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Setting the Scene I

Ever since humans first walked the Earth, they have been engaged in transport: *the movement of people or goods from one place to another*. Until relatively recently, with the development of air travel, there have been two general forms of transport: land and sea.

At first, land transport was simply walking and carrying, until the development of the first vehicle: the sledge. These were constructed of wood and were drawn along by hand, allowing materials and other people to be moved. The earliest of these sledges that has so far been discovered was that in Northern Europe, dating back to 7000 BC. It is likely to have been used by hunter-gathering communities that populated the area at the time. Transport remained in this form for some 3000 years, until the domestication of cattle and the discovery that castrating a bull created the docile but incredibly powerful ox, in Southern Russia and Mesopotamia.

Sea transport was initially simply a matter of lashing logs and reeds together to form rafts, or using the hollowed-out trunks of trees. It was with the latter of these options that real development progressed, as the sides were increasingly extended; essentially the form that boats took until the introduction of metal hulls in the nineteenth century. It was again the civilisation of Mesopotamia, along with Egypt, that began to use sea transport extensively.

It is at this point that the different modes of transport began to emerge. The opening chapter of Part I takes up the development of each of the main modes of transport separately. It is intended to be a brief historical narrative of the development of transport in Europe, with particular focus on the UK. A multiple-volume work could be devoted to a thorough study of the economic history of transport and so this is not the purpose here. The general developments will be outlined, pausing at times and events from which particular economic lessons can be drawn. An appreciation of the development of transport is important for all students of transport economics, as it illuminates the factors that have shaped the sector to be as it is today. It forms the starting point of an understanding as to why transport economists are faced with the problems that exist in the early twenty-first century. This is the intention of the opening chapter, which concludes with a discussion of the overarching lessons that should be learnt from the preceding narrative. For case studies of these transport industries today, see the parts that follow.

Chapter 2 sets the scene in terms of how important the transport sector has come to be to the European economy today. This is first done by analysing a range of current statistics to assess the very practical impact that the sector has on factors such as employment, and household and government expenditure. The importance of the sector to the economic theories of the free market is then outlined, and it is argued that without a well-functioning transport system the free-market economy could not achieve a state of efficiency. This is so important that it underpins the very basis of current economics.

The History of Transport in Europe

1.1 Railways

1.1.1 Initial developments

The first railways were developed in Germany in the 1550s as wagons pulled along wooden rails by horses. This system was copied for use by the expanding British coal mines in the early 1600s, where wooden rails were laid down on which a single horse could draw 50–60 bushels of coal. These *tramroads* spread quickly throughout the Tyneside coalfield.

Iron-rails were first used in the UK around 1767. What is considered to be the world's first public railway was opened on 26 July 1803 in Surrey, south of London. It was a horse-drawn freight line connecting Wandsworth and Croydon which lasted for only 42 years. The first commercial passenger-carrying railway, which was also horse-drawn, was the Oystermouth Railway, which was authorised to carry passengers in 1807.

In the year following the opening of the Surrey Iron Railway, the first steam locomotive, which had been built by Richard Trevithick, was used at the Pennydarren Ironworks in Wales. However, it was not until 27 September 1825, and the opening of the Stockton and Darlington Railway, that steam locomotives were proved to be useful for public use. The railway was a single track, 25 miles in length, with a hundred passing loops and four branch lines leading to different collieries. Such networks were further developed with the opening of the Liverpool and Manchester Railway on 15 September 1830. This is considered to be the first modern railway as it was designed entirely for steam engines with cuttings and embankments rather than pulling-ropes to aid horse-drawn wagons up gradients. It was on this line that George Stephenson's *Rocket* was used.

These first railways were regarded as being a new type of toll-road, on which customers had to pay for the privilege of being able to use their own vehicles. Gradually, the owners saw the possibility of charging customers to use their vehicles instead. The financial possibilities spurred a *Railway Mania* with small investors rushing to establish small stretches of line. It was necessary to obtain an Act of

Parliament to build a line, and by 1845 there were over 1000 projects proposed. If a proposal was successful, the Act of Parliament allowed railway companies to exercise powers of compulsory land purchase, but some landowners charged excessive amounts and powerful landowners could even block such an act being passed in the first place. This forced railway companies to build sub-optimal routes, creating bends that would lead to the development of tilting-trains way into the future.

The railways were an essential part of the industrial revolution. They competed against the canal systems to be the main mode of freight transportation. The railways gained the upper hand as they could be built in areas that were unsuitable for the more traditional canal systems. Consequently, the railways grew rapidly and by the 1850s many steam railways had reached London. A metropolitan railway was built to connect the different terminals, the first section of which was completed in 1863. The first *metro* was born.

1.1.2 Increasing government intervention

At first, the government took a laissez-faire stance to the railways until the issue of safety became important. In 1840, the Act for Regulating Railways was passed, allowing the Board of Trade to appoint railway inspectors. By the end of the nineteenth century it was still not unusual for a hundred people to die on the British railways each year. Following a crash in Armagh that killed 80 passengers, an act in 1889 insisted on further safety measures with all passenger trains being required to have continuous automatic brakes.

By the 1890s electric power was practical, allowing the further development of underground railways in cities such as London and Paris. Most street railways were also electrified and became known as *trams*. In many European countries, these street railways expanded beyond city boundaries and actually connected cities, a notable example of that being Belgium.

In Britain, the Railways Act of 1921 amalgamated nearly all the railway companies into the *Big Four*, which consisted of the London, Midland and Scottish Railway; the Great Western Railway; the London and North Eastern Railway; and the Southern Railway. They all undertook strategies to rebuild their lines and their rolling stock, spurring a period of great competition between them. This truly was the golden age of the British railway. The act also introduced rail regulation in the form of the *Railway Rates Tribunal*, which was created to approve fare structures.

During the First World War, the railways were successfully taken under government control. Operating expenses were cut to a minimum and efficiency improved. By the cessation of hostilities, though, the railways were faced with growing competition from motor vehicles and road haulage. Prior to the war, the railways had enjoyed a monopoly in freight haulage and so the government had passed a legislation that turned them into *common carriers*, meaning that they had to transport any cargo that was offered to them at a nationally agreed price, which was below that to be profitable for the railways. Consequently, they had to cross-subsidise loss-making operations with profitable ones, causing them to raise prices.

Until 1957 when this obligation was removed, the railways suffered at a disadvantage to road haulage. The *Big Four* never ran a healthy profit: in fact, the LNER never made a profit at all.

1.1.3 Failures and lessons in Britain

The railway companies failed to respond effectively to the challenge that motor vehicles posed, belatedly adopting two strategies: reducing fares and attempting to obtain a foothold in the road market. The first of these was ineffective as, in general, it was uniformly implemented across all services rather than being tailored according to differences in profitability and costs, meaning that the net effect was a reduction in revenue. The latter response was initially focused on the passenger market. In 1928 the railway companies began to acquire financial interests in existing bus operators and, as noted in Aldcroft (1974), within three years they were associated with about 47 per cent of the buses on Britain's roads. The perfectly competitive nature of the road-haulage market at the time made it more difficult for them to employ a similar strategy in that and so they concentrated their response on purchasing and operating their own vehicles. By 1938, they owned approximately 2 per cent of the freight vehicles in operation. This was too-little-too-late and the passenger and freight motor-vehicle markets expanded at the expense of the railways.

The railway companies learned from their failure to stem the tide of competition from the motor industry and were determined to respond more quickly to the emergence of domestic civil aviation in the early 1930s. In March 1934, the four railway companies, along with Imperial Airways, established the Railway Air Services. This new operator was to compete directly with the emerging domestic airlines and was to be operated by Imperial Airways until it could purchase and manage its own craft. The company rapidly expanded its operations, focusing on the West Coast where the railway lines were under the greatest competition from the new airlines (the East Coast Main Line was subjected to very little competition from the skies). However, along with the other domestic airlines, the company made continual losses. The railway companies also invested in other airlines, acquiring a dominant interest in many but not owning many outright, and so were able to help consolidate the air industry to a certain extent.

During the Second World War, the four companies worked together and the network was used more than it had ever been before. Only necessary maintenance work was made, though, and so the network deteriorated greatly. In the UK the network was not damaged by bombing as much as in other European countries, which compounded the problem because it did not enjoy the rebuilding that occurred in these other countries after the conflict. It was clear that it could only be maintained by the private sector with great difficulty, and so with the Transport Act of 1947 it was nationalised.

By the 1950s the UK network was far behind those in Europe. Even in 1955 steam accounted for 87 per cent of the total miles travelled on the British network, compared to 10 per cent by electric power and the remaining 3 per cent by diesel.

It would be nearly 50 years after electric and diesel technology became feasible that it was extensively applied in Britain, whereas in mainland Europe it had been adopted much earlier. Even in the years following nationalisation the replacement policy was firmly in favour of steam locomotives. Why it took so long for the technology to be adopted in Britain has been debated and many possible explanations have been raised: the economic returns to electrification were doubtful; there was a lack of finance; and the competition from motor vehicles and air transport may have distracted railway companies from investing in new technology; but Aldcroft (1974) argues that the strongest factor was the comfort that the old technology afforded to the management, both before and after nationalisation. A modernisation plan of electrification and dieselisation was finally implemented. It cost over £1 billion at the time and largely failed as it misdirected funds towards activities that were no longer demanded from the system and as it rushed diesel locomotives into production before being fully tested.

In 1963, Richard Beeching published a report as head of the railway system, in which he proposed to close 5000 miles of track and 2363 small stations. These closures were mostly implemented but they failed to produce the desired savings or increase in profitability. The 1970s saw British Rail (a name that was adopted in 1968) introduce the high-speed diesel InterCity-125 trains, which attracted increasing numbers of passengers and an improvement in finances. However, by the 1980s much of the rolling stock was obsolete and approaching the end of its lifetime. The 1990s would see further dramatic changes.

1.2 Roads and automobiles

1.2.1 Early road vehicles and the Roman Empire

One of the earliest wheeled-wagons ever to be found was that near Zurich, dating back to 3000 BC. Within a century from when this wagon was being utilised, heavy-wheeled vehicles were in use across Europe, moving at a pace of around 2 miles per hour. It was during this time that they took on a regal status, being used primarily by heads of state.

Between 2000 BC and 1000 AD, the Roman Empire spread across Europe, building roads as the arteries of the empire. The Romans viewed the quick transportation of soldiers and goods as of the utmost importance and so countless soldiers and slaves were used in the construction of absolutely straight roads. Post-houses containing fresh horses were situated every 10 miles and lodgings for the travellers every 25 miles. By 1000 AD there were over 50,000 miles of such roads across the empire.

1.2.2 The expansion of public transport

The later contraction of the Roman Empire saw the deterioration of the European road network. It was not until the 1600s, when the surfaces began to be improved

with paving stones, that the use of the roads once again increased. Horse-drawn carriages were available for hire in London in 1605 and by the second half of the century there were the first traffic jams. From 1640 onwards, public transport consisted of the stagecoaches which carried up to eight prosperous travellers inside, second-class passengers in an open basket at the back, and the least privileged on the roof with the luggage and a simple handrail for safety. It was during this time that the rich would send their young sons on the *Grand Tour* across Europe in private, well-sprung and comfortably upholstered carriages. It was on such a journey that the great economist Adam Smith was employed by Charles Townsend, a former Chancellor of the Exchequer, to guide his wife's son.

In 1782, John Palmer proposed to the government that mail should be carried in coaches. Two years later, the first mail coach ran from Bristol to London and within a year there was a network of such services to 16 other cities across Britain. By 1797 there were 42 routes, average speeds had increased to 10 miles per hour and Edinburgh could be reached from London in 3 days (it had been 12 days in 1750).

The early 1800s saw the road network improve considerably with the expansion of the turnpike system: toll roads that were administered by trusts, with users contributing to repair costs in proportion to their usage. In their peak, the turnpike trusts numbered over 1100 and administered some 23,000 miles of road. The trusts were inefficient, though, as there were no checks or limits on extravagance or borrowing; they failed to ensure particular repairs were made; they failed to establish a single nationwide system of roads; and certain individuals were given unjustifiable preferences.

The 1830s was the height of coaching, with the time required to travel from London to Edinburgh being cut to 42 hours and 33 minutes. By this decade the market was highly organised, with the fastest speeds being achieved on routes with the highest competition.

In terms of local public transport, there were two types of service in the early 1800s: hackney carriages and horse-drawn omnibuses. Up until 1830, the number of the former was regulated. In 1824/1825, there were some 1500 available for hire in the capital. However, after 1830, the number soared as the market was deregulated and it quickly became dominated by single-vehicle operations.

Horse-drawn omnibuses appeared in London in the late 1820s, having been copied from those in Paris that had operated successfully for many years. As with the hackney carriages, regulation was minimal and so many new single-vehicle operators entered the market. The difference between the markets was that associations of omnibus operators which acted collusively soon emerged.

In terms of private vehicles in Europe, the late 1700s and early 1800s saw the development of steam-power. Such vehicles were fashionable for a time and saw quick technological improvements until there was a backlash against them which included the British government passing laws that self-propelled vehicles on public roads must be preceded by a man on foot waving a red flag. This effectively killed further road developments and engineers largely turned their attention to the railways. The red flag law was not repealed until 1896.

1.2.3 Mass production and consolidation

At the end of the nineteenth century, the turnpike trusts were in decline (the last being abolished in 1895); hackney carriage and bus markets were booming; and the responsibility of maintaining the main roads had been transferred to county councils, thereby establishing the modern system of road administration. By this time the first automobiles with gasoline-powered internal combustion engines had been created. Commercial production of automobiles that utilised this power source was started in Germany by Daimler in the 1880s, shortly followed by Panhard et Levassor in France in 1889.

The motor vehicle was given legal recognition in the UK in 1903, along with regulations regarding licences, safe driving, identification and weight. Hundreds of small manufacturers competed with one another, driving innovation further and further on and the volume of vehicles higher and higher. Savage (1966) notes that in the UK there were 17,810 automobiles (excluding bikes) produced in 1904. By 1910 this number had increased to 107,635, by 1918 it was 330,518 and by 1922 it was 952,432, and still rising. It was during this time that the famous Ford Model T was created, ushering in a new era of mass production.

1.2.4 Buses

The first motor buses appeared in Britain around 1898. There was then rapid expansion in the market during the opening decade of the twentieth century as thousands of companies and individuals established operations, often only single-vehicle concerns. Severe competition led to wasteful and even hazardous conditions, with operators adopting strategies that encouraged dangerous driving. The conditions of the vehicles in terms of both mechanics and interior comfort also left a lot to be desired. Profits were low and losses were common.

After 1910, many of the technical difficulties were resolved and the competition began to stabilise. By the start of the First World War the market was beginning to be increasingly monopolistic, but the end of the war saw a new surge in entrants as soldiers that had been trained to operate vehicles during the war needed to find employment, the government sold wartime vehicles off cheaply, and in most areas anyone could establish a bus-operating business without a licence.

It was to address this that the Road Traffic Act was passed in 1930, introducing regulation into the market. Entry was restricted and it often protected existing concerns. The large companies steadily expanded at the expense of their smaller counterparts, but it was the local authorities that experienced the largest growth as they switched provision away from the tramways.

The effects of the regulation were, on the whole, positive: average fares declined over the 1930s; reliability and punctuality improved; the standard of the vehicles and of the operators' conduct also improved; and co-ordination between operators and the railway companies who invested in the market increased.

1.2.5 Freight transport

The early decades of the twentieth century saw tremendous growth in road freight. Despite the fact that there were no restrictions to entry into the market up until 1933, the vast majority of freight (some 80 per cent) was transported by the owners rather than by professional hauliers. As with the motor bus market there was severe competition between single-vehicle operations in the market, but this gradually gave way to consolidation as many of the weaker concerns were forced out. Rates varied according to service regularity, punctuality, insurance and the type of cargo, with companies increasingly specialising in either parcels or tonnage.

Road freight was generally less expensive than the railways and the service was often considered to be superior. Roads had the advantages of speed over small distances, reliability and flexibility, as well as being able to provide door-to-door services. Consequently, road freight expanded at the expense of the railways. This was made worse by the legal obligations placed upon the railways. Their fares were determined by the Railway Rates Tribunal and they had to be based on the value of the cargo rather than on the costs of transportation. This allowed the road companies to charge less for the goods of the highest value. The railways also had to publish their rates, which the road companies were able to use to their advantage and which meant that customers could demand comparable rates across the network. The road companies also largely focused on the routes that had been the most profitable for the railways. Overall, therefore, the railways were left with the least valuable cargoes on the least profitable routes. The railways responded by improving facilities and by purchasing interests in a handful of road-haulage companies. This failed to stem the tide, although in 1938 the railways still carried the largest share of traffic in Britain.

1.2.6 To today

By the 1930s most of the technology used in motor vehicles had been invented and throughout the 1950s speeds rose and they spread across the world. The market changed significantly in the 1960s as Detroit, the then leading centre of vehicle manufacturing in the world, began to fear foreign competition. Leading producers formed agglomerations to consolidate the market and to take advantage of economies of scale. By the 1970s the market contained far fewer producers, and manufacturers of small performance vehicles, such as BMW, Toyota and Nissan, began to increase market power due to the 1973 OPEC oil crisis, new emission regulations and the stagnation of the American industry.

Usage of motor vehicles has continued to increase, with such consumer expenditure largely accounting for the increasing expenditure on transport-related products and services. However, the health of the industry is no longer what it was.

1.3 Shipping

1.3.1 The wooden era

From 3000 BC, the Mesopotamian and Egyptian civilisations extensively employed water-borne transport. The Egyptians exploited the wind to sail southwards down the Nile and then oarsmen to travel back again, a fact that is even depicted in the hieroglyphic symbols for travelling south and north.

The Phoenician civilisation, from 1100 BC onwards, developed two types of ship: one for transporting passengers and freight; and the other for military engagements. The second of these were to become known as *galleys* and were used to ram the ships of the enemy: a military tactic that was to remain until 1571.

Development of shipping was focused on warships, simply playing the role of adding to the banks of oarsmen. By 700 BC the Phoenicians were using biremes (two banks of oarsmen) but within 500 years another two banks were introduced (quinqueremes, first used by the Carthaginians but quickly adopted by the Romans). Cargo ships changed very little from those used by the Phoenicians. Even in the thirteenth century European cargo ships still had a single mast with a single square sail.

It was the Chinese who led further developments in the form of their *junks*. They introduced bulkheads to make the hull rigid and more watertight in rough seas; sternpost rudders, allowing more effective steering in deep seas (until this time the convention was to use a long oar projecting from the stern); and multiple masts, facilitating the use of larger vessels. These developments were gradually adopted by Europeans who, by the fifteenth century, had developed *caravels* which were used by the explorers Dias, Columbus and Magellan.

Smaller, but still significant, developments were made in the subsequent centuries until the seventeenth and eighteenth centuries when the East India companies of Europe invested in large ocean-going ships in order to engage in the profitable trade with India and the East Indies. Shipping continued in such wooden sailing ships, some of which were magnificent, until the development of iron steamships in the nineteenth century.

1.3.2 The iron era

The first iron boat was constructed in 1787 by John Wilkinson as a way of transporting the artillery equipment that his Shropshire-based business manufactured. It was a natural development as there were no railways, the roads were unsuitable for such large heavy loads, and the existing wooden hulled boats were unreliable for such cargoes. His business built many other metal barges for use on the River Severn but it would be more than another 40 years before iron steamships were constructed by the Laird brothers in Liverpool. The first ocean-going iron ship was the *Alburkah*, launched in 1832.

By the second half of the nineteenth century the shipping market had largely taken on its modern shape, being divided into two parts: *liner* services, which

included all regularly scheduled services transporting relatively small cargoes on predetermined routes; and *tramp* services, which included all irregular services transporting larger cargoes at a daily rate per tonne. As shipping was the only form of international travel across the seas, the liner element included passenger services as well as those for freight.

1.3.3 British dominance

Britain established itself as the world's dominant shipping power in both of these sub-markets. It was also the dominant ship manufacturer, and the adoption of new techniques in ship building ensured that this supremacy was largely maintained until the First World War. In the early years of the twentieth century, British ships were transporting approximately half of the world's sea-borne trade.

From the second quarter of the nineteenth century onwards, Britain came under increasing competitive pressure, especially from Germany. Aldcroft (1974) notes that between 1890 and 1911 the British share of the total world fleet (in terms of tonnage) fell from 35.8 to 33.8 per cent, whereas that of Germany increased from 6.4 to 8.7 per cent. British dominance was especially challenged in the short-haul trades from home, Europe and Scandinavia.

Up until the First World War the shipping market was certainly not a freely competitive one. First, it was commonplace for governments to subsidise their fleets in a range of different ways. At this time, the maritime fleets were seen as being the flag carriers of the nations and, therefore, a part of national identities in a similar way in which the airlines were viewed in the second half of the twentieth century. The British government largely subsidised British lines covertly, paying them hugely inflated amounts for transporting mail. The German government employed three further types of subsidisation: direct payments to ship-owners for specific purposes; special railway rates for exported goods allowing the lines to undercut rivals; and special customs facilities for imported ship-building materials.

The subsidies granted by the French government warrant a brief consideration. It took a more centrally planned approach to its maritime fleet by granting navigational and constructional subsidies, the last of which were directed towards the construction of relatively inexpensive sailing ships. Consequently, at a time when most countries were replacing sailing ships with steam-powered vessels, France was actually expanding its sailing fleet. This was to be significantly disadvantageous to French shipping interests.

Secondly, by the twentieth century the shipping market was largely structured in collusive agreements (a second characteristic that it was to share with the airline industry in the second half of the twentieth century). The rise of competition had led to a whole series of agreements between shipping lines which, among other things, set prices, determined which ports different lines could access, and even pooled revenues for sharing between lines. This is known as the *conference system* and it generally left trade from the UK to the British lines, in return for their abstinence from trade from mainland Europe. The agreements were often broken, particularly by German lines. This occasionally led to rate wars but, more often

than not, the British lines were prepared to overlook such transgressions to avoid harmful competition.

Thirdly, different lines from the same country often worked together against foreign competition, although this was less true of the British lines. It was rare, for instance, to see the German lines competing against one another. In fact, in the early twentieth century the ten largest German lines established a shipping union which had some 23,000 tonnes of shipping capacity to use in foreign competition.

1.3.4 The early twentieth century

During the First World War the British government took control of shipping as it did of the railways as well. The difference was that, after the hostilities had ended, the shipping industry was largely allowed to gradually go back to being privately run. The government maintained some control for a time, due to the requirements of adjusting back to a peace-time economy, but by the end of 1920 nearly all control had been relinquished.

As trade began to expand again, there was a boom in the shipping industry with rapid construction of new capacity. In fact, there was over-production which led to a subsequent crash in the market. There is an argument that had the government maintained a tighter control on the industry, the effects on British shipping companies of these problems in 1919–1920 could have been largely avoided.

1.3.5 The modern era

Since the Second World War, the structure of the shipping industry has experienced four major changes. The first was the demise of the passenger liner services. Prior to the war the majority of international travel that crossed the seas, especially trans-Atlantic journeys, still relied on the passenger sea-liners. The war marked the end of the age of these majestic ships and ushered in the age of civil aviation.

The second change was caused by the significant industrial changes of the time. Heavy industries began to source their raw materials from overseas, semi-manufactured products began to be traded in volume, and marketing systems became truly international. The effect of these changes was the emergence of a demand for the transportation of large cargoes of an unscheduled nature that had not existed before. In response, the tramp shipping market further divided into markets for *bulk* and *specialised* shipping.

The third change was to the way in which the market was shared between different shipping nations. The British fleet continued to decline relative to those of other countries. In 1939, the British fleet had accounted for 28 per cent of the world shipping tonnage but this fell to 11.5 per cent within 30 years. Britain was still the largest ship-owning country apart from the flags of convenience, but its dominance had been eliminated. In the decade following 1958, the tonnage of the world shipping fleet increased by 79 per cent; that of Norway doubled, the Greek fleet quadrupled, and those of Sweden, Denmark, Finland, Germany and Poland all grew more rapidly than that of Britain.

Finally, during the last decade of the twentieth century many of the major industries that owned their own shipping fleets, such as the oil and large liner companies, began to reduce the size of their fleets in preference for chartering the capacity that they required. As such, the importance of the tramp market has increased. It is also a sign of the competitiveness of the tramp market relative to the advantages to a company of owning its own fleet.

1.4 Aircraft

1.4.1 Taking to the air

Gliders and kites were the first forms of aircraft to be developed, but lighter-than-air flying airships were the first serious forms of aircraft. In June 1783, the brothers Joseph and Etienne Montgolfier lit a bonfire beneath a balloon made of canvas and paper, and observed as it inflated and rose into the air to a height of 3000 feet. In September of the same year, they repeated the exercise in front of King Louis XVI, this time with the balloon carrying three passengers: a sheep, a cock and a duck. This time it flew more than 2 miles and the passengers alighted unharmed. They repeated it for a third time in November with a larger balloon and with two human passengers. It travelled 6 miles in 25 minutes and also landed safely: the first (human) passenger aircraft.

The future for balloon transport was not to be with hot air, though. Earlier, in 1781–1782, scientists in England and Switzerland filled soap bubbles with hydrogen and watched as they rose to the ceiling. Jacques Alexandre César Charles harnessed this power and on 27 August 1783 his hydrogen balloon ascended to the same height as the Montgolfier balloon, but travelled 15 miles in 45 minutes before springing a leak and crashing. This balloon was more controllable than the earlier hot-air balloons, and in a second flight Charles reached 10,000 feet.

The first powered and controlled flight of an airship is considered to be that of Henri Giffard, who travelled 15 miles in France in 1852 with a steam-powered engine. Another important advance was in 1884, with *La France*, a French Army electric-powered airship covering 5 miles in 23 minutes.

During the nineteenth century, there were numerous advances in glider technology and achievement. By 1891, the modern hang-glider had been created, making flights of over 25 metres. The first self-propelled flight was that by Clément Ader's steam-powered *Eole*, which travelled 50 metres near Paris in 1890. In 1896, the American experimenter Langley made further advancements with his craft, reaching a distance of approximately 1460 metres.

It was the Wright brothers who designed a way of controlling such craft in flight. On 17 December 1903, they made the first controlled and powered flight. In the years that followed they made numerous public flights and by the end of 1905 they had made flights of over 39 kilometres in length. On 14 May 1908, they made what is accepted to be the first two-person aircraft flight.

The first aircraft to make routine controlled flights were non-rigid airships: *blimps*. In 1901, Alberto Santos-Dumont combined a balloon with an internal combustion engine and successfully flew his airship over Paris and around the Eiffel Tower. Designs of such *dirigibles* were advanced rapidly by the German count Ferdinand von Zeppelin.

Planes were quickly adopted for military use. The first country to do so was Bulgaria in the First Balkan War, and during the First World War they were used for both reconnaissance and fighting. The interwar period was a time of rapid technological advancement with planes being constructed of aluminium rather than wood and with engines being greatly improved. Awards were given for distance and speed records, spurring innovation.

In 1929, the first round-the-world flight was completed by the Graf Zeppelin airship and, in October of that year, the same aircraft commenced the first commercial transatlantic service. However, the age of the dirigible ended in 1937 with the infamous fire aboard the Zeppelin *Hindenburg*. It was on craft powered by jet engines (which were developed in the 1930s) that air transport would rely.

1.4.2 British Airlines in the 1920s and 1930s

During the 1920s Britain's external air services developed rapidly as the government granted Imperial Airways a monopoly of subsidised operations. In May 1928, the world's first purpose-built international air terminal was opened beside the Purley Way, south of London. In these early days of commercial passenger flights the passengers were weighed along with their luggage to ensure the aircraft would be balanced.

Domestic air services failed to develop during the 1920s for a number of reasons: ground organisation and navigational aids simply were not adequate; there was a shortage of pilots; Britain's weather conditions did not favour such services; the British public viewed flying with distrust and did not enjoy sufficient time off from work to take advantage of flights (until this time flights had been the sole reserve of the affluent); and air services failed to offer worthwhile advantages compared to the existing surface transport.

By the 1930s the first, second and fourth of these were beginning to be rectified, and so from 1931 many new companies were formed to establish internal air services. In 1935, there were nearly a score of companies operating some 76 services in all. The 1938 Holidays with Pay Act enabled a much larger proportion of the population to enjoy a week away from work than had ever been the case. However, the impact of this would only benefit the airlines in the future as the prices of flights in the 1930s and 1940s were still prohibitively high for the majority of the population. Even in 1952 there was only one class of seat: first class.

Domestic operations were never profitable during the 1930s. The bulk of the revenue came from passengers and so was highly seasonal. This, along with the adverse weather conditions and the lack of equipment for night-travel, meant that

craft were under-utilised. The load factors were also very low, even in the peak periods, with few companies managing to exceed 50 per cent and none breaking even. The air services were simply more expensive than the other modes, and often failed to bring sufficient benefits. Only on long-haul services, particularly over water, did the airlines bring sufficient time savings. The airlines would probably have fared better had they transported more freight, but the craft were not designed for heavy loads and the competition was even fiercer in this market.

Once again there was too much competition and many of the operators were too small to be efficient. The industry naturally began to experience consolidation. In October 1935, a merger was announced between Hillman Airways, United Airways, Spartan Airways, and British and Continental Airways with the aim of creating an efficient domestic services organisation called British Airways. It became the government's second chosen operator for the development of continental routes, and so withdrew from domestic operations. The railways also initiated some consolidation by becoming the dominant interest in a large proportion of airlines as a way of defending themselves against the growing competition. Their involvement appears to have brought some improvements in efficiency but the services remained unprofitable and over capacity (see Section 1.1.3).

1.4.3 After the Second World War

At a conference in Chicago in 1944, 54 countries agreed on rules for international flights. Each country had the right to control its own airspace, and flights in and out of them would have to be agreed by the respective national governments. Bilateral treaties were to be agreed, normally through the International Air Transport Association (IATA), between countries to dictate the characteristics of services. Governments could protect their own airlines from competition.

The end of the Second World War ushered in the period of commercial flights. Initially, ex-military aircraft were converted into passenger and freight transporters. Within a few years numerous companies existed, with routes that criss-crossed Europe. By 1952 the British state airline BOAC had introduced the first jet airliner, the *DH Comet*; the first jet crossing of the Atlantic had been achieved; and the first charter airline had been established, in which entire aircraft were contracted out for a certain purpose, such as for package holidays and transporting army personnel. It was not long before the Boeing 707 ushered in the new age of commercial airlines. In 1969, Boeing unveiled the 747 (which is still one of the largest planes to have ever flown); and in 1976, the Concorde facilitated the first supersonic service across the Atlantic.

The last 30 years has witnessed not only a slowing of the technological advancement in commercial aircraft, but also incredible changes in the structure of the European airline market. There has been an increasing move towards liberalisation, with IATA now playing no role in fare setting and only a few fare agreements requiring government approval. However, the emergence of the low-cost airlines has perhaps been the most notable and the most wide-reaching change.

1.5 Canals

Canals have proved to be an invaluable way of civilisations across the world connecting navigable rivers and seas throughout history. The first canal was probably constructed in Mesopotamia to control the waters of the Euphrates and the Tigris rivers. In 520–510 BC, Darius I built the *Great Canal*, linking the Nile to the Red Sea. The Chinese also have a history of great canal building. It was a Chinese engineer in the tenth century who invented the *pound lock* that allowed boats to easily pass both up and down a stretch of canal for the first time. The first of these used in Europe is believed to have been in the Netherlands at Vreeswijk in 1373.

The first European canal that was constructed purely for transport purposes was the Naviglio Grande. It was built between 1179 and 1209 in order to transport marble into the city of Milan for the construction of the cathedral. From that point on, European canals became increasingly ambitious and complicated. In 1391, the Stecknitz Canal rose 40 feet from Lubeck and then descended the same height to reach the Elba; all within 36 miles. In 1681, the Canal du Midi joined the Mediterranean Sea to the Atlantic. It consisted of 150 miles of man-made waterways, three aqueducts and a tunnel stretching for 180 yards. At one point it dropped 206 feet in 32 miles.

The first canals in Britain were Roman-made: often for irrigation, or were short stretches to connect navigable rivers. The real emergence of canals as a serious part of British transport came with the Industrial Revolution in the mid-eighteenth century. Between 1759 and 1761, James Brindley constructed the Bridgewater Canal for the Duke of Bridgewater who wanted a cheaper way to transport coal from his mines into the city of Manchester. On 17 July 1761, the first barge-load of coal was pulled along the canal and into the city by horses. It was the first canal in Britain to run its entire length independently of any river, and was a huge success. The price of the Duke's coal was halved and the investment in the canal was recouped within a few years. This canal captured the imagination of countless engineers across England and the wider world, and within a few years other canals were opened.

These early canals were built to a narrow width, causing the boats to be termed *narrow boats*. Due to the length of the locks they were restricted to a capacity of around 30 tonnes: ten times the amount that could be pulled in a cart, but not sufficient to compete with the railways in the nineteenth century.

Between 1770 and 1830, the canal system expanded to be nearly 4000 miles in length, and numerous companies competed fiercely with one another. The canals were used as toll roads, with customers paying a rate to use their own boats on them. The money collected was used to maintain the canals and to pay the lock-keepers that operated the system on a day-to-day basis.

From the 1830s the railways began to compete with the canals. Due to the limited capacity of the narrow boats, the railways were able to transport greater quantities and at greater speeds. The canal companies slashed their prices in an effort to compete, but their profits fell. The wages of the boatmen also fell, motivating them

to take their families onboard the boats to live. In the mid-nineteenth century, there were some 10,000 boat people. It was at this time that the narrow boats were decorated. By the 1850s the cargo transported by the canals had fallen by nearly two-thirds. Many struggling canal companies were bought out by the local railway companies, often to simply close them down.

In many European countries (such as France, Germany and the Netherlands) the canals were modernised and widened to take much larger loads: often as much as 2000 tonnes. This made them more economical, allowing them to compete much more effectively with the railways. The canals of Germany and the Netherlands, in particular, are still viably transporting a significant amount of freight and over recent decades have even witnessed an increase in this. However, in the UK such modernisation never occurred, largely due to the powerful owners of the railways blocking any plans to do so. Consequently, the amount of freight transported by the canals in recent times has fallen to a mere 200 million tonne-kilometres. The one major exception to this is the Manchester Ship Canal, which was built in the 1890s to take ocean-going ships into the city.

During the early 1900s the British canal network began to be abandoned. It saw brief surges in usage during the wars, but these failed to help stop the long-term decline. Most of the remaining companies were nationalised in 1947 and were run by British Waterways. By the 1960s, now facing competition from road haulage as well as the railways, the network had contracted to less than 2000 miles. It was at this time that it was proposed that the system should take on more of a leisure function, and since then many hundreds of miles of the network have been restored. Due to the growing concerns about congestion and pollution there is now even emerging interest in the possibility of using the network for freight once more.

1.6 Lessons from History

A number of observations can be made from the preceding historical narrative, holding potentially important lessons for the European transport sector today and into the future.

1.6.1 The innate drive for transport innovation

An obvious first observation is that, since the beginning of human civilisation, there has been a drive for greater transport innovation in all cultures and societies. The ability to move goods and people from place to place has always been highly prized by the human race for social and economic reasons. Any possibilities to improve this in terms of speed, capacity, cost or comfort have been investigated and seized upon. This is evident from all the modes of transport discussed so far. Even in the airline industry, which has experienced a slowing in technological advancement over the last 30 years, there have been significant developments in the structure of the market, making air travel affordable to a much wider population than would

have been anticipated 50 years ago. The drive for improved transportation is innate in human society and will continue into the future.

This drive emanates from both passengers and producers. There will always be a desire to visit new places, taste more exotic products and experience different cultures; and as such, there will always be a demand for cheaper, faster and more comfortable modes of passenger transport. Historically, developments in these areas have been profitable for transport operators, especially those that have reduced the durations of journeys. A similar account can be told of freight transport, as producers have always sought to transport greater volumes at quicker speeds and in more reliable fashion. For example, the desire to transport coal was the initial catalyst in the development of the British canal and railway networks.

Experience demonstrates that this drive for innovation can be shaped, but not halted. The *red flag law* in the UK, which insisted that every motorised vehicle should follow a pedestrian waving a red flag, effectively killed further motor-vehicle innovation in the nineteenth century. This failed to stop innovation in transport, though, as the attention of the engineers turned to the railways, which benefited from improvements in the steam engine and from increases in speed and reliability.

1.6.2 The myopia of policy-makers

The largest lesson from past government transport policy is that of the need to tread carefully, as legislation can have serious implications. Government control of transport networks during the First World War was largely successful. In the railways, for example, operating costs were cut to a minimum and efficiency was improved. It is likely that having such a pressing and immediate overall strategic purpose and aim for transport, namely to support the war effort, helped to discipline decision-makers. After the second global conflict, the long-term effect on the railways of government control was negative.

Devising transport policy requires an appreciation of the wider effects that it will have, which are likely to be significant due to the volume of demand in the sector and the size of the investments involved. An illustration of this is that of the introduction of charging regulations for the railway operators, which effectively meant they were obliged to transport cargoes offered to them at a previously and nationally agreed price. This was designed to stop the railway operators from exploiting the monopoly power that they enjoyed prior to the First World War but, in practice, it meant that they could not maintain a healthy profit as they had to raise their prices in other markets to cross-subsidise the loss-making freight markets. They simply could not compete, allowing the roads to expand at the railways' expense.

Devising transport policy also requires an appreciation of the long-term effects that it will have. The specific demands from a transport network do not remain constant; they evolve over time. The first railways were used for the transportation of coal from the mines to the markets in the growing industrial towns. However, it would not be long until the demands placed on the railways were to transport passengers from town to town as well. If policy-makers fail to appreciate the needs

of the transport sector in the future, any current policy may be ineffective and wasteful. The clearest example of this is that of the railways modernisation plan in the UK in the 1950s. The government, investing large sums of money to keep the network the same as it had been in the past, failed to appreciate that much of the freight transport had already shifted to road haulage, making the investment largely ineffective and wasteful. Similar things can be said of the French maritime subsidies, which favoured sailing vessels and so hampered French competitiveness in the shipping market.

1.6.3 Political capture

Transport has always been a lucrative activity to be engaged in, and one that, at times, has brought with it tremendous social status. As a result of this, the politically powerful have sought to be involved, making the transport sector vulnerable to *capture* by these individuals and groups. The shape of the railway network in the UK was largely determined by powerful individuals blocking companies from creating the routes that would be optimal for the network. Very simply, bends were made necessary that would slow locomotives into the future and would stimulate the recent innovation of tilting trains. Another example of such political pressure is that of the canals in the UK, which were never modernised because of the influence of the railway magnates. This effectively consigned the canal network to abandonment. It is crucial that transport economists and policy-makers appreciate this tendency for transport developments to be captured when designing appropriate policy.

1.6.4 Competition, consolidation and collusion

A trend that has been common across all of the main modes of transport is that of consolidation. Shortly after its birth, the car industry comprised a highly competitive number of producers. The same is true also of the London bus market, the road-haulage market, the domestic airlines and (to a lesser extent) the railway and shipping markets. It is generally maintained by free-market economists that such competition is desirable, as it disciplines producers to become more economically efficient, benefiting society through improved quality and lower prices. In the transport sector, this conclusion needs to be tempered due to the innate dangers that accompany transport provision. This is demonstrated most clearly by considering the dangerous practices that motor-bus operators employed in the early twentieth century.

The periods of unrestrained competition in these markets all gradually gave way to consolidation, as the benefits that could be accrued from exploiting economies of scale, scope and density became apparent. This has also had the effect of causing freight transport to emerge as a separate business entity. The market for road hauliers transporting the cargoes of others has expanded dramatically, which has been mirrored in the shipping sector by the more recent decisions of the large

oil and liner companies to reduce the size of their own fleets in preference for chartering the capacity they require.

This trend of consolidation has often created an incentive for transport providers to collude. By signing collusive agreements and creating cartels, producers have sought to maintain their independence rather than succumbing to the pressure that would see them swallowed by large entities. The London horse omnibus operators soon created associations after their appearance in the late 1820s, the conference system dominated the shipping industry in the twentieth century, and the German shipping lines sought to increase their international competitiveness by establishing their own shipping union.

1.6.5 The early start

A less practical, but interesting, historical observation is that of the disadvantages that come from economies having an early start in the development of their transport sector. Britain was the first industrialised economy and, as such, was the first to develop whole railway and canal networks (although individual canals had been constructed much earlier in other parts of Europe). This was beneficial, and even crucial, to the industrialisation of the economy, but would lead to unforeseen problems in the future. The canals were constructed in a narrow form and so the locks restricted the narrow boats to a capacity of only 30 tonnes. Initially this was far greater than the road-carts that had previously been used, but it was not long until the canals simply could not compete with the railways that were able to transport far greater volumes. However, in continental Europe, engineers were able to see and avoid these pitfalls by constructing wider canals that still compete economically with the railways.

A similar story can be told of the railways, but this time as a result of the Second World War. The war demolished huge amounts of the continental railway networks, meaning that they had to be rebuilt and could be significantly improved from the lessons learned from British experience. The British railways were spared the experience of such destruction, though, and so were never rebuilt or improved. The continental railways were able to benefit from Britain's early start, and the British system has suffered as a result.

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