# Introduction

# It is obvious that passenger transportation worldwide has been doubled by 2000. As the need for travel grows in our increasingly globalized and interconnected world, there is a greater emphasis on developing systems that can meet this rising demand while being efficient and socially and environmentally responsible in connecting people across the globe.

In current circumstances rail transport is the most sustainable solution to meet the global demand for mass transit. However, railways often face competition in a free and globalized market, where passengers have the freedom to choose their preferred mode of transport based on various factors, with cost typically being a dominant consideration. While environmental and personal safety impacts play a significant role in today's travel decisions, railways are not always the most appealing option for passengers. As a result, increasing rail passenger usage requires the development of strategies to make rail travel more attractive to customers. In addition, regular maintenance and improved user-friendly access are essential areas that require significant attention. Despite ongoing population growth and the presence of worldwide branches of global high-tech companies in Ireland, it is notable that, as of 2023, rail transport has not regained the popularity it had in 2019. This is especially surprising considering the widespread use and popularity of rail travel in other European countries.

“Apple also raised how “the slow progress regarding the public infrastructure in Cork is very worrying and hindering Apple growth plans”. The document adds: “The current roads network is not sufficient to enable 6,000 Apple employees on their daily commute and is also a struggle for the residents, the traffic and transport situation being so bad.” (C.Mcquinn, 2024).

Given the points outlined above, the current dataset was selected to analyse the existing situation and explore potential strategies for driving a more positive trend in rail transport in the upcoming period.

# Strategic overview of the business problem and Business understanding

Overview.

The initial focus on business understanding is essential because it ensures that technical work is aligned with business objectives and prevents data scientists from tackling a problem without a clear understanding of the broader business context.

Having studied for many years in France and Switzerland, I was consistently impressed by how these countries developed such efficient rail networks, even in less populated areas. However, now that I am living in Ireland, I often find myself wondering what the potential obstacles might be that prevent the Irish Rail network from reaching such an advanced level of development.

My motivation is to explore factors such as safety and accessibility in rail travels, and how these elements can contribute to improving the future of rail transportation. Irish Rail has significant potential to become an efficient and competitive mode of transport for Ireland.

Briefly about business activities and operations Iarnród Éireann (Irish Rail). Ireland's railways originated during the "Railway Mania" of the 1830s and 1840s, with the first railway opening between Dublin and Kingstown (now Dun Laoghaire). In 2022, Irish Rail celebrated its 175th anniversary, marking 175 years at the core of both North Ireland community and Ireland’s railway network. The rail network in Ireland spans around 2,400 km of track and includes 1,501 stations, including five stations in Northern Ireland that are directly served by cross-border services. The national rail network operates three main types of services: InterCity, Commuter, and DART. These service categories share certain sections of the rail lines.

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Project plan

Despite the overall trend of population growth and the establishment of European branches of global high-tech companies in Ireland, it is noteworthy that, as of 2023, the popularity of rail transport has not returned to the levels seen in 2019. According to a Data.cso.ie/table/PEA03, the population in Ireland rose by 98,700 people which was the largest 12-month increase since 2008. There were 149,200 immigrants which was a 17-year high. Additionally, the Government of Ireland is dedicated to enhancing high-capacity public transport, ensuring it is appealing to passengers through improved accessibility. This commitment aims to make public transport a convenient and attractive option for all users.

The dataset suggests that the number of train or public transport users in 2023 has not reached the peak levels of 2019 due to a variety of potential factors. These could probably include:

1. Post-Pandemic Effects:Following the COVID-19 pandemic, many people may have continued to favour private cars for safety and convenience, as concerns about public health and train overcrowding likely persisted. To explore this factor further, I will include a survey conducted by the Carzone Motoring Report below.
2. Work-from-Home Trends: The shift towards remote work, which became more common during the pandemic, may have reduced the need for daily commutes, leading to fewer people using public transport.
3. Economic Factors: Rising costs, such as fuel prices or inflation, could influence people’s choices, and public transport may not be seen as competitive in terms of cost or convenience.
4. Service Availability and Reliability: Issues related to the availability, reliability, or accessibility of the public transport system—such as delays, maintenance, or limited routes—could deter passengers from using rail services. This factor will be explored in this and subsequent works.
5. Changes in Population and Demographics: Although the population may be growing, shifts in demographics or changes in urbanization patterns could impact public transport usage, particularly if people are relocating to areas with limited rail connectivity.

The aim of this current work is to explore how factors such as safety and ease of access could influence people's mindset, encouraging them to use and prefer public transport over private cars.

First of all, base on Iarnród Éireann (Irish Rail report for 2023), safety is a top priority and will remain a key focus for the company. The company is dedicated to maintaining a safe railway environment and preventing any harm to the health and safety of customers, employees, and contractors as a result of our operations.

In terms of safety, customers are particularly sensitive to the security of a transportation system. Railways are commonly viewed as one of the safest modes of transport. However, rail accidents do occur, and when they involve fatalities, they tend to be highly publicized and dramatic, garnering extensive media coverage. This can, in turn, generate considerable concern and alarm among passengers. According to the Eurostat (2021), only 5% of the railway accidents are due to train collision although they account for the 80% of the total fatalities. Meanwhile, injuries sustained in have increased by 5% on 2023 figures, up to 62 from 65. However, there is a positive downward trend of a reduction of 18% in the number of incidents per million passenger train journeys, with passenger journeys increasing by almost 29% in 2023 (Iarnród Éireann, Annual Report 2023).

At the same time, by the following the latest Carzone Motoring Report for the first semi-annual 2024 Ireland remains a nation deeply rooted in car culture but **81%** of Irish people opting for cars as their primary mode of commuting over public transport. However, based on the Road Safety Authority (RSA), for 2023 a total of 184 people died in 173 fatal collisions in 2023 compared to 155 deaths in 149 collisions in 2022. Whereas fatal injuries in the rail network for 2023 reached 11 people, in 2022 it was 6, and in 2021 it was 5 tragical results.

Thus, based on this data, using rail transport could offer significant advantages to the residents of Ireland in terms of safety. However, the question of why preferences still lean towards personal transportation remains open.

Let considers factor such as service availability and reliability within the Irish rail network.

To copy with this issue, Railway Operations prepared for the year by restructuring its operations base and creating Service Delivery and Customer Experience Teams. This allowed to build on traditional strengths of safety and operational performance by putting customer experience delivery at the heart of all our activities. Recently, I myself was surveyed by the Railways team regarding security and my level of satisfaction with using the Luas as a means of transport to the city centre.

Evaluation.

According to G.Melo (2024), for one or more models that seem to perform adequately, reasonable caution is taken during evaluation to see how well these models will perform on fresh data.

*Customers often have competing objectives and constraints that must be properly balanced. The analyst’s goal is to uncover important factors that could influence the outcome of the project. CRISP-DM understanding.*

*practical experience tells us that it makes sense to consider the ways and means of deployment during the business understanding phase as deployment is crucial to the success of the project. Deployment.*

*Decide on the data to be used for analysis. Criteria include relevance to the data mining goals, quality, and technical constraints such as limits on data volume or data types. Note that data selection covers selection of attributes (columns) as well as selection of records (rows) in a table. Data Preparation.*

*This task addresses data mining questions using querying, visualization, and reporting techniques. Data understanding.*

As seen at the beginning of this thesis, modern railways can be the most capacious, efficient, safe and

sustainable passenger transport modes. These advantages were the key to help railways become the

major motorized system of people transportation in the 20th century and since the industrial revolution

in the 19th century. Certainly, railways have been the system responsible for carrying the most of the

worldwide passenger-km until the beginning of the 21st century, when aviation overtook the lead of the

global mobility.

The assessment method shows very low performance of the accessibility for persons of reduced mobility

in the railways in Spain. The three parameters analysed, accessibility in stations and in trains for

disabilities as well as the assistance by staff por persons with disabilities. Instead, interviews revealed

a positive feedback from the users, since there was unanimously an affirmative answer on the question

“Are stations and trains adapted for PRM’s”. Some expert user also pointed that there have been many

efforts to improve the accessibility on stations with works on platforms and lifts, and to rail carriages with

the introduction of low-floor vehicles.

However this is a parameter that must be considered by users with disabilities as other users might not

have the proper perspective to correctly value the performance. There were no users from interviews

with disabilities so in this case their views can’t be fully contrasted. In order to solve that, it would be

recommended that the KPI’s distinguish whether the respondents are persons with reduced mobility. A

feedback from a PRM user complaining against the accessibility to the railways or confirming it’s

accessibility will be certain, instead feedback from users without reduced mobility can’t be fully trusted.

Irish Rail –

Safety Certificates are issued to Railway Undertakings (RUs) by the CRR in accordance with the

requirements of the RSD and S.I. No. 476/2020 - European Union (Railway Safety) Regulations 2020. The

validity of Safety Certificates shall not exceed a period of five (5) years.

The purpose of the Safety Certificate is to provide evidence that the RU -

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(a) has established its Safety Management System in accordance with Article 9 and Annex III of the RSD,

and.

(b) can meet the requirements laid down in the Technical Specifications for Interoperability (TSI) and

other relevant European Community legislation, and in National Safety Rules, in order to control risks and

provide rail transport services safely on the network.

An RU’s Safety Management System and Safety Certificate shall be wholly or partly updated whenever the

type or extent of its operation is substantially altered and shall, in any case, be renewed at intervals not

exceeding five (5) years. RUs shall, without delay, inform the CRR of any major change in the conditions

of the Safety Certificate and any consequential changes to the Safety Management System and,

furthermore, shall notify the CRR in advance of introducing any new category of staff or any new types of

rolling stock, or substantially modified rolling stock that may require an authorisation for placing in

service. The CRR may require that the Safety Certificate be revised following any substantial change in the

safety regulatory framework.

The Iarnród Éireann network currently extends to approximately 2,400 km of operational track, c.4,440

bridges, c. 1,100-point ends, c.970 level crossings, 146 stations, 3,300+ cuttings and embankments, 372

platforms and 13 tunnels. The network includes main line, Dublin suburban and commuter passenger

routes, together with freight-only routes.

A number of lines are currently not available for traffic, these being:

Athenry - Claremorris

Claremorris - Collooney

Midleton - Youghal

Navan - Kingscourt

Mullingar - Athlone

Waterford – Rosslare Strand

Limerick – Foynes

Tralee – Fenit

Waterford – New Ross

There is a cross-border connection to the railway system in Northern Ireland between Dundalk and Newry.

The distance from Dundalk Station to the border is 8.4km and the distance from Newry Station (in

Northern Ireland) to the border is 15.5km.

The maximum speed is 160 km/h for passenger trains and 80 km/h for freight trains. However, on certain

sections of line and/or for certain types of train lower maximum speed limits apply. These Permanent

Speed Restrictions are set out in Appendix 4.

Temporary Speed Restrictions (TSRs) are advised through the Weekly Circular published internally by

Iarnród Éireann. The major criteria for the imposition of TSRs include track defects, engineering works and

weather conditions.

The 41 x new Intercity carriages on order from Mitsui and Hyundai Rotem since December 2019 are an additional order to expand existing diesel intercity trains that operate nationwide. They are single carriages and will make existing trains longer (5 car will become 6 car and so on) and as such are very similar to the existing vehicles.

Toilets – no toilets are fitted to these vehicles, existing trains that are being lengthened already have a toilet in every carriage. A multipurpose area is installed instead featuring 9 x flip up seats and a standing area with hand rails, bicycle storage

Bike Capacity – The existing train already has capacity for 2 x bicycles. These additional new carriages have a further 2 nominated bicycle spaces (with locating straps) in the multipurpose area. However this multipurpose area can accommodate a variety of uses for example such as a larger group of bicycles and cyclists provided they are attended during the journey or families with buggies and so on

Fuel type – Diesel as per the existing fleet. These carriages come ready for hybrid battery fitment when available in the near future.

Project Overview

Iarnród Éireann is undertaking the Cork Line Level Crossings Project to identify the best approach to  
removing/upgrading seven level crossings located along the main Cork to Dublin line. These level  
crossings are being removed/upgraded to provide a safer environment for those living near the rail line  
and a more efficient service for all Iarnród Éireann customers.

There are currently seven manned public road level crossings in operation on the Cork to Dublin line  
between Limerick Junction and Mallow stations in Counties Cork and Limerick. The crossings are  
located within a 24km section of the line between the Cork and Limerick county boundary.

The crossings are located at Fantstown, Thomastown, Ballyhay, Newtown, Ballycoskery, Shinanagh  
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**Strategic overview of the business problem Project plan  
Business understanding  
Data understanding**

**Data preparation  
Machine learning implementation Findings  
Conclusions  
Any future recommendations**

**Project will quadruple customer capacity and deliver electrification of route from Hazelhatch & Celbridge to Heuston and South City via Phoenix Park Tunnel**

**An Bord Pleanála have approved the Railway Order application to extend the electrified DART network from Hazelhatch & Celbridge to Heuston Station and the South city via Phoenix Park Tunnel. The application was lodged in March 2023.**

**DART+ South West will provide a greatly enhanced and more sustainable transport option for communities in Hazelhatch & Celbridge, Adamstown, Clondalkin & Fonthill, Parkwest & Cherry Orchard, Drumcondra and at a new station at Heuston West. This will be achieved through infrastructure works resulting in higher frequencies and electrification, and new trains, to increase passenger capacity from the current 5,000 to 20,000 per hour per direction. The DART+ Programme is a key element of the NTA Greater Dublin Area Transport Strategy, 2022-2042. DART+ will facilitate sustainable mobility and development to enhance quality of life in our capital and its surrounding counties, through a series of fleet and infrastructure projects. The DART+ Programme is being delivered by Iarnród Éireann on behalf of NTA.**

**The planned infrastructure improvements include:**

* **20km of electrification and re-signalling of the Hazelhatch & Celbridge Line to Heuston and the south city via Phoenix Park Tunnel.**
* **Construction of a new station at Heuston West to serve the community of Clancy Quay and Island Bridge.**
* **Four-tracking of the rail line from Park West & Cherry Orchard Station to Heuston to enhance capacity.**
* **All civil, bridge and ancillary works as necessary to accommodate the project.**
* **Upgrading of the Phoenix Park Tunnel.**
* **New electric DART carriages for the DART+ Programme will be deployed on Hazelhatch & Celbridge services.**

**The procurement process will now commence for the construction stage contracts. Subject to funding being allocated it is anticipated that construction will commence in 2026.**

**Project development for Navan rail line to begin**

**25 November 2024**

**Initial phases to focus on scope development and route option selection**

**The project to bring passenger rail services back to Navan is set to begin, following the appointment by Iarnród Éireann of RPS as multi-disciplinary consultants for the duration of the project to work with the rail company’s in-house project team.**

**The project seeks to deliver a new rail line of approximately 40 kilometres from the existing terminus station at M3 Parkway, north of Dunboyne, to the busy and growing commuter town of Navan, delivering direct Navan to Dublin city centre rail services.  Following an initial feasibility study, the project is included in the approved National Transport Authority (NTA) Greater Dublin Area Transport Strategy 2022-2042. The Navan Rail Line is being delivered by Iarnród Éireann on behalf of NTA. Funding for the project is provided by Department of Transport through the NTA.**

**The first phase of the programme will see scope and design development, and route option selection, developed over the next two years.  This will include public consultation on the emerging preferred route proposal, and will prepare for a Railway Order (equivalent of planning permission) application to An Bord Pleanála in 2027.  The line is expected to serve new stations, including at Dunshaughlin and Kilmessan, along its route.**

**A train tracks next to a building

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**Subject to planning and funding approvals, the project delivery phase is envisaged between 2030 and 2035 under the NTA’s Greater Dublin Area Transport Strategy.**

**Benefits of the project include:**

* **Faster more sustainable travel options for people living in catchment areas including Navan, Kilmessan and Dunshaughlin**
* **Environmental benefits, with a sustainable, low-carbon rail service preventing further congestion on the road network and supporting Ireland’s transition to a sustainable transport network**
* **Enable Growth: Support sustainable economic development and population growth in the Navan – Dublin corridor through the provision of high frequency, high-capacity public transport services.**
* **Improve Connectivity: Improve access to jobs, education, and other social and economic opportunities through the provision of improved connectivity and integration with other public transport services.**
* **Enable Compact Growth: Enable transport-oriented urban compact growth along the corridor to unlock regeneration opportunities and more effective use of land in the eastern region, for present and future generations.**

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**Chief Executive of Iarnród Éireann Jim Meade said: *“Today is a great day for the communities of North Kildare and South Dublin, the provision of DART services will transform commuting for the existing and new communities along this railway corridor. It will make travelling with us more sustainable, more frequent and more reliable. This is the second DART+ project to receive planning. DART+ West Railway Order was granted in July of this year. DART+ Coastal North Railway Order Application was lodged last September & South will follow. The DART+ programme, when delivered will truly revolutionise commuting in the Greater Dublin Area and assist in meeting Ireland’s climate action targets by reducing reliance on the private car and providing sustainable high frequency, high capacity transport”*  
  
Anne Graham, CEO of the National Transport Authority said: *“When we invest in transport infrastructure, we are investing in the future of Irish communities and their ability to access dependable, sustainable public transport alternatives. The Railway Order approval by An Bord Pleanala today for DART+ South West marks a significant milestone for the communities that will be served by this improved service, as it will bring increased passenger capacity, higher frequency services, and ultimately a more sustainable, accessible, and reliable rail service to the region.*  
*“NTA looks forward to continuing to work with Iarnrod Éireann in delivering this key piece of transport infrastructure.”***

**Improving and Developing Rail and Bus Networks**

* **Continuing to advance the Metrolink programme**
* **Developing the DART+ programme, including arrival of the new DART fleet**
* **Continuing construction on train stations including Galway Ceannt**
* **Protecting and renewing the existing heavy rail network**
* **Continuing the first phase of the Cork Area Commuter Rail Programme**
* **Investing in electric and hybrid-electric buses, and in charging infrastructure at depots**
* **Constructing the first of the new Core Bus Corridors in Dublin**

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**[[1]](#footnote-1)**

1. [↑](#footnote-ref-1)