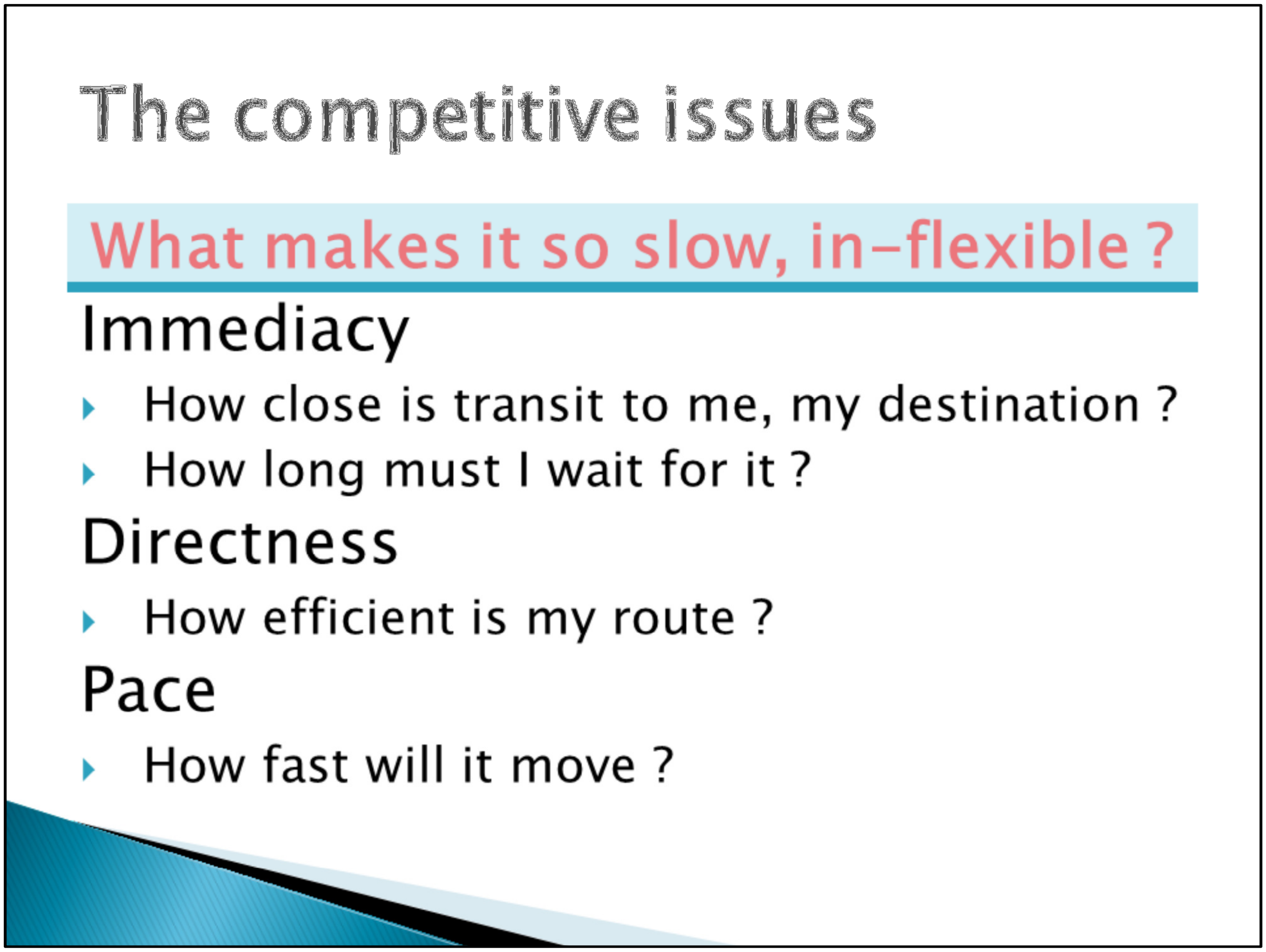
The biggest negative perceptions of mass transit have to do with speed and flexibility.

Flexibility concerns are mainly about coverage. Does it go where I need to go ? How close can I get ? Does it operate at the hours I need to commute ? At what frequency ? What are the train/bus routes I need to use to get from here to there ? And even if the answers to all these questions are affirmative, it is still more complicated than just hoping in the car and going.

The biggest negative perception regards commute times. Mass transit is generally perceived as much slower than the car. And most studies of most transit districts bare out this perception as accurate – certainly slower, and in many cases much slower.

Again, these perceptions fit our consumer model to explain survey data. Mass transit is cheaper, but slower, than the car. So mostly those who cannot afford to use the car will settle for the slower alternative.

But there are exceptions to this “less affluent riders” trend. There are transit districts where the ridership demographics are not dominated by the less affluent. And in those districts the perception of mass transit speed is better. These tend to be dense urban centers served by what is called “grade separated” mass transit. “Grade separated “ means the transit has its own separate right-of-way, rather than sharing the right-of-way with cars. Subway systems and elevated trains are the common grade separated transit technologies. Mass transit typically stops and starts far more often than automotive traffic. So there is no way that grade shared transit can be faster than automobiles. But if grade separated transit only stops and starts at stations, and not at traffic lights in between, then it is possible for transit to actually be faster than cars, and far more predictable than rush hour traffic.

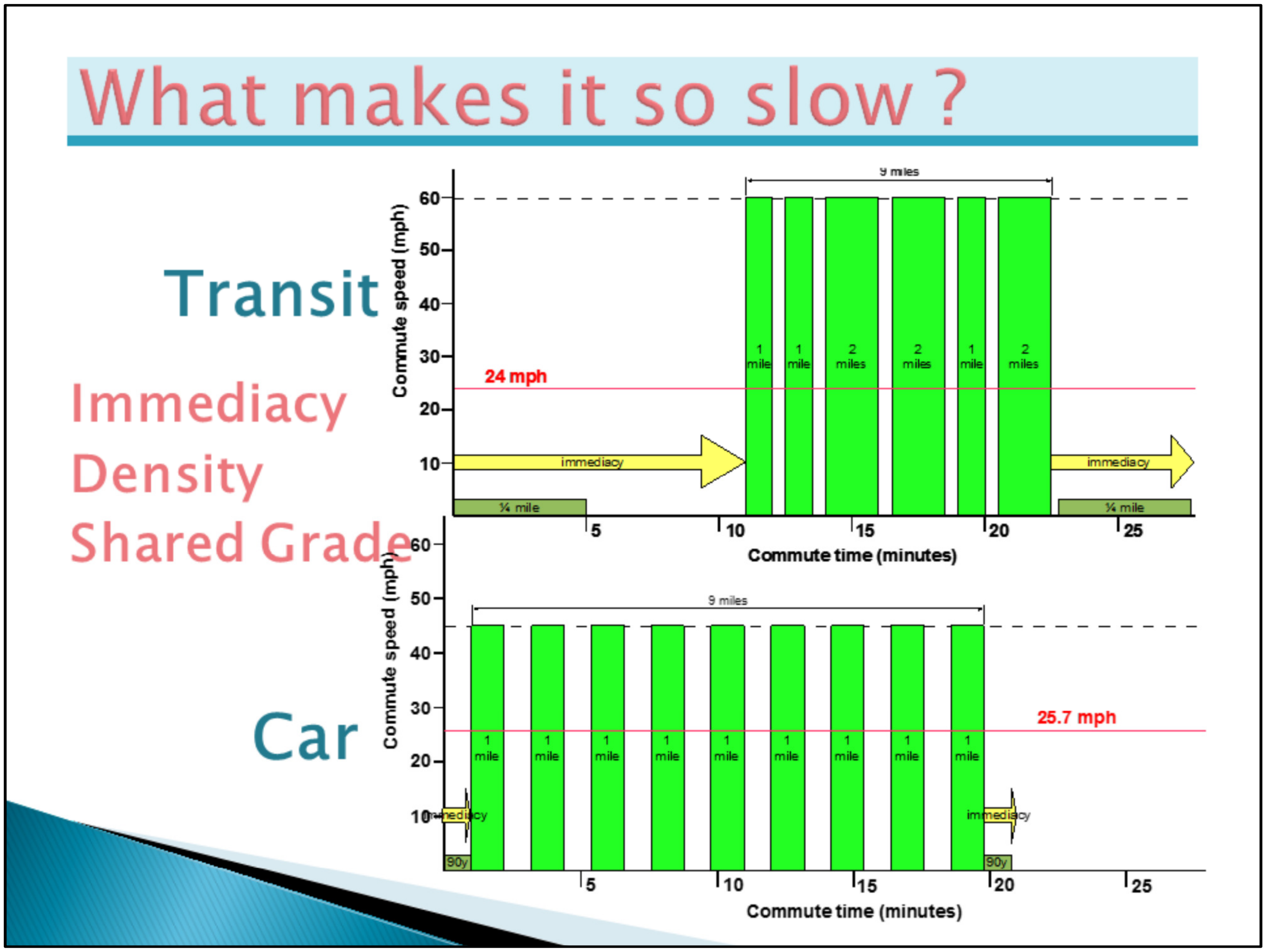


Since transit time is so critical in the consumers transit decision, and since in general mass transit is perceived as slower, it is worthwhile to examine why. What makes current transit so slow, and is this something we can fix ? Is it possible for transit to match or exceed automotive commuting speeds ? Simple first year physics is all we need to do this, looking at time and distance relations. Commute time starts the moment the traveler decides to go, and ends the moment he arrives at his destination. We just need to look at how every minute between those two time points are spent.

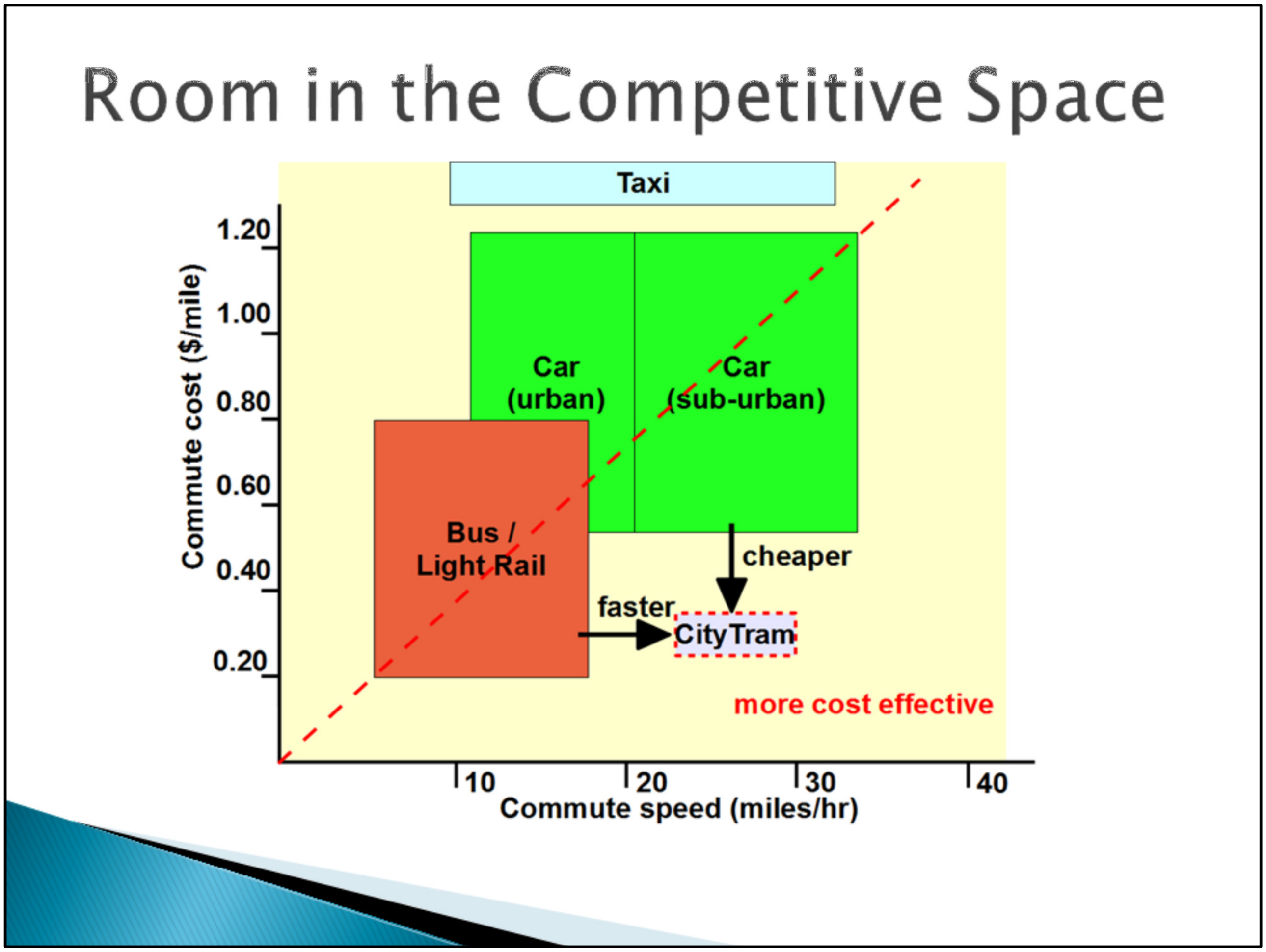
Essentially the commute time can be broken into 3 pieces. The first piece is spent getting to the transit vehicle. The second piece is riding the transit vehicle. The last piece is getting from the transit vehicle to the destination. The first and last pieces define what I call “immediacy” – how immediately is transit available ?

The first interval is spent walking to a transit station and waiting for the transit vehicle to arrive. The last interval is spent walking. Since walking speed is quite low and waiting speed is literally zero, these intervals tend to significantly degrade average commute speed.

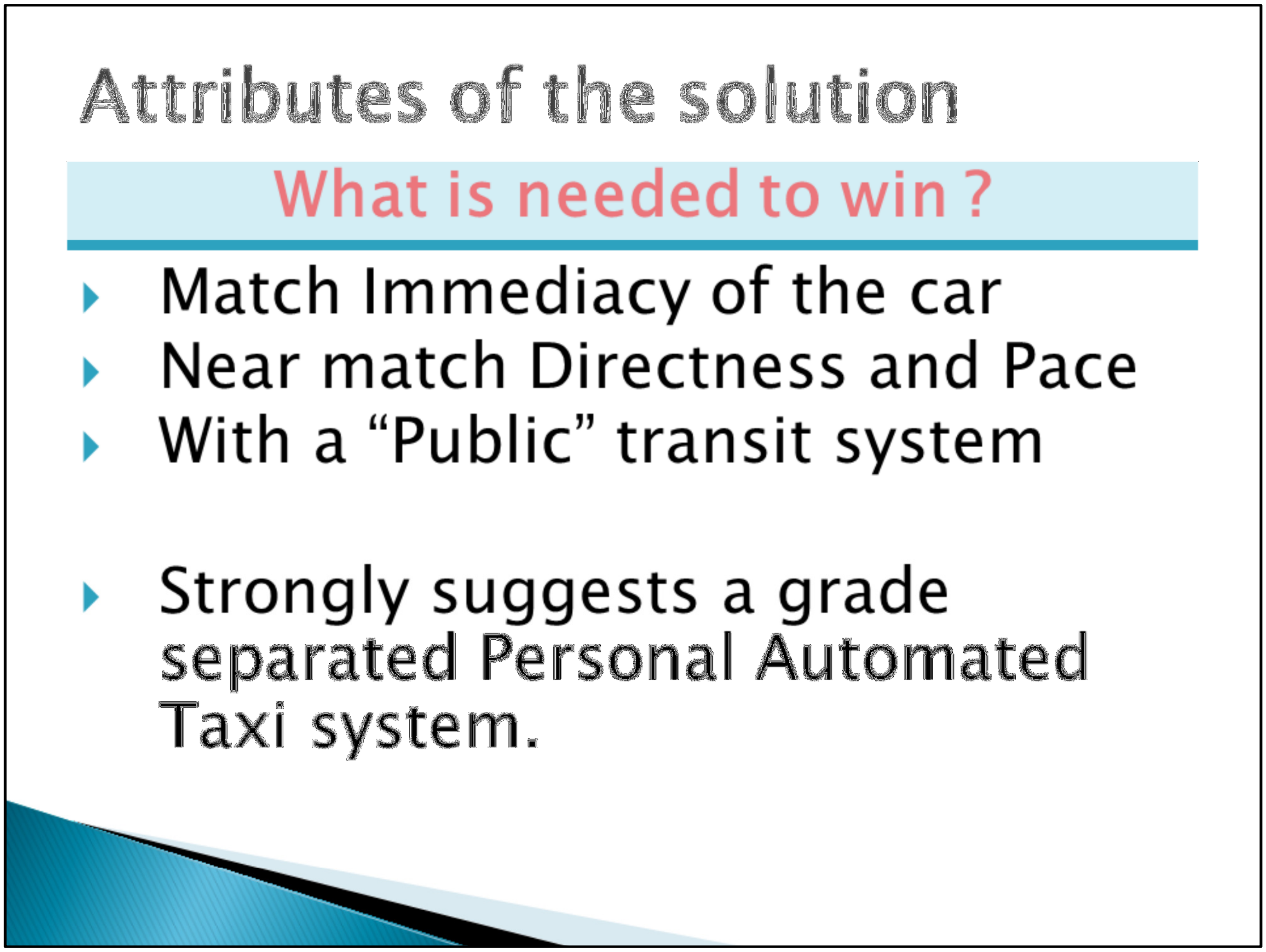
The middle interval is spent on the moving transit vehicle. The length of this interval is determined by how direct a path is travelled between origin and destination stations; and by how fast the vehicle moves along that path.



So we see clearly why mass transit is slower than the car. First the car has greater immediacy. We have built parking lots closer to the commuter than transit stations, so less time is spent walking to the car than to the transit station. Second, the car is a personal vehicle rather than a shared vehicle. So it is waiting for the commuter, rather than the opposite. The commuter simply gets in, starts it up, and drives away. And often transit cannot make up the lost immediacy time by travelling faster. If it shares the same grade as cars, then it has the same pace. Plus it must stop and start more often than the cars – at each station as well as at each traffic light. A very dense road network makes a direct route available to cars. Unless a transit route is assigned to each road, the transit route cannot be as direct. As a result, the transit rider must wait longer to ride, and then ride a longer distance at a slower rate. It will certainly take longer.



It would seem rather unlikely, given the realities of the current perceptions, that we could change the market behavior among the current alternative solutions. But there does appear to be room in the competitive space for a more cost effective solution. Mass transit users might be enticed to use a faster solution if it was no more expensive. Those driving cars might be enticed to use a cheaper solution if it were nearly as fast.



This analysis seems to point clearly to some design requirements for our step 1 goal. CityTram must match personal vehicle use when it comes to immediacy. And it must nearly match the car with respect to directness and pace. If it does this then it will achieve a very close match to the commute time for automobiles.

Matching the pace of cars requires that starting and stopping at intermediate stations must be eliminated. This suggests a taxi system, where a small vehicle is used for one trip at a time, with a route directly connecting the origin and destination. This obviously approaches the directness of cars as well. The directness will only be limited by the density of the system. If the transit is grade separated, then the pace can actually exceed that of cars.

Matching the immediacy of the car requires station density matching that of the density of parking lots, and it requires a local queue of vehicles, like a taxi stand.

The economics of personal sized vehicles, and the desire to move away from amateur drivers, argues for an automated system.

Their impact

	Immediacy	Directness	Pace
Safely	+		
Predictably	+		
Flexibly	++		
Quickly	+++	++	++
Affordably			

If such a solution were possible, it is no surprise that it would improve perceptions regarding the speed of public transit. But it might be a surprise that perceptions on other criteria would also be improved.

If transit is more immediate, then the commuter is exposed for a shorter period of time. If the vehicle is small and exclusively used, then there is no exposure during the actual commute. Therefore the sense of personal safety is improved.

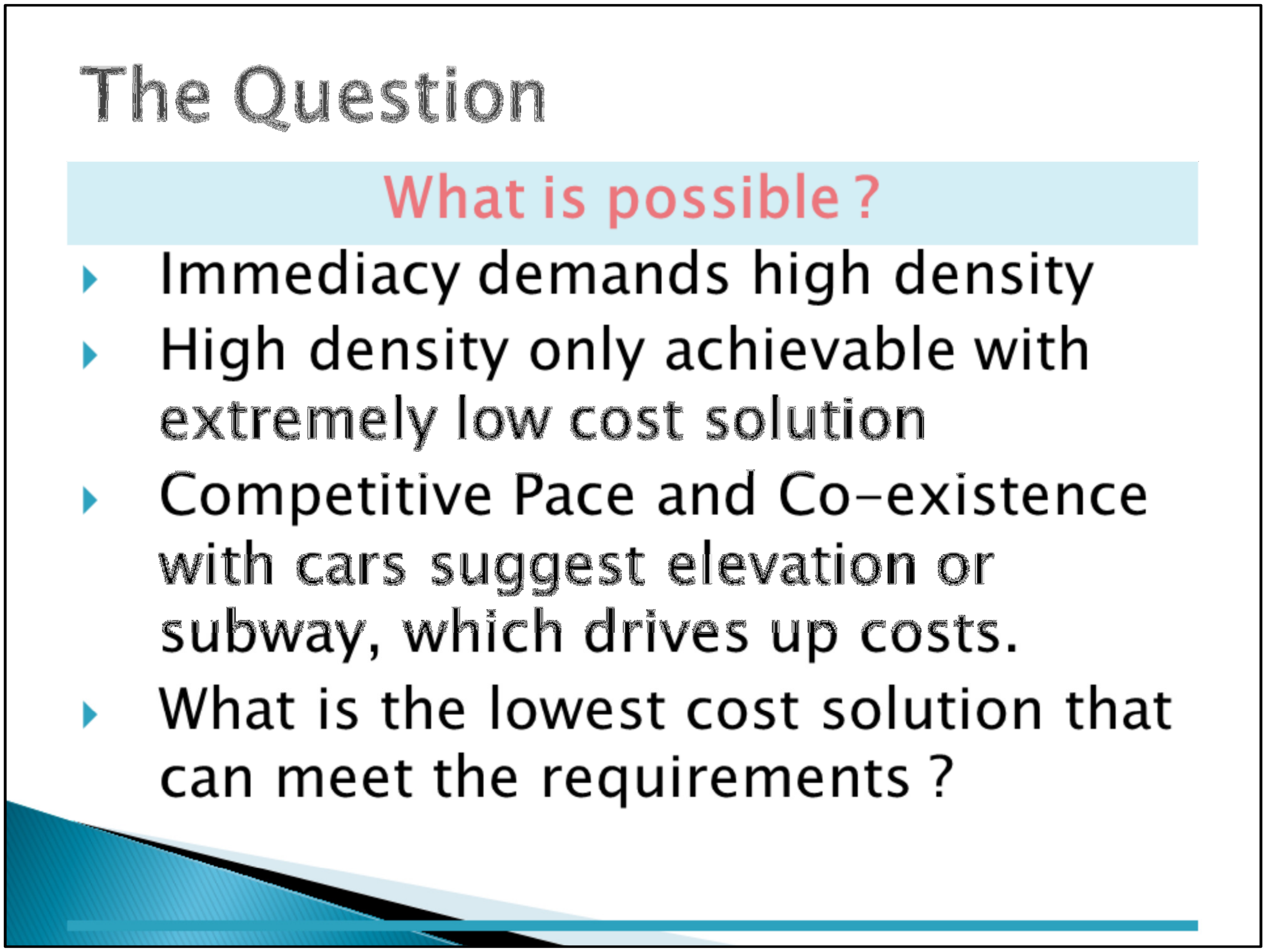
If the wait for a vehicle is very short, then a big factor in un-predictability is eliminated.

If the system is dense, then when a change in destination occurs, it can be acted upon more quickly. So flexibility is improved.

Predicted CityTram (perceptions)

To get from point A to point B		
Safely	0	About same as car
Predictably	0	About same as car
Flexibly	–	Goes where I need ? When ?
Quickly	0	About same as car
Affordably	+	Cheaper than car

If we take the mass transit perceptions as a starting point, and then apply the impact of this new public transit approach, something like this results. Keeping in mind our consumer model, this looks like a winning formula. Significant voluntary conversion should occur.



I know you are expecting me to sum up this presentation by stating some conclusions. But in this case the conclusion is a question – what is possible ?

Its fair to say I believe the consumer decision model is reasonable. It seems to correctly model survey results we know about.

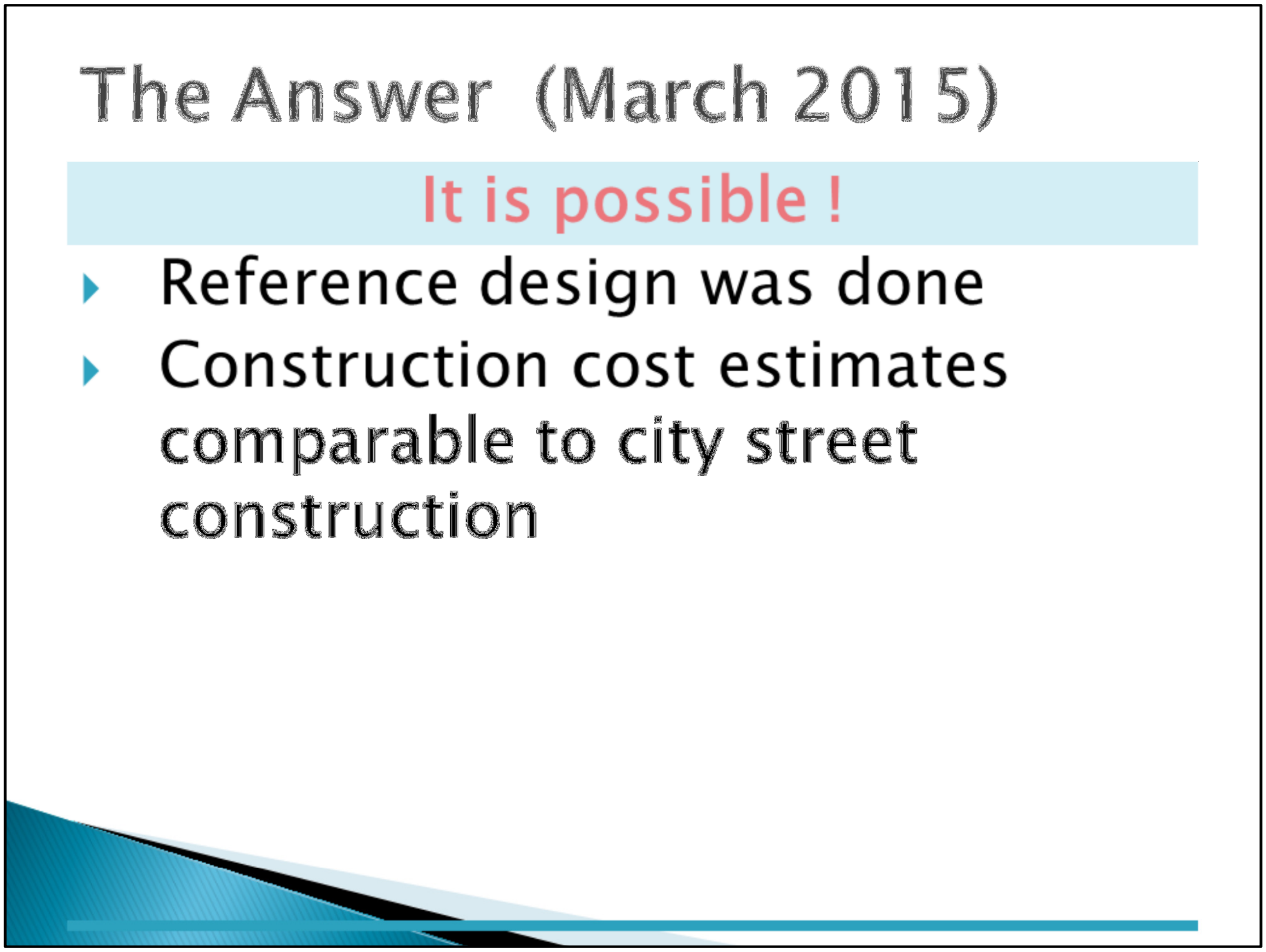
That model shows commute speed is the primary value being purchased. Surprisingly, we have concluded that the private automobile wins the commute speed race against mass transit primarily on foot, not in motion. Transit vehicles can go as fast or faster than cars, and while they must start and stop at each station, cars must start and stop at each red light. In the end the commute time for a given distance is pretty close. Where mass transit looses the race is walking to and from the station, and waiting for the transit vehicle. Walking to or from the parking lot, and driving away is a lot faster.

So we understand the attributes of a new transit technology that could compete with the current automotive system. What we do not know is if that new technology is economically and pragmatically achievable. Take all the cars off the roads and out of the parking lots, and let us re-use those, and a better system is clearly achievable. But that is not a practical alternative.

Matching the immediacy of cars demands a high station density. That means the new system must go almost everywhere. For that to be economically feasible, the per mile cost must be extremely low. This strongly argues for a shared grade solution – to share the existing roads. But sharing the grade limits pace. It also creates a control dilemma. Intelligent control is needed. But this means a professional driver, an amateur driver, or automation that does not yet exist. The professional driver is only economically viable with large shared vehicles. This degrades pace, and immediacy, and the sense of personal safety. The amateur driver degrades vehicle safety, and creates a load balancing problem to be solved. Large scale deployment of an autonomous vehicle solution would be pushing the bleeding edge of technology a bit too much.

Competitive pace and co-existence with cars, bikes, and pedestrians of a safe automated system is much easier to envision with a grade separated solution. But that means either a subway or an elevated system. Either approach for separation drives up the per mile cost significantly.

So the question is what is possible ? What is the lowest cost solution that can meet the requirements ? Is it cheap enough to be feasible ?
This is the step 1 challenge for the CityTram project.



The only way to really answer the critical questions was to design a solution and measure it. After an 12 month reference design effort the answer is in. A solution IS possible. Estimates of construction cost for CityTram are comparable to the cost of city street construction. This proves it is feasible to have a very dense "road" network, even though grade separate, which is critical to delivering high immediacy.