

This paper is on reducing contagion spread associated with Mass Transit.

From a [study of influenza on the London Tube](#):

Dr Goscé explained: "Higher rates [of influenza-like cases] can be observed in boroughs served by a small number of underground lines: passengers starting their journey in these boroughs usually have to change lines once or more in crowded junctions such as King's Cross in order to reach their final destination."

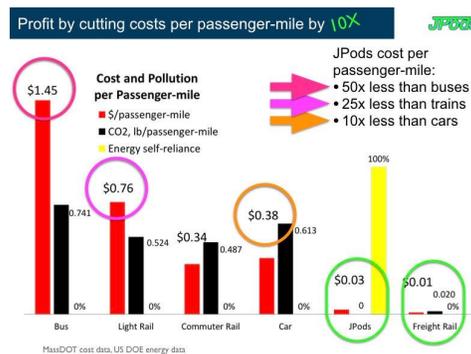
"On the other hand, lower influenza-like rates are found in boroughs where either the population do not use public transport as the main form of transport to commute to work; or boroughs served by more underground lines, which guarantee faster trips with less stops and contacts with fewer people."

Key points:

- The more queues, the more virus transmission.
- The more transfers, the more virus transmission.
- The more direct the travel, the less virus transmission.

This paper is on how JPods networks apply the principles of **Just-in-Time** (Six Sigma and Lean Thinking) and the **Prime Law of Networks** to personalizing travel, eliminate queuing, transfers, and crowding on Mass Transportation.

JPods are networks of grade-separated, self-driving cars with the carrying capacity of the family car (1-6 people). People travel only with those in their party; no riding with strangers.



Prime Law of Networks applied to the lessons of the London Tube:

Prime Law of Networks: *Network value and capacity increase exponentially based on the number of interconnected nodes, divided by packet size.*

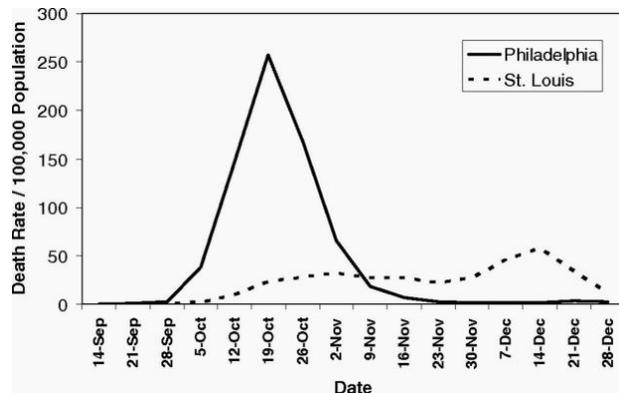
www.PrimeLawOfNetworks.com

Packet Size and Social Distancing:

- [Desired Social Distancing between people during a contagious event is greater than 6 feet.](#)
- Mass transit packet sizes are typically 50 people on a bus and 100 to 1,000 on a train.

Spacing around each seat is zero to 3 feet. A sneeze can carry a virus 6 to 8 feet. The coronavirus can [live upto 3 days](#) on some surfaces. Mass Transit fails the need for Social Distancing.

[Death rates in 1918 from the Spanish Flu Epidemic.](#) Philadelphia held a parade and St Louis canceled their parade.



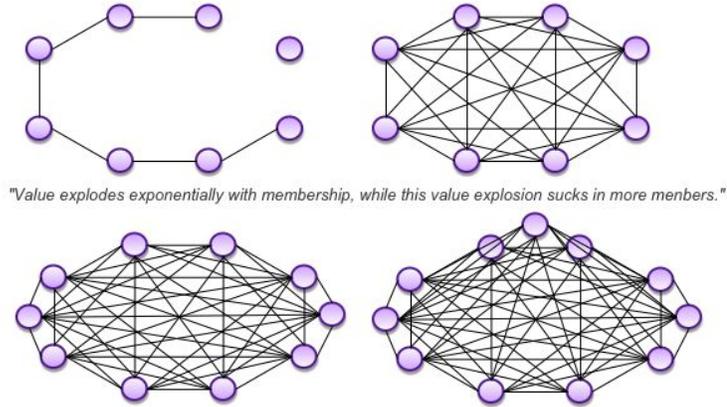
- JPods networks drive the packet size to one - a trip tailored to the needs of that specific traveler/family. JPods have the same Social Distancing as Mass Transit within a traveling party (1-6 people). JPods provide excellent Social Distancing between parties.
- Because JPods vehicles are inexpensive and personal in nature, there can be enough pods so they can be cleaned between uses in high risk situations. Vehicles can be specifically designed to be self-cleaning via ultra-violet lighting and anti-viral surfaces.
- Because you control the vehicle with your phone, you do not need to touch common surfaces such as elevator buttons.

By making the trip personal with JPods:

- ***There are no queues:*** A person/family gets into a JPods vehicle and immediately leaves to go directly, non-stop from origin to destination. It is this non-stop travel that cuts the energy to power the trip by 10X.

- ***Trips are direct, non-stop:***

The personal size of the JPods vehicles, 1-6 people, reduces station costs by 10X, allowing 10X more stations. Again, the multiplicity of stations makes trips direct without transfers. The vehicles switch guideways instead of the people switching trains/buses.



Just-in-Time (Six Sigma and Lean Thinking)

The gist of Just-in-Time is in its name. Strive for continuous improvement by removing the sources of variation, driving batch sizes towards one so resources are delivered to need just as they are required; not early, not late, just-in-time to fill the need.

Quotes from those who led the shift from Mass Production to Just-in-Time:

- *"Without a Standard, there is no logical basis for decision making or taking action."* Joseph M. Juran
- *"If you can't describe what you are doing as a process, you don't know what you're doing."* W. Edward Deming
- *"The Most Dangerous Kind of Waste is the Waste we don't Recognise."* Shiego Shingo
- *"Efficiency is doing things right; effectiveness is doing the right things."* Peter Drucker
- *"Excellent firms don't believe in excellence - only in constant improvement and constant change."* Tom Peters
- *"It is not necessary to change. Survival is not mandatory".* W. Edwards Deming

Tiny red cells as the packets, and the circulatory system in our bodies are an example of a Just-in-Time delivery system. The small packet size and the flow of many packets allows resources to shift to fill needs as we run, think, and digest food.

The packet-switched nature of the Internet is another example of Just-in-Time. Packet flow on-demand to meet the vastly different needs of each of us as we access information.

Just-in-Time, Six Sigma, Kaizen, Lean Thinking, Toyota Way are various names for the general concept of continuous improvement. Just-in-Time manufacturing is associated with Toyota and other Japanese auto manufacturers adopting the concepts of continuous improvement led by Drs Deming and Juran after World War II. Japanese carmakers entered the US market and immediately won huge market shares with radically better quality in the 1970s.

To compete with Japanese manufacturers and comply with The Clean Air and Water Acts, American manufacturers significantly replaced Mass Production with Just-in-Time during the 1980-1990s.

Just-in-Time dominates transportation:

- The personal automobile is a Just-in-Time mode of transportation with a cost per passenger-mile (CO2) of \$.38 (.6). Because of its better service at lower costs it dominates commutes to work.
- Mass Transit is a batch process similar to Mass Production. Mass Transit in America [carries fewer than 3% of workers to and from work](#) at the extraordinary per passenger-mile cost ([pounds of CO2](#)) of \$1.45 for buses (.7), \$.76 for trains (.5). Aside from the high costs, the quality is terrible as reported:
 - [Subways hit highest 'on-time' rate in six years](#), of 86%.
 - [MBTA system strained by worker absences, report finds](#); on average workers take 57 days of unauthorized absences each year.
 - [MTA Blames Uber for Decline in New York City Subway, Bus Ridership](#). MTA blames customers for their willingness to pay more for better quality service instead of correcting their own poor level of service.

Mass Transit is a batch process with high costs, high pollution, and low quality. Mass Transit's spread of contagion is a consequence of batch processing.

The JPods team has been applying Just-in-Time to manufacturing processes, software processes, selling, and logistical processes for decades. Two examples:

- Bill James, was part of Honeywell's adoption of Just-in-Time in the 1980's. He founded [Applied Statistics, Inc](#) in 1986 which became part of Allen Bradley and is now Datamyte. He founded WebClerk in 1989 to apply Just-in-Time to the selling process in small businesses. This software was awarded "Best High Tech Product of the Year" by Twin City Business monthly and was invited on two national tours by Apple.
- Charlie Fletcher applied Just-in-Time principles as the Commanding General for Corps Logistics during the invasion of Iraq and the subsequent rebuilding of Iraq. When constrained by resources and uncertainties, getting the right things to the right places at the right time has huge consequences.

JPods networks apply Just-in-Time to the mobility process to provide on-demand access, direct non-stop routing, and drive queuing to zero. This personalized service drives down the cost per passenger-mile (CO2) to \$.04, solar-collectors over the guideways power the network with zero CO2. The [Personal Rapid Transit \(PRT\) network in Morgantown, WV](#) is similar to JPods networks. Congressional Office of Technology Assessment study [PB-244854](#) identified these Just-in-Time networks of self-driving personal cars on grade-separated guideways as the solution to urban traffic congestion and foreign oil addiction.

Combining the Prime Law of Networks and Just-in-Time to limit contagion:



The larger the batch size the more difficult it is to assure quality.

- Personalizing the size of the vehicle provides Social Distancing and the ability to move and isolate infected people with fewer resources.



- Personalizing the trip eliminates transfers.

On the cost side of reacting to contagion, the small vehicle size, ability to automate routing, automate cleaning, and the relative ease of cleaning, means those infected or suspected of being infected do not have to be accumulated together awaiting transportation. The ability to personalize support for each person can be improved and resources consumed to handle each person at risk can be reduced.

Conclusion:

“Measurement is the first step that leads to control and eventually to improvement. If you can’t measure something, you can’t understand it. If you can’t understand it, you can’t control it. If you can’t control it, you can’t improve it.” H. James Harrington

- Traffic jams indicate a lack of understanding of transportation efficacy.
- Viral spread on mass transit indicates a lack of understanding of health needs.

Good metrics are essential to understanding and improving urban mobility and constraining contagions:

- Energy consumed/CO2 produced per passenger-mile.
 - Resources consumed per unit of economic work provided.
- Trip Quickness, combined travel, queuing, and transfers.
 - Quality of service and risks of exposure.
- Injuries per million people.
 - Quality of safety measures.
- Equity in access regardless of age, ability, or wealth.
 - Capacity to allocate on-demand resources to all
- Ease of exercising disinfectant protocols relative to risk per vehicle.
 - Ease of sterilizing vehicles between uses based on risks.
 - Designed to minimize resources consumed in sterilizing vehicles.
- Low cost vehicles so specialized vehicles can be used for specialized needs.
- Ease of routing resources to needs.
 - Separate stops at medical facilities for staff, sick people, and visitors.
 - Routing support into and controlling outflow from pockets of contagion.

- Efficacy of controlling access based on risk.
 - Quarantine enforcement
 - Grade-separation allows free flow between non infected areas.

JPods networks Just-in-Time nature, automation, and grade-separation provide radical improvement over Mass Transit and private automobiles on road networks in all these metrics.