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STATISTICS: SPUR TO PRODUCTIVITY OR PUBLICITY STUNT? LONDON UNDERGROUND RAILWAYS 1913-32

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A rapid deterioration in British railways' financial results around 1900 sparked an intense debate about how productivity might be improved. As a comparison it was noted that US railways were much more productive and employed far more detailed statistical accounting methods, though the connection between the two was disputed and the distinction between the managerial and regulatory role of US statistical collection was unexplored. Nevertheless, The Railway Companies (Accounts and Returns) Act was passed in 1911 and from 1913 a continuous, detailed and standardized set of data was produced by all rail companies including the London underground. However, this did not prevent their eventual amalgamation into the London Passenger Transport Board in 1933 on grounds of efficiency. This article finds that despite the hopes of the protagonists, collecting more detailed statistics did not improve productivity and suggests that their primary use was in generating publicity to influence shareholders', passengers' and workers' perceptions.

Introduction

The productivity performance of British railways became a critical concern around 1900. Returns on shares had deteriorated rapidly throughout the previous decade, but 1900 was a turning point because of inflationary pressures associated with the Boer War and the outcome of the *Smith and Forrest vs. The LNWR and Others* case. The war precluded a return to profitability via falling commodity prices and the court judgement in favour of the appellants contesting a 5 percent increase in

railway rates by the LNWR (London and North Western Railway) meant that restoring operating margins by adjusting fares upwards was not feasible (Robert Irving, 1978). This specific anxiety had especial resonance because it correlated with broader fears about a crisis of British economic productivity against worldwide competitors, particularly the USA and Germany, and because railways were considered the key enabler of almost all other economic activity, especially exportable outputs (Avner Offer, 1991; George Paish, 1902). Some experienced contemporary commentators such as Sir George Gibb, Sir George Paish, Sir William Ackworth and Cyril Mossop proposed that until British railways began collecting detailed statistical information about their business as per the US example there could be no improvement in their management and productivity performance (Acworth and Paish 1912; Mossop 1911; Paish 1902; UK Board of Trade 1909).

In June 1906 the newly-elected Liberal government set up a nine-member Board of Trade Committee to investigate these concerns. It held 67 meetings and cross examined 29 witnesses, 25 of whom were senior executives in British, Indian, Canadian and Argentine railways. The remaining four represented the Civil Service and the railway shareholders. It reported in 1909, offering both arguments for and against increased statistical reporting (UK Board of Trade 1909). The three members of the committee who argued most firmly in favour of greater statistical detail in reporting (Acworth, Paish and George Peel) made several points. Firstly, existing accounts were not uniform in the recording and presentation of data. Secondly, the data were too sparse and more suited to a period in which the only items of interest in railway operation were the financial returns. Thirdly, railways now controlled many businesses other than railways which were not properly reflected in their accounts. Fourthly, according to those who favoured gathering more statistics, a business could not be adequately controlled or understood by its managers without more information than railways currently recorded. All these arguments concerned statistics as a function of better management of the railways. Those in favour of increased statistical measurement (Acworth, Paish and Peel now joined by Alfred Cole, George Stapylton-Barnes and Charles Fox) also advanced a set of arguments which broadly related to statistics' regulatory function aimed at improving the railways' image and

relationship with the outside world. Firstly, Acworth, Paish and Peel claimed that shareholders, alarmed by falling returns, now demanded better oversight of the companies in which they had invested. Secondly, passengers and their representatives in the Courts and in Parliament needed to understand better the railways' true financial predicament before they passed damaging verdicts or legislation based on false assumptions. Thirdly, the rest of the world but especially America was overhauling Britain economically. By extension, there was a great deal that could learned and applied from the enormous advances in productivity that detailed account-keeping had allowed American railways to profit from (UK Board of Trade 1909).

These views caused the nine-man Board of Trade committee to split three ways. Three members (Cole, Barnes and Fox) were content to endorse the proposal of extending the reporting and accounting duties of the railways. Three members (Acworth, Paish and Peel) stated that the proposals did not go far enough, and provided an appendix of additional information which they regarded as essential. Three other members (Walter Bailey, Charles Owens and George Whitelaw) wrote an extensive though repetitive set of reservations arguing that they saw no need for any additional accounting duties. The gist of their argument was that the expense would be too great (£35,000 per annum) and that "Practically no instance has been brought to our notice of any definite increase of earnings or decrease of expenditure in any specific case, which was the result of the use of the Ton Mile figures, and which could not, and ought not to, have been brought about by other means" (UK Board of Trade Report 1909: 25).

Nevertheless, the recommendations of the report, though not Acworth, Paish and Peel's additions, became law in 1913 after the 1911 Railway Companies (Accounts and Returns) Act was passed. The Act required every railway company to submit a standardized financial account and a statistical return, the contents of which can be found at Appendixes One and Two. In this article we use data from four major underground railway companies: The Metropolitan and District Railway, The London Electric

Railway,[1] The City and South London Railway and The Central London Railway. In 1913 the process of amalgamation between them had begun, though each company continued to file separate annual reports to the Board of Trade under The Regulation of the Railways Act 1871 (John Glynn 1984) until all of them, along with 100 or so smaller competitors from across the transport industry, were eventually merged into the London Passenger Transport Board (LPTB), a quasi-public corporation which provided all transport in London from 1933. Developments in the London underground network during this period can be found by comparing the maps shown in Figures 1 and 2.

The particularly close connection of some of the key protagonists of the proposals for greater statistical information gathering to the management of London transport companies (Gibb and Acworth) and the American experience and connections of the architect of a unified transport system for London (Ashfield) mean that we can be confident that these methods were believed in and applied wholeheartedly and unreservedly from the top in the pursuit of improving London transport's productivity. Evidence of this conviction can be found in the detailed accounts of the London underground railways companies from 1907 onwards which give minute monthly breakdowns of earnings, expenses, passengers carried, mileage, equipment, property etc. long predating the legal requirement to do so.[2] As Joanne Yates (1991) points out, these data collecting activities come at a cost which was evidently thought to be worth paying by the London underground railway managers. In view of these developments, the managerial and statistical stage was now set to see whether an improvement in railways' productivity performance could be achieved by gathering more numbers.

[1] This consisted of an amalgamation of The Baker Street and Waterloo Railway, The Charing Cross, Euston and Hampstead Railway and The Great Northern, Piccadilly and Brompton Railways.

[2] London Metropolitan Archives (LMA), London Electric Railway Commercial Report, ACC-1297-LER-04 series.

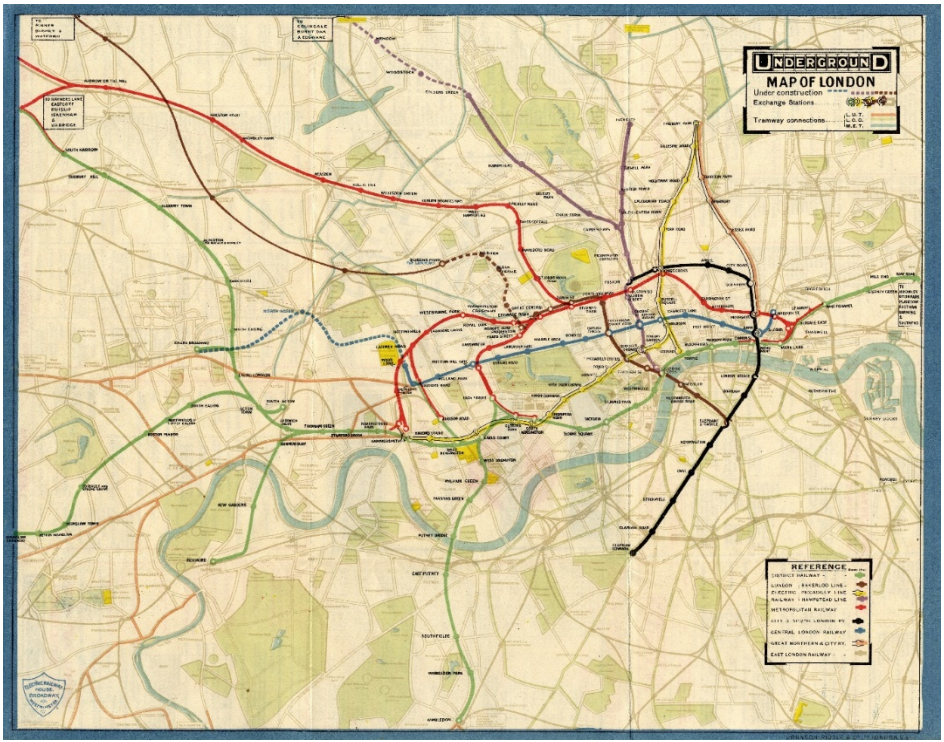


Figure 1
The London Underground Railway Network in 1913
Source: © TfL from the London Transport Museum collection.



Figure 2

The London Underground Railway Network in 1933

Source: © TfL from the London Transport Museum collection.

Literature

We begin by considering information and accounting history and the functions that statistics may play in organizations in terms of an external regulatory framework and the internal management of operations. Here there is a considerable academic literature. Paul Miranti's works (Miranti 1989 and 1990; Leslie Oakes and Miranti 1996; Nandini Chandar and Miranti 2005) on the Interstate Commerce Commission look at the how statistics were employed to construct a regulatory framework within which US railways were governed in the nineteenth and early twentieth century. Glynn (1984) does a similar though less detailed job for British railways in the same period. Yates (1991), Alan McKinlay, Chris Carter, Eric Pezet and Stewart Clegg (2010), McKinlay and John Wilson (2012) and Clegg (1994) examine how organizations may use statistics as part of their internal management systems.

Glynn and Miranti find that the motivation for requiring companies to provide detailed statistical accounts in the nineteenth century had nothing to do with raising productivity. Instead, legislators wanted to provide the investing public with accurate information about the operations and prospects of the railway companies so that individuals were safeguarded from fraud and capital was allocated efficiently within the economy. This changed over time. Oakes and Miranti (1996) demonstrate that productivity and profitability became central to the arguments for statistical accounting in the early twentieth century. For example, Louis D. Brandeis claimed that US railroads could save a million dollars a day if they introduced scientific management and standard cost accounting. The railway companies disagreed and offered to pay Brandeis all the savings that his system achieved. Whatever the truth of the matter, the case caught the public imagination and sparked the 'Efficiency Craze' which lasted until US entry to the First World War.

These studies encapsulate the shift in the discourse about the function of detailed statistical accounting from nineteenth century external regulation to twentieth-century internal management tool. Regarding the latter role, Yates (1991) explores how mass information was created and directly applied within organizations, noting that sometimes novelty trumped efficiency so that productivity gains were non-existent. Indirectly, Clegg (2004), McKinlay et al. (2010) and McKinlay and

Wilson (2012) focus on the workforce identities and managerial discourses that intensified statistical accounting methods created, concluding that detailed real-time statistical information was essential to create the disciplined employee required for mass production with commensurate gains for factory productivity.

In summary, the literature on accounting history suggests that while statistics were intrinsic to establishing a tighter regulatory framework for railway companies and bought about clear changes in the quotidian rhythms of organizational management, their function in raising productivity and profitability was disputed. It might only have come about indirectly as a result of their managerial function in creating a disciplined force of employees out of a more autonomous group of hired hands (McKinlay and Wilson 2012). This is certainly plausible within the industries considered in that study, but we note that British railways in general, including the London underground, had no real need to create a well-disciplined corps of railwaymen as they had begun and completed that process long before manufacturing, making this an incomplete explanation for adoption and use of mass statistical accounting for the specifics of this case study (Peter Kingsford 1953).

We turn now to the literature that holds that the function of information, both regulatory and managerial, is explicitly political. This is alluded to by Oakes and Miranti (1996) when they demonstrate that part of Brandeis's appeal was that management by statistics offered apolitical neutrality in an era riven by political discord between left and right. 'Neutrality' was also one facet of what George Gibb and his protégé Frank Pick had in mind when they advocated and then implemented the collection of statistics for London transport companies (Christian Barman 1979).

Theodore Porter (1995) theorizes the same on the basis of his study of the American and French Army Engineering Corps. He argues that the language of quantity has a quality of its own in that its supposed objectivity shields the organization from criticism. As Porter (1995, 8) notes: "Quantification is a way of making decisions without seeming to decide. Objectivity lends authority to officials who have very little of their own" However, as Porter continues (1995, 85-86) this comes at price: "Quantification is a powerful agency of standardisation because it imposes

order on hazy thinking, but this depends on the license it provides to ignore or reconfigure much of what is difficult or obscure."

In common with other reviews this article does not intend to dispute either point (Trevor Pinch 1996; Matthew Wise 1996) but it does intend to try and reapply his arguments in a private sector setting in the UK. Though we consider that his contentions are reliable, there is some scope to extend their validity as Porter's evidence is drawn primarily from either the US Army Engineering Corps in the 1940s or the French equivalent in the nineteenth century, a rather narrow evidential field in especially terms of sector but also in terms of nationality and time period.

Keith Grint (2005; 2008) and Stephen Brookes and Grint (2010) tackle the issue from a different direction. In their view the purpose of statistics is not necessarily to apply them to a problem facing an organization, or to shield weakness or to impose standardization. Instead they may be used by decision-makers to reconfigure the perception of the problem in the minds of other decision-makers, service users or customers. Rather than uncertain officials answering their questioners with a fog of statistics, this argument is more suggestive of powerful elites confident enough to question the question, albeit in a subtle manner. Again, this article does not intend to dispute the point per se, merely to see if it stands the test of an alternative evidential setting. Grint's work is situated primarily in his studies of the UK's National Health Service in the late twentieth and early twenty-first centuries. As with Porter his evidence is drawn from a public organization with an unavoidable commitment to public accountability. How officials might behave in a private organization less obliged to divulge information remains open to speculation. In summary, theories of the alternative applications of statistics in organizations are found to be well argued but would benefit from being applied in private sector case studies.

Finally, moving to the London transport literature, reviewing what actually happened to productivity, profitability, management and regulation there is harder. The existing historical studies of London transport simply do not cover the productivity of the organization(s) to any significant degree (Theodore Barker and Michael Robbins 1976; Alan Jackson and Desmond Croome 1962; Christian Wolmar 2005). These focus primarily on the expansion of the network, technical and engineering

developments, industrial design and artwork, and the development of the suburbs and architecture. Some time is spent on discussing the financial history of London transport, and this can be used as a proxy with interpretive caveats for trends in productivity. But the fluctuating value of an activity is not necessarily correlated to the output as the contributors to the 1909 report were keen to point out (Acworth 1912). Moreover, the financial evidence presented by Barker and Robbins, Jackson and Croome, and Wolmar is relatively scanty and non-continuous. All authors admit that their work is for the generalist not the specialist reader.

Thus the regulatory framework and management of London transport is discussed almost entirely in terms of progress towards a unified transport network. Amalgamation is held to have achieved some economies of scale and standardization, though fewer than expected (Wolmar 2005, 254-277). The workforce is found to have been well motivated, highly professional and had good relations with the management (George Johnston and Thomas Spates 1930; Hugh Clegg 1950). No direct connection is drawn or discussed to the use of statistics and scientific management methods in achieving this outcome, despite their proponents making strong claims for both in the period (Arthur Lowes-Dickinson 1924; Herbert Morrison 1933). Nor are productivity statistics produced in support of either amalgamation or good labor relations as desirable outcomes.

Regrettably, this absence in the canonical histories appears to be mirrored in the academic literature too. There is little to compare with the managerial, regulatory and financial studies of mainline railways by Michael Bonavia (1981), Glynn (1984), Anthony Arnold and Sean McCartney (2005), or Roy Edwards (2010). In the period, Cyril Hurcomb's (1925) article avoids passing judgement on the issue by claiming that insufficient time has elapsed since the end of the First World War for the effects of the reliable application of statistics to make themselves felt. In conclusion, there are considerable omissions in the London transport literature on this topic, and the wider literature suggests an ongoing and lively debate on the function of statistics. Addressing this gap and offering a case study-based judgement on the function of detailed statistical accounting are contributions that this article makes to business history.

Contribution to Business History

In the absence of extensive work on this topic in the London transport field, this article intends to answer two questions: Firstly, did productivity improve after 1913 in the wake of the accumulation of detailed statistical evidence concerning the operation of London's underground railways? Secondly, if it did not, what was the true purpose of this exercise? As discussed earlier, did gathering statistics have internal managerial value in its own terms for the railway industry, or was it done for regulatory reasons because it was realized that the industry had to defend itself against external critics in the courts, parliament, trade unions and shareholders' associations?

Answering the first question can be achieved relatively simply and quantitatively via archival records. In doing so this article expands what is known about London's transport history. Answering the second question allows us to explore how statistics were used in the regulatory and managerial spheres, and whether their 'neutral' status was in fact highly politically charged. By doing this we can construct a hypothesis about the function of statistical reporting in a historical organization which devoted considerable resources to that task, but the outcomes and motives of which we currently know relatively little.

Methods

This article is the evaluative history of London transport. In this case study, theories will be confronted with detailed historical evidence to test their explanatory power and identify limitations (Mairi Maclean, Charles Harvey and Clegg 2016). While this case study is of a single instance, the primary data are considered continuously over two decades which we argue is sufficient to overcome anomalies and rebut the charge of exceptionalism (Marcelo Bucheli and R Daniel Wadhwani 2014). The primary sources were identified by archival search in the archives most pertinent to organizations in question, Transport for London archive (hereafter TfLA) and the London Metropolitan Archives (hereafter LMA). Data are presented from 1913 (the implementation of the Railway Companies (Accounts and Returns) Act 1911) to 1932 (the year before the formation of the LPTB). The secondary sources were identified by study of the relevant journals, articles and following their citations. The

quantitative figures and clear definitions of the terms of railway productivity from the primary and some secondary sources provide the theoretical lens and the conceptual vigour of organization studies. This can be married to a historical interpretation of the past through secondary sources as a subjective process and thus elements of synthesis and dual integrity from both history and organization studies can be achieved.

Maclean et al. (2016) also discuss representational truth, contextual sensitivity and theoretical fluency as principles of the same creative synthesis. Methodologically, this article does not seek to provide an absolute positivist proof, not least because historical specificities undermine attempts to provide universally applicable answers. Nevertheless, 'Representational' truths about the historical operation of organizations can be arrived at, particularly when the primary evidence is situated within well-defined business principles and theories such as passenger/ton mileage, traffic density, situational leadership theory etc. which lend a theoretical fluency to the analytical process.

Findings–The Use of Statistics to Boost Productivity

The main service of a railway is transportation, which involves the carriage of quantity for distance. The multiplication of one of these factors by the other represents the most basic building block of measuring the service performed, and the terms to express the results are passenger miles and ton miles (Mossop 1911). Due to the nature of London transport, this article deals with passenger miles. Normally this is achieved by multiplying the number of passengers by the number of train miles run, but the high standards of statistical exactitude implemented by the London transport companies are immediately apparent since they calculated mileage by car (carriage) rather than by train. Multiplying these figures gives results in the order of trillions. More succinctly, a different calculation allows us to see how many passengers were carried for each mile each piece of rolling stock moved. Table 1 below shows a clear pattern which is that the latter part of the First World War produced a spike in passenger journeys against a stable number of car miles run. After 1919, however, London underground railways became less productive, falling below the 1913 levels from 1924 onward. Fewer and fewer passengers were being conveyed for every mile run by their rolling stock. Evidence

Table 1
Passenger Journeys and Car Mileage on London Underground Railways, 1913-32

Year	Passenger Journeys (000s)	Car Miles Run (000s)	Average Number of Passengers Carried per Car Mile
1913	250,394	48,526	5.16
1914	251,247	48,410	5.19
1915	256,313	50,957	5.03
1916	287,884	52,726	5.46
1917	340,510	55,099	6.18
1918	381,726	54,767	6.97
1919	399,824	55,841	7.16
1920	402,595	63,202	6.37
1921	338,038	58,082	5.82
1922	324,970	58,448	5.56
1923	305,249	57,378	5.32
1924	297,425	58,896	5.05
1925	318,022	65,437	4.86
1926	309,333	65,398	4.73
1927	342,883	79,005	4.34
1928	368,232	81,108	4.54
1929	391,529	83,482	4.69
1930	403,404	85,286	4.73
1931	394,885	84,197	4.69
1932	376,946	85,669	4.40

Source: London Metropolitan Archive, ACC-1297-04-065.Underground and London Traffic Statistics Book No. 1.
Note: For the purposes of simplicity and continuity in interpreting the archival records, London Underground Railways are taken to be The Metropolitan and District Railway, London Electric Railways, The City and South London Railway and The Central London Railway.

from Table 2 corroborates this from a slightly different angle. This shows the total number of passengers carried daily by each item of rolling stock in service. Despite peaks and troughs in the overall daily number of passenger journeys, the trend in the ratio of inputs to outputs with which

the London underground railways were transporting passengers was increasingly unproductive.

Table 2
Passengers Carried per Car per Day on London Underground Railways, 1913-32

Year	Passenger Journeys Per Day (000s)	Average Cars in Service per Day	Average Number of Passengers Carried per Car per Day
1913	686	978	701
1914	688	-	-
1915	702	-	-
1916	789	-	-
1917	933	-	-
1918	1,046	-	-
1919	1,095	1,137	963
1920	1,103	1,178	936
1921	926	1,062	872
1922	890	1,110	802
1923	836	1,103	758
1924	815	1,097	743
1925	871	1,123	776
1926	847	1,095	774
1927	939	1,307	719
1928	1,009	1,358	743
1929	1,073	1,453	738
1930	1,105	1,490	742
1931	1,082	1,523	710
1932	1,033	1,609	642

Source: See Table 1.

While output is one way of considering a railway's services, it is certainly not the only way. From an investor's perspective, the attraction of a hypothetical railway that carries 1,000 tonnes of gold 1,000 miles daily over a railway that carries 1,000 tonnes of stone the same distance is obvious given the current relative value of gold and stone, although their physical productive outputs in tonne miles are identical. Clearly the relationship between the revenue derived from the load to the cost of

conveyance, the operating ratio, is critical to railway operations. The London underground railway companies collected more data relating to this issue than any other. Some of this is displayed below in Table 3. This shows that nominal receipts and costs per passenger both rose considerably during the war period, but in the immediate postwar world costs rose far more rapidly than revenues posing a serious threat to the operating ratio. In the late 1920's and early 1930's costs fell steadily though receipts remained stable, allowing the operating ratio to regain some, but not all, of its 1913 margin. Adjusting for inflation simplifies the narrative: over the period receipts per passenger fell by 18 percent, costs rose by 6 percent. Whatever productivity trends on passenger mileage London's underground railways were producing, their ability to extract net revenue from their loads was diminishing. All in all this should not have produced conditions in which investors' financial interests could have been expected to flourish. Curiously, Table 4 shows that this was not the case. In fact, shareholders, especially holders of ordinary shares, had reason to be steadily increasingly cheerful over the entire period. The primary reason for the increasing amount of capital available to pay dividends despite a poor productivity record on the railways lies in the operation of the 'Common Fund' or financial pooling arrangement which all the London transport companies entered into during 1915. This allowed profits from transport companies with low fixed costs (buses) to be transferred to those with high fixed costs (railways). Secondarily, we can note that poor productivity does not necessarily result in the absolute amount of net income falling provided that the organization(s) expand fast enough. It is true that the London underground railway companies would have had even more net income available out of which they could have paid dividends if they had been able to carry more passengers per mile than they did. But even though the effectiveness of their use of rolling stock diminished, we can infer that the sheer volume of growth in passenger traffic, probably as a product of the growth of London's population and greater affluence in the Home Counties in this period, was sufficient to tide their net revenue over (Barker and Christopher Savage 1959; Julian Greaves 2005; Robert Millward and John Singleton 1995).

Overall, we find that the London underground railway companies failed to improve their productivity during a period of economic

uncertainty in the First World War, the recession of 1920-22 and the onset of the Great Depression 1929-32. They failed not only to carry passengers more efficiently as a ratio of physical inputs to outputs, but they also failed to improve the ratio of revenue to costs involved in the carriage of that traffic. Counter-intuitively, this failure corresponds to a period in which financial returns, the cause of the original fears about railway productivity around the turn of the century, steadily improved.

Table 3
Passenger Receipts, Operating Costs and Operating Ratios, 1913-1932

Year	Average Receipt per Passenger (Pence)	Average Receipt Adjusted for Inflation	Average Operating Expenses per Passenger (Pence)	Average Operating Expenses Adjusted for Inflation	Operating Ratio
1913	1.72	1.72	0.87	0.87	51
1914	1.71	1.72	0.92	0.93	54
1915	1.89	1.67	1.12	0.99	59
1916	1.89	1.36	1.16	0.84	61
1917	1.93	1.04	1.15	0.62	60
1918	2.01	0.85	1.28	0.54	64
1919	2.27	0.86	1.60	0.61	70
1920	2.52	0.81	2.17	0.69	86
1921	3.1	1.08	2.39	0.83	77
1922	3.1	1.23	2.11	0.84	68
1923	2.85	1.20	2.09	0.88	73
1924	2.86	1.21	2.14	0.91	75
1925	2.79	1.18	2.06	0.87	74
1926	2.82	1.20	2.25	0.96	80
1927	2.85	1.24	2.17	0.95	76
1928	2.87	1.25	2.05	0.90	71
1929	2.86	1.26	1.96	0.86	69
1930	2.85	1.29	1.84	0.83	65
1931	2.87	1.36	1.90	0.90	66
1932	2.91	1.41	1.89	0.92	65

Source: See Table 1.

Notes: Operating ratio (author's calculation) = Average Operating Expenses per Passenger x 100/Average Receipt per Passenger. Adjustments for inflation are calculated by the author at RPI, constant 1913 prices (Measuring Worth, 2019).

Table 4

Average Returns on all Classes of Shares Paid out of Revenue, Net Income, Amount Available to Pay Dividends and Amount Derived from Pooling on London Underground Railways, 1913-1932

Year	Average Return (%)	Net Income (£000s)	Amount Available to Pay Dividends (£000s)	Amount Derived from the Operation of the Common Fund (£000s)
1913	2.7	1,141	220	Nil
1914	2.5	1,112	178	Nil
1915	2.5	1,180	312	271
1916	3	1,336	394	345
1917	3	1,684	428	354
1918	3.2	1,793	513	430
1919	3.1	2,061	425	335
1920	2.8	1,782	315	241
1921	4	1,479	726	649
1922	4.1	1,871	958	772
1923	4.1	1,583	1,005	751
1924	4	1,504	934	615
1925	4	1,604	882	633
1926	4.2	1,392	866	609
1927	4.5	1,726	1,030	788
1928	4.5	1,948	1,215	887
1929	4.5	2,173	1,233	870
1930	4.5	2,384	1,255	874
1931	4.4	2,283	1,179	776
1932	4	2,318	923	510

Source: See Table 1.

Having discounted the existence of productivity improvements in the areas of physical output and financial efficiency as a result of more detailed record keeping, this leaves us with one final medium through which to assess the activities of the London underground railways: their social utility. This is not directly related to productivity, but it plays an

important role in shaping the public and political perceptions alluded to earlier in the Brandeis case and by Porter (1995) and Grint (2005; 2008) in theorising about the management of opinion.

Tim Leunig (2006) considers that the social saving from railways is the minimum additional amount that society would have to pay to do what the railways did without them. The railways' social saving therefore measures the fall in wider national resources required to provide a given level of output, and the social savings are a measure of the contribution of technological change to productivity growth. Leunig's method of quantifying that social saving is to express it as the time saved by an individual travelling by rail as opposed to other previous means, typically walking, riding on horseback or by stage coach and then multiplying it up by estimates of the value of one hour of a worker's time. In London's case, the well-documented congestion means that we need only consider average walking speed (2.5mph) as the comparator. Tables 1 and 5 show that in 1913 passengers made 250,394,459 journeys at an average speed of 17.3mph. On those figures 18,905,000 hours of time were saved. By 1932 passengers made 376,945,606 journeys at an average of 20.5mph, giving an impressive 68 percent rise to 31,852,000 hours of time saved. Even if the number of journeys is held constant, the rise in average speed still generates an additional approximate total of 2,300,000 hours.

The headline fact is that London underground railways moved more passengers faster and thus generated increasing social savings for the wider economy in both absolute and relative terms. However, Leunig admits that assigning a monetary value to the time saved is a problematic. Examples cited by him vary from 4.5 to 8 pence per hour in the mid-Victorian period (Dionysius Lardner 1855; Terry Gourvish 1980). Nevertheless he finds them to be significant, estimating that they were worth 5 percent of GDP in 1865 and 14 percent of GDP in 1912.[3] This article eschews placing any specific value on the time saved by London's underground railways, but notes in general that London s population grew very slightly as a proportion of the rest of the UK from 17 percent to 17.5

[3] Nominal UK GDP was £34 per capita in 1865. By 1912 it was £51 per capita. Since cumulative inflation between those dates was just -0.07% the values are directly comparable (Measuring Worth 2019).

percent in the period 1911-1931, that the incidence of unemployment was always 5-15 percent lower than in other UK regions (excluding the wider South East) after 1920 and that average productivity and incomes were appreciably higher than average UK ones (Stephen Broadberry 1986; Greaves 2005; Peter Scott 2007). Overall, we infer that London underground railways' social savings to the London economy were significant. Whether they were a productivity measure used by management is debatable, but increasing speeds undoubtedly played a role in generating good publicity. We will return to this function of statistics as a tool to influence opinion later.

Table 5
Average Speed on London Underground Railways, 1913-1932

Year	Average Speed (mph)
1913	17.3
1914	16.6
1915	16.5
1916	16.5
1917	16.5
1918	16.5
1919	16.1
1920	16.1
1921	16.1
1922	16.1
1923	17.7
1924	18.3
1925	18.1
1926	17.7
1927	17.7
1928	19.2
1929	19.2
1930	19.6
1931	19.5
1932	20.5

Source: See Table 1.

In summary, we find that the increasing volume of statistics coincides with a period of decreasing rather than increasing productivity in terms of physical output on London's underground railways, and that there is a similar trend in revenues versus costs. Nevertheless, pooling revenues and a generally buoyant and expanding market allowed dividends to rise. The hopes of Paish, Acworth, Gibb and Ashfield in the value of statistics were misplaced, but crucially the origin of their fears was dispelled.

However, before closing the case on the data enthusiasts we should consider five questions. Firstly, but for the increased collection of statistics, would productivity have been even worse? The issue here is that apart from the evidential problems with counterfactual history, even if it could be proved that accumulating more data slowed the rate of decline statistics were not the solution that they were purported or needed to be. Clearly the railways' structural productivity problems went deeper than data collection could remedy. A measure that was intended to improve matters was not even able to stabilize them.

Secondly, did the fall in productivity 1913-32 have a different external cause(s)? In this case, whatever the varying economic conditions and uncertainties faced by the London underground railways, the trend of diminishing productivity is essentially steady. Over twenty years circumstances come and go, but decline is un-arrested. Hurcomb's plea in 1925 that the fruits of statistical labor today would create more productivity jam tomorrow could only be credible for so long.

Thirdly, was the new regime after 1913 for statistical gathering still too incomplete in its scope to be effective? We know that Paish, Acworth and Peel considered the breadth of the provisions for gathering statistics in the 1911 Act, to be incomplete, and that this view is echoed by Mossop (1911), who regarded some statutory extension of the terms as being essential. These additions consisted of recording the engine hours, the wagon/carriage mileage, passenger mileage, density of traffic, goods/passenger carriage loads and passenger/ton mileage (UK Board of Trade 1909). However, the close involvement of the enthusiasts for statistical measurement as a management tool in London transport meant that all these additional measures were built into their record keeping. Regrettably for them, it still bought about no improvement in productivity.

Fourthly, if the statistics were gathered as a function of regulation, were they put to actual managerial use? Earlier we saw that Yates (1991) documented cases where statistical recording of certain phenomena continued to occur even after senior management had indicated that it no longer served any purpose, and systems of accounting were the product of inertia or novelty value. Evidence from the archives offers examples in London transport where statistics were the basis for fare setting, negotiations with trade unions or shareholders and used as the justification for the provision of services and the construction of new lines.[4] It seems fair to conclude that statistics did play some direct function in managerial decision-making, but that raising productivity remained unsolved.

Fifthly, were the statistics categorically counting the wrong thing? The railways delivered tremendous welfare gains to travellers and society that were not easily captured in financial terms (Leunig 2006). Irving (1978) suggests that from 1870, railways reacted to their increasingly poor image in the eyes to the public by concentrating on the effectiveness of their services in providing what the public wanted, rather than maximising their efficiency in input–output terms. If, despite the protestations of its supporters, the true function of statistical gathering lay away from productivity improvement, we should explore some alternative purposes for the collection of statistics by an organization. To that end we will now consider the management of opinion.

Findings–The Use of Statistics to Influence Public Discourse

Having discounted the generation of productivity enhancements, the use of statistics by the management of London transport may be better explained by accepting elements of several other propositions. Previously we saw in Oakes and Miranti (1996) that statistics–or their absence–were used as a stick to beat US railway companies and point out their failings in a highly successful publicity campaign. They emphasized that an otherwise dry set of statistical debates in the case was only energized by

[4] TfLA: Fixing a Fare LT 1182-2, The Problem of the Fare 1413-01, Wage Comparisons from 1914 LT 353-221, Annual Reports of The Metropolitan Railway LT 103-01 series, Pick-Ashfield Business Correspondence LT 527 series. LMA, Proposal for the Thames River Boat Service ACC-1297-LPT-01-009-037.

Louis Brandeis' extensive media contacts. This then generated a society-wide 'efficiency craze' for several years which drew in organizations which had no industrial function such as churches, schools and households. We can infer then that in this period statistics were potentially a very powerful weapon in controlling or shaping public opinion. Much of their resonance in the period lay in the perception that statistics were 'neutral'. This supports Porter's (1995) argument that organizations use statistics to give a simulacrum of objectivity in decision making because they are too weak to justify their decisions to external actors on the basis of their own professional subject matter expertise.

Lastly, we note that the challenges which public service organizations have to deal with may be primarily political or social constructs not susceptible to positivist de-construction (Grint 2005). In this interpretation, in order to be successful, the role of senior management is to successfully reinterpret the problem facing the organization in the minds of the major stakeholders. In other words, rather than answering the question–which may not have an answer–they need to change the question (Brookes and Grint 2010). The role of statistics remains important, but their function is to influence the perceptions of regulators rather than changing managerial processes.

Public Perceptions of London Underground Railways

If railways in general had a somewhat tarnished image by the 1900s (Irving 1978), then London's underground railway owners' image had suffered especially badly. In 1902 maladroit manoeuvring between American financiers Charles Yerkes and J.P. Morgan had caused the failure of a major tube railways scheme (Barker and Robbins 1976). In 1904, the main shareholder in the parent company of the Baker Street and Waterloo (Bakerloo) Railway committed suicide in the Royal Courts of Justice after being convicted of major fraud. As well as taking poison, he was found to have had a loaded revolver in his pocket while in court (Stephen Halliday 2004). In 1907, the tortuous financial system which had sustained The Underground Electric Railways of London Company (UERL) collapsed, and its entire debt had to be restructured (Jackson and

Croome 1962). [5] Confidence in the integrity of the owners of London's underground railways had taken a terrible series of blows, and at the end of the First World War members of parliament were prepared to say in the House of Commons that London transport was secretly controlled by German financiers who were 'Hook nosed patriots' that sang 'God save the King' in broken English (the House of Commons debate 1920). Public confidence in the management and leadership of London's underground railways was very low indeed, amply fulfilling Porter's hypothesis that a retreat into the use of 'objective' statistics by management was likely.

It was widely held that confidence in industry in general in the uncertain post war economic climate could be restored by a better public understanding of the financial facts upon which arbitration between workers, managers, consumers and owners could be based. These facts were naturally based on gathering statistics, and yet again, the Americans were found to be ahead in the publicity game (Lowes-Dickinson 1924). More specifically in the case of transport, there was strong movement to professionalize the industry. It was hoped that this would ensure that decisions were made on the basis of objective evidence and that 'scientific management' principles were employed. This was epitomized by the creation of the Transport Institute in 1920 (Kevin Hey 2010).

All these measures were designed to restore public and employee confidence in the industry and had statistical information as the basis for rational, quantitative-based decision-making at their core. Owners' intuition had become synonymous with corruption and inefficiency. Instead, managers would now gather all the facts and figures. Once they were known then the action required should be clear, or at the very least the action taken would be defensible. Thus the reputation of London transport's senior management could be rescued by a discourse located in statistics which claimed the efficient reconciliation of the competing claims of the consumer, the worker, the owner and the manager in the operation of industry (Lowes-Dickinson 1924).

[5] This company later amalgamated with a succession of bus and tram companies, and by the 1920s it had become the principal provider of transport in London. Its chairman (Lord Ashfield) and vice-chairman (Frank Pick) later assumed those same posts in the LPTB.

Statistics as a Defense against Regulators

We have seen how the primary motive for the introduction of more detailed statistical accounting for railways in the nineteenth century was to facilitate their regulation so that investors were better protected against fraud. This regulatory burden steadily deepened and widened with successive Companies Acts, and the state also widened its interests to include those of passenger safety, comfort and economy. Due to these increasing requirements the railway companies began to collect statistics of their own. This was in order to defend themselves against regulation arising out of cases in courts and legislative change (Miranti 1989).

From 1907 onwards, the chief threat against which Lord Ashfield and the senior management of the UERL wished to defend themselves was governmental or municipal takeover. For a variety of reasons, the political forces propelling those proposals were seriously hampered and divided (Edmund Dell 2000; James Chandler 2007). This did not mean though that if London transport were managed badly that it would remain inviolate, and in any case several attempts were made by the London County Council (LCC) and in Parliament to municipalize or nationalize London transport in the 1910s, 1920s and 1930s.

In the event, Ashfield and Pick almost entirely had the better of it. Jackson and Croome point out that proposals for the LCC to buy the UERL's debt in 1907 were defeated as were their proposals to run municipal buses and tubes in 1920.[6] In 1915 London underground railways remained outside direct government wartime control. In 1921 proposals for the reorganization of London transport from a committee under the chairmanship of William Kennedy-Jones, the member of parliament for Hornsey in London, were defeated, with Lord Ashfield playing a key role. In 1924, in spite of the protests about the quasi-monopoly status that Lord Ashfield's transport 'Combine' had now achieved, the government legislated to stop the spread of small private 'pirate' bus companies which were undermining the revenues of his organization (Morrison 1933, 54-81).

The 'pirate bus' episode offers the opportunity to explore a short case study where statistics were used in an explicitly political manner by the

[6] TfL Archives, LT-346 series.

London transport combine. The 1919 Select Committee report on London transport noted that the Combine was already forcibly making the statistical case that small competitors were driving down revenues.[7] It is clear that the explosion of small private bus companies was carefully documented by the Combine in the years following the First World War.[8] Their performance, finances and activities were noted, and then used as the basis for stories, usually casting them in a negative light, which then appeared in the press.[9] There was tacit co-operation between big business (the Combine) and large trade unions (the Transport and General Workers Union) to eliminate small scale competition as noted by Morrison (1933). This pincer movement was based on statistical proof of falling revenues and falling wages and in 1924 it was successful in getting the London Traffic Act passed which dramatically curtailed competition (Clegg 1950).

This process was taken to its logical conclusion with the creation of the quasi-public corporation the LPTB in 1933. This is held to be the apotheosis of Ashfield and Pick's careers. They became the unrivalled masters of the management of London transport (Wolmar 2005). Commentators at the time and subsequently have attributed this achievement at least in part to their overwhelming command of information which allowed them decisive advantages in contests with their critics. Frederick Menzler, the LTPB's Chief Financial Officer commented: "Of Pick, it could be said without sarcasm, that he knew all the answers ... In this connection his handling of statistics, though often brilliant, was at other times shattering to the self-respect of his advisors."[10] In a similar vein, his comment on Lord Ashfield was that he suffered from a sort of 'divine discontent' which resulted in him constantly reviewing and urging the review of reports, policies and practices.[11] Elsewhere, Lord Latham, Chairman of the LCC and later of the London Transport Executive emphasizes the same themes: "Both [Pick and Ashfield] had the supreme quality of never being satisfied or complacent about their

[7] TfLA, The 1919 Report of the Select Committee on Transport in the Metropolitan Area. LT-370-03.

[8] LMA, ACC-1297-UER-04-065. London Transport Statistics.

[9] TfL Archives, LT 346-001, Press Cuttings.

[10] TfLA, LT1172-013. Lord Ashfield and the Public Corporation, 7.

[11] Ibid, 6.

achievements. Mr Pick in particular was responsible for the evolution of a whole gamut of statistical controls which ... still provide the basis many of the methods we employ today."[12]

It is clear that neither man was satisfied until he was the master of his brief. Would be critics and regulators soon discovered that they could not rival their command of the figures.[13] Evidence from Pick and Ashfield's business correspondence and the views of their contemporaries offer a compelling record that statistics were important ammunition in counteracting their critics, especially in Parliamentary committee or in the press. Pick's mentor, Gibb, had likened them to an essential quarry or an arsenal, and the records are replete with evidence of the frequency and effectiveness with which Pick and Ashfield brought them to bear.[14]

The evidence from the period also points towards a movement in the management of London transport from a position of weakness at the end of the First World War towards an elite of powerful influencers of wider opinion by the 1930s. As Pick himself observed in 1936: "The London Passenger Transport Board (LPTB) is a new experiment in administration ... authority is vested in a small group of seven people selected for their knowledge and experience–a kind of aristocracy of business ... these seven people are practically beyond control."[15] The evidence from the early 1920s demonstrates that the use of statistics was a keystone of defense against regulators as Miranti and Porter (1995) would suggest.[16] Later, the evidence shows that over time it became more than just a defense. By the

[12] TfLA, LT248-181, Efficiency in London Transport, 3.

[13] For example, see transcripts from TfLA, LT493-080 Conference of The London General Omnibus Company and the Transport Workers Federation, October 14, 1921, and LT571-034 Report of the proceedings at the meeting of London members of parliament and The Rt Hon Lord Ashfield, March 3, 1920.

[14] TfLA, LT 249-182, Accountancy in a Large Scale Industrial Organisation; LT249-181, Efficiency in London Transport; LT345 Series, Articles published by Pick-Ashfield;

LT1172-019, Record of the Second Annual Conference of Members and Officers of the London Passenger Transport Board–1937.

[15] London Transport Museum Archives, B6 Box 5. Frank Pick Speech at Oxford 1936, 1.

[16] The National Archives, Kew, London, MT36/1 The Formation of a London Traffic Authority; MT36/10 The Proposed Structure of a London Traffic Authority.

1930s Pick's speeches indicated that the LPTB's unaccountable managerial elite were confident enough to openly describe themselves as such.[17] That they could make these claims and retain the confidence of the public, shareholders, minsters and trade unions in their ability to be the appropriate guardians of an enormous public utility says much about their aptitude in shaping perceptions.

Statistics as a Mechanism for Shaping Public Perceptions

Appropriately, the shaping of public opinion began with an extensive positive publicity campaign post 1907 run by Pick (Barker and Robbins 1976). He was a firm believer in the necessity of detailed statistical information in running an organization (Barman 1979). The first move in Pick's publicity strategy was the standardization of signage, information and design across a disparate network to make the London underground railways and transport in general immediately recognisable. The ubiquitous roundel was soon in evidence across London followed by the famous Beck map (Barman 1979; Ken Garland 1994). He then advocated using colourful simple designs with innovative fonts in a series of poster campaigns, many of which have become artwork icons (David Lawrence 1994; 2000).

A small minority did directly presented statistics relating to London transport operations, notably the progress of the New Works projects in the 1930s. Most depicted pastoral scenes, suburbia or London's attractions. However, in common with the mainline railways, much of this latter type of 'bucolic' publicity also directly or indirectly emphasized speed, convenience, safety, punctuality, and economy (Colin Divall 2011; David Ashford 2013). All these claims could only be substantiated by recourse to statistics. Finally, as well as the direct presentation of statistics, domestic idylls and tourist attractions there was a 'social realist' school of poster which portrayed imposing technology, rugged workers and power stations. This ostensibly had nothing to do with statistics. However, we suggest that it was nevertheless part of creating an image in the public mind of an organization that had embraced the application of scientific

[17] London Transport Museum Archives, B6 Box 5. Frank Pick Speeches to the London School of Economics 1935 and at Oxford 1936.

methods to progress and achieving efficiency which was entirely commensurate with or indeed dependent upon statistical analysis (Hey 2010).

As well reassuring the public that their transport was safe in the hands of experts, there was another set of actors who also had to be placated or persuaded to actively hand over power to a managerial elite. These were the financial owners, trade unions and politicians at various levels of government. Statistics proved useful in each case, but in the main politicians proved the easiest to persuade. As Chandler (2007) and Offer (1981) demonstrate, Conservative politicians were keen to remove the provision of public services from democratic control at both municipal and national level. Thus, experts wielding 'apolitical' statistics as a basis for decision making as opposed to voters awarding themselves ever-growing public services at the expense of local taxpayers seemed ideal managers. Organized labor was equally in awe of experts in this period, albeit for different reasons. A fair society obviously required rationality in the way in which resources were allocated. This would be achieved through centrally gathering statistics which experts could then fruitfully employ for the greater good as opposed to the wastefulness of competition (Dell 2000, 77-100).

Shareholders and trade unions proved harder to persuade but, with politicians already won over, they were left to dispute the terms of the agreement to create the LPTB with LPTB managers rather than the agreement to hand over power itself. Evidence shows that London Transport handled their claims on a case by case basis, each instance heavily backed up by recourse to statistics.[18] Managerial elites occasionally lost battles to these interest groups, but they had already won the war of perceptions which had granted them control of private monopoly in the first place. In summary we suggest that while the direct employment of statistics in publicity campaigning was not nearly as prominent as in committee or legal work it was nevertheless a pervasive

[18] TfLA, LT374 Series, Compensation Claims by Former Owners; LT493 Series, The 1937 Bus Strike; LT 653 Series, Publicity Relating to Stock Prices.

and essential background to the organizational image that London transport's mangers were seeking to create.

Conclusions

This article began by asking whether the increasing detail with which statistics were compiled by London's underground railways had the promised effect of improving measures of railway productivity in a period of economic uncertainty. We find that the answer is a conclusive no. However, when the value of railways' services is interpreted more widely to include social value then there is evidence of improvement. However, this function is related to the management of regulatory opinion. The use of statistics as a managerial function appears to have failed.

Thus, we come to the second debate over what other function, if any, statistics played. We find that there is a strong case for the use of statistics both as a defense against direct attempts to regulate and also to shape qualitative public perceptions of London transport, thus forestalling further regulation before it was even posited. The use of statistics is most notable in the against criticism but it was also visible, though more subtly, in the positive publicity campaigns run to persuade society that London transport was managed by a small elite who could be trusted to act scientifically, objectively and efficiently.

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Appendix One: Financial Accounts Required of Railway Companies by The Railway Companies (Accounts and Returns) Act 1911.

No. 1 (a). Nominal Capital authorised, and created by the Company.
No. 1 (b). Nominal Capital authorised, and created by the Company jointly with some other Company.
No. 1 (c). Nominal Capital authorised, and created by some other Company on which the Company either jointly or separately guarantees fixed dividends.
No. 2. Share Capital and Stock created, as per Statement No. 1 (a), showing the proportion issued. No. 3. Capital raised by Loans and Debenture Stock.
No. 4. Receipts and Expenditure on Capital Account. No. 4 (a). Subscriptions to other Companies. No. 5. Details of Capital Expenditure for year ending
No. 6. Estimate of further Expenditure on Capital Account.
No. 7. Capital Powers and other Assets available to meet further Expenditure on Capital Account.
No. 8. Revenue Receipts and Expenditure of the whole Undertaking.
No. 9. Proposed Appropriation of Net Income.
No. 9 (a). Statement of Interim Dividends paid.
No. 10. Receipts and Expenditure in respect of Railway working.
ABSTRACT A.-Maintenance and Renewal of Ways and Works.
ABSTRACT B.-Maintenance and Renewal of Rolling Stock- (1) Locomotives. (2) Carriages. (3) Wagons.
ABSTRACT C.-Locomotive Running Expenses.
ABSTRACT D.-Traffic Expenses.
ABSTRACT E.-General Charges.
ABSTRACT F.-Expenses of Collection and Delivery of Parcels and Goods.

ABSTRACT G.-Running Powers. Receipts and Payments in respects of Running Power Expenses. ABSTRACT H.-Mileage, Demurrage, and Wagon Hire.
ABSTRACT J.-Jointly owned and jointly leased Lines. Receipts and Expenditure.
No. 11. Receipts and Expenditure in respect of Omnibuses and other Passenger Vehicles not running on the Railway.
No. 12. Receipts and Expenditure in respect of Steamboats.
No. 13. Receipts and Expenditure in respect of Canals.
No. 14. Receipts and Expenditure in respect of Docks, Harbours, and Wharves.
No. 15. Receipts and Expenditure in respect of Hotels, and of Refreshment Rooms and Cars where catering is carried on by the Company.
No. 16. Receipts and Expenditure in respect of other Separate Businesses carried on by the Company. No. 17. Electric Power and Light Account.
No. 18. General Balance Sheet.

Appendix Two: Statistical Returns Required of Railway Companies by The Railway Companies (Accounts and Returns) Act 1911.

1. Mileage of Lines-
(A).-Mileage of Lines open for Traffic.
(B).-Mileage of Lines authorised but not open for Traffic.
(C).-Mileage of Lines run over by the Company's Engines.
II. Rolling Stock-
(A)-Steam Locomotives and Tenders.
(B)-Rail Motor Vehicles.
(C)-Trains worked by Electric Power.
(D)-Coaching Vehicles (other than Electric).
(E)-Merchandise and Mineral Vehicles.
(F)-Railway Service Vehicles, and Horses for Shunting.
III. Horses and Road Vehicles employed in the Collection and Delivery of Parcels, Goods, and Passengers.
IV. Steamboats.
V. Canals.
VI. Docks, Harbours, and Wharves.
VII. Hotels.
VIII. Land, Property, &c., not forming part of the Railway or Stations.
IX. Other Industries (if any).
X. Maintenance and Renewal of Ways and Works (Abstract A).
XI. Maintenance and Renewal of Rolling Stock (Abstract B).
XII. Engine Mileage.
XIII. Passenger Traffic and Receipts.
XIV. Goods Traffic and Receipts.
XV(A). Tonnage of the Principal Classes of Minerals and Merchandise carried by Goods Trains. XV(B). Number of Live Stock carried by Goods Trains.
XVI. Summary of Financial Results secured in comparison with those for past Years.
Certificates of the Responsible Officers as to the Upkeep of the whole of the Companies' Property. Auditor's Certificate. Index. Map.