

# COVID-19 Along with Autonomous Vehicles will Put an End to Rail Systems in Isolated Territories

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**ABSTRACT** – Even before the COVID-19 pandemic outbreak, rail systems in islands turned out to be a failure. The main concept of rail systems is to convey many people in one large means of transportation; however, in islands the small area limits the ability of the train to go through a good path that can meet the need of a sufficient number of people, therefore the rail systems are unproductive. Moreover, in the near future, the trains will have a tough competition with autonomous vehicles. Autonomous vehicles will go in platoons with constant distance from the vehicle ahead which will look like a long train. These autonomous vehicle trains will be much more efficient than the old fashioned trains. The COVID-19 influenced many passengers to leave the rails, because the rails seem to be one of the most substantial disseminators of COVID-19. Train passenger numbers may perhaps rebound little by little following the COVID-19 crisis, but the looming technology of autonomous vehicles will be too tough competition for the rails and such a passenger numbers rebound is unlikely to succeed. Therefore transportation authorities in isolated territories should refrain from investing in infrastructure of rail systems.

**Keywords** – COVID-19, Autonomous Vehicles, Rails, Islands, Transportation Means.

## I. INTRODUCTION

The COVID-19 pandemic has severely harmed the public transportation, whereas rail systems have been affected particularly harshly [1]. In some isolated territories like Puerto Rico the trains have been completely put off until further notice.

According to [2], New York City's subway system has been one of the main disseminators of COVID-19. The gathering of interchanging groups of people in a crowded railroad car is one of the worst experiences for keeping the health of the passengers.

Most of New York City's subway users were from low economic status and were identified to be associated with low testing rates, nevertheless a high proportion of positive tests was observed [3]. These users, who many of them cannot afford health insurance and take care of their health by no one, usually continue with their daily routine and infect other people. Therefore, COVID-19 has been massively disseminated in New York City's subway system.

Even before the COVID-19 pandemic, isolated non-large countries did not have good reasons for construction of railways. In a non-isolated country even if the country is very small, a railway system can connect the country to its

neighbor countries. E.g. Monaco's size is only 2.2 km<sup>2</sup> and even though Monaco has a railway system that connects Monaco to French and other neighboring countries in Europe [4].

There are also some railways in islands very adjacent to the mainland like Long Island in New York, USA [5], Sicily in Italy [6] or Hainan in China [7]. In such islands the railways are usually connected via bridges [8], tunnels [9] or ferries [10] to the mainland and they can actually be considered as an undivided portion of the mainland.

On the other hand, isolated territories like islands even if their size is larger than Monaco's size, there will be no economic viability for a railway system. Railway system may only succeed in a large territory where there is a necessity to convey a large number of people as will be explained in this paper.

## II. CASES OF ISLANDS WITHOUT ACTIVE RAILWAYS

Cyprus is an island that is surrounded by the Mediterranean Sea from all its sides. Therefore, there is no railway system in Cyprus. As a matter of fact, there was a railway of 122 km in Cyprus, but since it was unprofitable, it

was closed in 1951 and currently no railway system exists in Cyprus [11].

There are still railway remnants in some locations in Cyprus [12]. E.g. the Abandoned Railway Crossing Lights shown in Figure 1.



Figure 1. Abandoned Railway Crossing Lights in Cyprus

The Republic of Trinidad and Tobago has a similar railway history to Cyprus. There was a railway of 173 km in The Republic of Trinidad and Tobago, but since it was unprofitable just as Cyprus railway system was, the railway system of this republic was closed in 1968 and currently no railway system exists in The Republic of Trinidad and Tobago [13].

Crete railways have been shut down even earlier. Although there have never been a train passenger in Crete, an industrial railway focusing in the aim of construction the harbor in Iraklion was constructed in 1922. However, when the harbor's construction was over, the train was pointless and unprofitable, so in 1937, the train was closed and since then, there is no train in Crete [14]. An old and inoperative locomotive dumped in a field in Crete can be seen in Figure 2.

A similar story to Crete was in Negros Island in the Philippines that has never had a passenger railway. Negros Island is a large sugar producer and exporter. Actually, sugar is the largest industry in Negros Island and the railway was constructed to transport freights of sugar.

In 1985, the price of sugar in the international market crashed. Most of the sugar factories in Negros Island went bankrupt and there was no good reason to keep on the railway, so it has been closed and currently there is no sugar railway in Negros Island, nor is there any other kind of railways [15].

A new bridge to Negros Island is planned by the Philippines government; however, it will be a bridge only with a road but no railway [16].



Figure 2. An old and inoperative locomotive in Crete

Like the failure of the railways in the Philippines, the railways in Jamaica were an unsuccessful business as well. The railway system of Jamaica was opened in 1845 and this system was the first system outside Europe and North America. The British government built railways in many of its colonies and Jamaica was the second British Colony to have a railway system [17].

Actually, the railway system of Jamaica was built only twenty years after the United Kingdom government started to build the first railway system in the main island of Great Britain [18].



Figure 3. Defunct train station in Jamaica

The railway system of Jamaica was on and off for more than a century until its closure in 2012. Sometimes the railway system was opened only for freight like bananas or

bauxite, whereas sometimes the railway system was opened for passengers. There were also times the railway system was opened for both freight and passengers. In each of these openings, the trains were loss-making, so the railway system went out of business. In point of fact, any attempt to revive the railway system followed by insolvency [19]. A defunct train station with some defunct rolling stock in Jamaica is shown in Figure 3.

Another railway system in a British Colony was built by the British government in the island of Salsette. This island is nowadays under India sovereignty; however, the railway system was already shut by the British governor in order to make way for an airport [20].

The airport was for military flights, but when India gained independence, the government of India decided to convert the airport to a civilian airport and to keep the railway closed. Although the rails in India mainland are prevalent, the government did not believe that a railway in this island is capable of being cost-effective, so until this day, there is no railway in the island of Salsette [21].

Not only in British colonies were railroads built, but also in German colonies. During the time of German sovereignty in the island of New Guinea, many railways had been built in the German part of the island [22].

At the beginning of the 20th century, Germany decided to give a boost to New Guinea's economy by building a railroad system. The railroads were an extensive failure. Some dozens of million German Marks were invested with little return. In the First World War Germany lost its part in the island of New Guinea to Australia. The Australians did not want to go on with this unproductive rail project, so the railroads fell into poor condition. In the other parts of the island there has never been a railroad system, so as a result, nowadays there is no active railroad in the entire island of Papua New Guinea [23].

The conclusion of this survey about cases of islands without active railways is that even before the COVID-19 outbreak and the emergence of autonomous vehicles, rail systems in islands were not a lucrative business, so many governments preferred to relinquish the services of rail systems.

### III. CASES OF ISLANDS WITH UNSUCCESSFUL RAIL SYSTEMS

Ireland is a country within an island in the north east Atlantic Ocean. Even though Ireland is isolated, the government owns a lengthy railway system of 1,200 miles. The Irish railway infrastructure is poorly developed and ineffectively functions [24]. In addition, the Irish railways have the lowest rail electrification rate in the EU (2.7% in 2016).

In contrast to the poor railway infrastructure, the subsidy for the railway company is high-priced. USD \$887 million are annually paid to the Irish rail company - Iarnród Éireann by the Irish government as a subsidy. However, only 1.7

billion passenger-kilometers are travelled annually in Ireland, that is to say the subsidy cost is USD \$0.52 for each passenger-kilometers [25].

Even when comparing this subsidy price tag to China which provides an excessive subsidy to its rail system, the numbers are thought-provoking. China annually subsidizes its sizable rail systems with USD \$128 billion [26] and the train usage of China's rail system is 1,470.664 billion passenger-kilometers [27], that is to say the subsidy cost is in fact USD \$0.087.

China's economy leans towards planned economy and heavy intervention in the market [28], whereas Ireland leans towards a free market [29]. Nevertheless, Ireland rail subsidy is significantly higher.

When the COVID-19 pandemic began to spread in Ireland, many of the rail routes were closed like Waterford to Limerick and Ballybrophy to Limerick routes. The other routes' frequency of service was significantly lowered [30]. As a result, the inefficiency of the Irish rail company - Iarnród Éireann has been becoming much worse lately.

Another territory with an unsuccessful rail system is Puerto Rico. Puerto Rico is an unincorporated territory of the United States located on an island in the Caribbean Sea. There is an unsuccessful train in Puerto Rico that received a lot of negative criticism, called "Tren Urbano" [31]. The train consists of 16 stations operating on only 10.7 miles all owned by the Government of Puerto Rico.

Puerto Rico's Highways and Transportation Authority who manages this train, complains on a regular basis on the financial difficulties of this train and declares that as a matter of fact the train is completely running at a loss. The trains are averagely 90.43% empty [32]. Figure 4 shows a train before the COVID-19 crisis with only a single passenger within a railroad car of Tren Urbano.

The expected ridership of a minimum of 115,000 passengers per day [33] seems to be absolutely overstated when in 2018 the average weekday Daily ridership was only 18,600 passengers [34].



Figure 4. Almost empty railroad car of Tren Urbano



In a hearing before the Subcommittee on Regulatory Reform, Commercial and Antitrust Law in 2015, The Puerto Rico's Highways and Transportation Authority gave this disapproving statement: "There are rising operating subsidy requirements to the Tren Urbano light rail, an underperforming and underutilized asset, which has long been a burden on the overall system. Recent reports also indicate that the system has stopped paying third-party vendors amid mounting cash flow pressures." [35]. Therefore, the future of this railway was unclear, even before the outbreak of the COVID-19 pandemic.

The COVID-19 epidemic induced the Puerto Rico government to immediately stop all the services of Tren Urbano until further notice [36]. Passengers can get used at this time to the absence of the train as the service reopen is still undecided.

#### IV. UNSUCCESSFULNESS OF RAIL SYSTEMS

The information given above is gathered in Table I. The statistic in this table indicates that the potential of a railway system to succeed in an island is improbable. Only in large territories where there is a necessity to convey a large number of people, a rail system can have the possibility to be effective.

TABLE I  
PRACTICABILITY OF RAIL SYSTEMS IN ISLANDS

Name	Population (million)	Sovereignty	Area (square miles)	Does railway exist?	Profitability
Salsette	15.1	India	239	No	No rail
New Guinea	12.6	Papua New Guinea, Indonesia	303,381	No	No rail
Ireland	6.8	Ireland, United Kingdom	32,595	Yes	No
Negros	4.5	The Philippines	5,048	No	No rail
Puerto Rico	3.5	United States	3,500	Yes	No
Jamaica	3	Jamaica	4,320	No	No rail
Cyprus	1.5	Cyprus, Turkey	3,565	No	No rail
Trinidad	1.4	Trinidad and Tobago	1,934	No	No rail
Crete	0.63	Greece	3,220	No	No rail

In the US, only the Amtrak routes in the northeast region which is the densest region in the US are money making [37]. In the northeast region (Massachusetts, Connecticut, New Hampshire, Maine, Rhode Island, Vermont, New York, Pennsylvania, New Jersey, Virginia, Maryland, West Virginia, Delaware, District of Columbia) live 74,035,662

people [38] and the region is connected to the rest of the US and to Canada, so this is the opposite set of circumstances of an island. All the other routes of Amtrak run at a loss, all the more so some of the routes within the northeast region like Amtrak's Hartford Line from New Haven to Springfield runs at a loss.

From this review, it can be realized that rail systems in islands were not profitable in the 21st century and a fortiori when the COVID-19 broke out and autonomous vehicles emerged, the rail systems' future has been doomed as will be explained in the coming sections.

#### V. AUTONOMOUS VEHICLES RENOUNCE THE NEED FOR RAIL SYSTEMS

In [39] the authors provide evidence that public buses in the near future will remain economically competitive only in dense and large urban areas. Rails have separated and dedicated pathways, so their construction costs are higher and moreover they endeavor to stop near more passengers' destinations, so all the more rails will not be economically competitive [40].

Furthermore, drivers do not drive the same way. They take turns differently. They also accelerate and apply the brakes in their own way. This different way of driving is one of the key reasons for traffic jams and traffic congestions as was explained in various researches [41,42].

Many unexplained traffic congestions are generated when a vehicle goes on a dense road slows down even slightly, the vehicle behind it will slow down even more and the slowing down propagates backward all through a vehicle line, getting severer the farther the slowing down propagates. Sooner or later, there might be vehicles that are forced to completely stop in order to avoid hitting the vehicles ahead engendering a traffic jam [43].

In contrast, autonomous vehicles of even competing companies fulfill the driving assignments almost in the same way. Moreover, they can drive in a platoon [44] which means all the vehicles on the road will go like a long train keeping the same distance from the vehicle ahead and also the same speed [45]. Such a platoon can be seen in Figure 5.



Figure 5. Platoon of cars.

When such platoons are the everyday site in the roads, the railroads will be of no use, because a train takes many passengers from one central station to another central station; whereas an autonomous car can take each passenger from a different location and give him a ride to anywhere a road is present which is a much better service than a train can offer [46].

A connection of two or more means of transportation can become a nuisance for the passengers if the connection is poorly implemented. Such poor connections can discourage potential passengers from using connected means of transportation like a train plus a bus; nevertheless, it is very problematic to implement all the connections well and actually there are many conflict requirements that make a perfect implementation for all connections impossible [47].

Autonomous vehicles will make these connections unneeded; therefore, they will have a significant advantage over the rail services.

In several states in the U.S. like Arizona, California, Michigan, and Ohio, autonomous vehicles are permissible even without the necessity of a driver [48] and such vehicles are impending in other locations [49].

When it comes to COVID-19 infection, a platoon of autonomous vehicles is much safer than a conventional train for the passengers. In autonomous vehicles, each passenger is surrounded by metallic barriers that thoroughly keep the passenger safe from COVID-19 infection. Obviously, such a platoon of vehicles can protect the passengers much more than a cloth mask [50].

In [51] the authors propose measures that should be implemented in public transportation in order to prevail on a virus. A key measure is separating people from each other for example by Plexiglas barriers. However, using a platoon of autonomous vehicles and putting each passenger in a separated vehicle is even better than a barrier because in separated cars, the people absolutely cannot infect each other. A virus cannot pass through the cars. So in fact, cars besides protecting the passengers from weather phenomena and accident injuries also protect the passengers from viruses including COVID-19.

It is uncertain how much time the COVID-19 pandemic and its ramifications will last. The pandemic itself can last even until 2025 [52]. Anyhow, the pandemic will not disappear in one day and vaccination of the entire world will take time. By the same token, worries and fears of many people from COVID-19 will not disappear in one day and will deter them from entering a crowded railroad car for unknown time even after the pandemic itself ends, as we still cannot fully anticipate the long-lasting effects of this pandemic on our societies [53].

The year 2025 was also mentioned by the US Secretary of Transportation who anticipated that autonomous cars will be all over the world by 2025 [54]. Yet again, this transportation market change will not take place in one day; rather it will

take some time to be adapted by more authorities and customers.

So, the COVID-19 pandemic and autonomous vehicles will affect our life in the foreseeable future. Both of them will make rail systems in isolated territories redundant and gradually these rail systems will fade away.

## VII. CONCLUSION

Rails were invented more than 200 years ago [55]. The model of rail systems is conveying many passengers from one central station to another central station. In islands such a model cannot economically do well. As was reviewed in this paper of various rail systems in islands in a variety of locations in the world, no rail system can be successful, nor can it be profitable.

In the coming years autonomous vehicles will be prevalent and these autonomous vehicles will be able to travel in platoons which means keeping invariable distance from the vehicle ahead. These platoons will be similar to trains, but with the ability to take each passenger to his individual destination rather than to a central station. For that reason, people will prefer to go in autonomous vehicles and there will be no financial justification for rail systems anymore [56].

The current COVID-19 pandemic has discouraged many people from travelling by trains [57]. It is unclear how much time this pandemic will last; however, even when the pandemic is over, passengers will not come flooding back all of a sudden as the train services are resumed.

A substantial portion of the population will still avoid traveling in crowded trains even if a vaccine for COVID-19 is available. Some of the people will worry about the efficiency of the vaccine and some people will worry about other viruses [58]. Furthermore, a poll in the US maintains that about 30% of the people do not want to take any vaccine for COVID-19 and about 50% of the people do not want to take a vaccine for COVID-19 that was not produced in the US [59]. According to this poll, travelling in crowded trains will be a worrisome choice for a substantial portion of the population even when a COVID-19 vaccine is available and they will prefer autonomous vehicles.

It will take a long period until these COVID-19 worries will be diminished to a minimal level as the situation was before the COVID-19 outbreak. During this period autonomous vehicles will be able to establish themselves as an accomplished means of transportation, capable of dealing with transportation challenges.

The looming technology of autonomous vehicles along with the current unsuccessfully and ineffectively functioning of the rail systems in islands should discourage the transportation authorities of islands from investing in rail systems in their territories.

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