CHAPTER - IV

LEVELS OF CAPITAL UTILISATION.

This chapter attempts to quantify levels of utilisation of capital stock in the Indian Railways. Generally in output-capital studies, output is adjusted to full capacity of capital to make up for utilisation levels.[1] But the present study is concerned with three variables -- capital, labour and value added. If value added output is adjusted to capacity, what about labour? It also needs adjustment. Instead of two adjustments, it is convenient to adopt the concept of 'technologically necessary capital'. Capital figures alone are adjusted to existing levels of utilisation keeping output and labour series unadjusted. First levels of utilisation have to be determined.

4.2 In railways, measurement of utilisation is extremely difficult. Railways operate with different types of capital viz. track, engines, wagons and vehicles. Track capacity is not a static capacity. It depends on investment in signalling and communication systems. Thus the nature of the problem is so highly technical that very few studies have been taken up so far. But in a study of technical relations like the present one, it isnot possible to ignore the levels of utilisation, however onerous and imperfect the task may be. It is impossible to evolve an ideal methodology. However we have made a serious attempt at measurement.

1. G.Rosen, Industrial Change in India, Asia Publishing House, Bombay, 1959, pp. 43-44.

4.3 Solow, when confronted with the problem of capacity output, merely adjusted the capital taking overall unemployment as an index and observes,[2] "What belongs in a production function is capital in use, not capital in place. Lacking any year-by-year measure of the utilisation of capital I have simply reduced the Goldsmith's figures by the fraction of the labour force unemployed in each year, thus assuming that labour and capital always suffer unemployment to the same percentage. This is undoubtedly wrong, but probably gets closer to the truth than making no corrections at all". But the method we have adopted is more scientific though admittedly it is not perfect.

Section 'A', that follows, deals with the theoretical and practical issues involved in the measurement of capacity utilisation. Section 'B' discusses estimation of under-utilisation of capital in the Indian Railways.

SECTION 'A'

Measurement of Capacity:

4.4 In recent years, attempts are made by various economists to measure capacity or potential output at micro and macro levels. Various measures are used to determine capacity output such as straight forward regression relating output to unemployment and fitting of aggregate production functions to data.[3]

2. R.M.Solow, 'Technical Change and the Aggregate Production Function', Review of Economics and Statistics, Vol.39, 1957.

3. cf.L.Taylor, D.Winter and D.Pearce, 'A 19 Industry Quarterly Series of Capacity Utilisation in the United Kingdom, 1948-68', Bulletin of the Oxford University Institute of Economics and Statistics, Vol.32, No.2, 1970.

In the U.S., various methods are used to compute capacity utilisation figures of the American economy. All these variants take into account peak production points and then certain adjustments are made.[4] However, from the point of view of operational use, the method adopted by the Wharton School, popularly known as 'Trend-Through-Peak' method may be regarded as a successful approach. Originally this method was developed by Klein,[5] and later its details were discussed by Klein, Summers and Preston.[6] Since the Wharton School capacity measure has a fairly recent theoretical support, it is not inappropriate to state the method in brief.[7] The monthly physical output series of each industry are seasonally adjusted and then averaged into quarterly production figures. These are arrayed and peaks in each of the series are selected. Each peak represents capacity and a straight line from peak to peak denotes capacity during the intervening periods. To cover the whole period, the linear segments at both the ends of the series are extrapolated. For macro purposes, the individual industries' capacity outputs are combined by assigning

4. For details, see A. Phillips, 'An Appraisal of Measures of Capacity', Papers and Proceedings of the American Economic Association, Vol.52, No.2, May, 1963.

5. L.R. Klein, 'Some Theoretical Issues in the Measurement of Capacity', Econometrica, Vol. 28, April, 1960.

6. L.R. Klein and R. Summers, 'The Wharton Index of Capacity Utilisation', Studies in Quantitative Economics, No.1, University of Pennsylvania, 1966 and L.R. Klein and R.S. Preston, 'Some New Results in the Measurement of Capacity Utilisation', American Economic Review, Vol. 57, No.1, May, 1967.

7. For details on the theoretical part, see L.R. Klein, op.cit.

weights on the basis of value-added of each industry in the total production.

4.5 In adopting the Wharton School capacity measure, a number of conceptual and empirical problems are encountered.[7A] First, the peaks selected should represent points of maximum output. For this purpose, the Wharton estimates of capacity utilisation for the U.S. economy made use of independent information, wherever possible, to substantiate the selection of peaks. In some cases, direct information was used to estimate capacity instead of trends through peak method.

Second, unless net investment is constant, between two peaks, it is not justifiable to interlink them by linear lines. To overcome this problem, Klein and Summers made attempts to take into account cyclical fluctuations in net investment, when interpolating between two peaks.

Third, if there is an abnormal output, it should not be reckoned with capacity since it cannot be sustained.

Fourth, when a weak intermediate peak occurs, while the industry's trend is exponential, connecting the peaks by straight lines is unscientific.

Fifth, when an industry's production trend is declining linking two peaks is not logical. Suppose, production at two periodsof time is same, but out of these two, only one period's production is deemed as capacity output since it is at a peak point whereas the other is regarded as below capacity.

7A. Wharton School Method has been critically examined by many economists. See L.Taylor, D.Winter and D.Pearce, op.cit. and A.Phillips, op.cit.

Lastly, in the Wharton method, the latter part of the capacity figures will undergo constant revision as more current data become available. For example, if the actual output is greater than extrapolated capacity, the capacity line has to be revised upwards.

4.6From the above discussion, it is clear that there is some reservation in accepting the lowest of several capital output ratios for peaks ofoutput as indicative of capacity. Though there are precedents to treat peak outputs as capacity, some modifications are essential. Inspite of these problems there is an important advantage in the Wharton method. When detailed technical data are not available from in-studies, this method gives reasonable hope to the analysist to proceed with his work. Once we know the actual output, reasonable estimates of indices of capacity utilisation can be easily compiled.

4.7 Since the Railways are a huge monolithic enterprise, employing highly qualified technical people, competent estimates are available within the enterprise about capacity utilisation. Thus there was no need to depend upon Wharton - School method based upon observed peaks.

4.8 In any method of capacity measure, we face a serious problem. Generally if there is some 4% of unemployment of labour, it is regarded as full employment. If capital assets are unemployed, what is its equivalent?[8] The concept and measurement

8. This question is raised by Solomon Fabricant in the discussion of'Appraisal of Measures of Capacity', op.cit.

of capacity depend on how such questions are answered. Since, these questions are answered by economists differently even with same purpose, the concept and measurement of capacity will vary. Thus, any measure of capacity is an approximate estimate and this is more true in the transport industry. We now discuss the difficulties involved in obtaining the relevant data of the Indian Railways and the method adopted to estimate capacity.

SECTION 'B'

4.9 There is great difficulty in determining the capacity of capital in the Railways compared to capacity of capital in manufacturing industries. From the Engineering data, plant capacity of a manufacturing industry can be more easily ascertained. The capacity output of railways depends at least on a combination of four important types of capital assets viz. track, locomotives, cars (wagons and carriages) and the tele-communication system. On the same unit of track, different volumes of output can be produced by operating more or less number of cars with more or less powerful locomotives. Mention may also be made about the supply and demand factors. In certain sections of a region, demand may be more but the capital assets such as track, locomotives, cars may be in short supply. At the same time, in other regions demand may be less than supply. But the immobility of assets like track prevents shifting of services to other more favourable markets. The gauges (paths) are not of uniform type, BG rolling stock cannot serve on MG or NG tracks. In view of these problems, estimation of capacity in the Railways has special problems. It may be stressed once again that our main objective is not primarily concerned with capacity as such but changing nature of technology. What we actually need is a reasonable estimate in order to correct the capital series. We now turn to the types of capital assets selected to estimate capacity.

4.10 The Indian Railways classify their capital expenditure into 9 broad categories such as land, rolling stock, structural engineering works, equipment.[9] About 75-80% of total capital is represented by structural engineering works and rolling stock. In the former, about three-fourths is accountable for track. In the present analysis, we took into account only the major important types of capital assets — track, and rolling stock. Though the Railways output also depends on other factors such as marshalling yards, terminal facilities, buildings, telecommunications and signalling equipment, organisation, we could not estimate their capacity due to lack of data and technical problems. However, they are indirectly reflected in the estimation of capacity of track and rolling stock.

4.11. After making certain reasonable assumptions, we estimated the capacity of each of the four capital assets (track, locomotives, passenger carriages and wagons) separately. The attention is focussed in finding out the chief bottleneck to expansion of output.

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9. For a detailed discussion on capital, see chapter V.

Once we know the bottleneck, our problem is simplified. To the extent the chief bottleneck asset is under-utilised, it represents the overall under-utilisation of the Railways capital.[10] We have taken into account existing conditions including the technological factors which condition the operations. To our knowledge, studies on capacity in railway transportation are not conspicuous except the in-studies by Railway's management. Hence, we are forced to fall back on our own methodology.

Definition of capacity output of Railways:

4.12 Capacity output of Railways may be understood in two ways viz. theoretical and potential. Theoretical capacity may be defined as that number of trains which can be moved if a perfect condition of train operation exists where all delays, other than those set by the time table schedule, are not considered. On the other hand, potential capacity means maximum number of trains that can be run over a certain division under existing method of directing train movements when it is assumed

10. Prof. D.U.Sastry of Institute of Economic Growth, Delhi and Prof. Geoff. Briscoe of University of Warwick, commented on an earlier draft of this chapter and wrote that a composite index of capacity utilisation using weights would be more meaningful. They rightly feel that utilisation factor is inter-dependent in the railways. Yet we have not used weights. Our estimated track capacity takes into account such interdependence. Thus in para 6.24 it is demonstrated that though frequency of trains have increased, track utilisation has decreased. Thus signalling and telecommunication improvements have increased both capacity and utilisation, the former more than the latter. Therefore ratios of utilisation to capacity have declined.

Prof. Briscoe further comments that human skills might be one of chief limiting factor in fuller utilisation of capital. We do not have data to that depth to undertake the job. However we place on record our thanks for his kind interest.

that trains are perfectly operated according to the rules. Thus the former concept does not consider delays set by rules such as safety train operation while the latter takes into account such delays. We follow, the latter concept in our analysis since it is more pragmatic.

Track Capacity:

4.13 Track is one of the most important and expensive type of capital contributing for production. Unlike in road, marine or air transport, path is the main constraint. Two trains cannot pass on the same track at a time. This means, until one train passes on a section of track, a second train has to wait at a crossing station (on a single line). On multiple tracks this constraint is not operative. Thus throughout the 24 hours in a day, continuously trains cannot be run. Besides, before a train is received at a station, many operations have to be performed such as signalling, operating token box instruments and other necessary formalities. The total time spent by a train is composed of operating time and running time and they depend on signalling facilities and speed. Thus the throughput is a function of the interval between a train reaching a station and a train in the opposite direction starting again. If this interval is minimised, more output is possible. Thus speeds of trains, composition of trains (passenger or goods, express or ordinary), operating time, type of technology, spacing of stations, efficiency of the personnel, time needed to maintain the track etc. determine the track capacity.

4.14 A number of formulae are used to estimate track capacity. One of the popular track capacity formulae is given by Scott (frequently quoted in the Railway in-studies) which is given below:

$$\text{Line capacity on a single line (in terms of number of trains both ways)} = \frac{\text{Minutes in a day}}{T + t} \times \text{Efficiency Ratio}$$

The minutes in a day are 1440, T means longest running time over any block station and t means operating time. Efficiency ratio refers to the efficiency with which personnel engaged in train operation discharge their duties.

Scott took the effiency ratio as 70% and t as 5 minutes. If the T is 11 minutes, then

$$\text{Line Capacity} = \frac{1440}{11+5} \times \frac{70}{100} = 63 \text{ trains both ways.}$$

Thus from each side about 32 trains can be operated in the above example. If there are two lines, assuming two trains are run unidirectionally, that is one line for up-trains and the other for down-trains, using the above formula line capacity can be calculated for each line separately. If there are three lines, capacity is worked out for 2 lines as mentioned above and for the third line on the basis of single line. In a similar way for quadruple or quintuple lines, capacity can be calculated.

4.15 In India till about 1960, track capacity used to be calculated on the basis of Scott's formula. From then onwards, it had been calculated by the use of Master Chart. From a scrutiny it is found that both the methods give almost the same results. The line capacity of a section is drawn up on a time-distance graph, which is known as Master Chart. In this method, the calculations depend on the skill of the person who draws it. In the Chart, first passenger trains are fitted and then as many goods trains as possible will be fitted. Finally, paths in which the run is completed in reasonable time or the economic paths, are selected. Thus line capacity of a section is determined by the use of graphical method.

4.16 Line capacity data are not published in the annual reports of the Indian Railways. Some of the Zonal Railways publish line capacity data in the 'General Manager's Annual Reports' for certain selected years specially from the beginning of the Third Five Year Plan (1961). Hence data were collected from the Railway Board's records and Zonal Railways' Annual Reports for the years 1956, 1961, 1966 and 1972. For 1951, line capacity data are not available. The area covered by a Zone is divided into certain sections. The distance of a section varies from 1 KM to 100 KMs. For each section, line capacity in terms of number of trains, per day as on 31st March is given. The distance of the section multiplied by capacity in terms of number of trains which the track permits, gives capacity train KMs per day on that section.

4.17 Having measured line capacity by the above two methods, the average actual number of train KMs performed are compared with the capacity train KMs to arrive at percentage utilisation. The ratio of capacity utilisation of track for all the Zones,

Table 4.1

TRACK CAPACITY — UTILISATION RATIOS

	Central Rly.	Eastern Rly.	Northern Rly.	North-Eastern Rly	North-East-Frontier Rly.	Southern Rly.	South Central Rly.	South-Eastern Rly.	Western Rly.	Total Indian Rlys.
1955-56										
Actual Train KMs (Lakhs p.a)	636	401	557	N.A.	-	617	-	N.A.	N.A.	-
Capacity Train KMs (Lakhs p.a)	748	664	921	N.A.	-	901	-	N.A.	N.A.	-
Utilisation (%)	85.0	60.4	60.5	N.A.	-	68.5	-	N.A.	N.A.	69.5
1960-61										
Actual Train KMs (Lakhs p.a)	713	489	650	260	154	652	-	N.A.	593	-
Capacity Train KMs (Lakhs p.a)	971	779	1051	503	232	1121	-	N.A.	1035	-
Utilisation (%)	73.4	62.9	61.8	51.7	66.4	58.2	-	N.A.	57.3	63.0
1965-66										
Actual Train KMs (Lakhs p.a)	312	566	736	302	186	724	-	479	703	-
Capacity Train KMs (Lakhs p.a)	1233	898	1375	565	334	1048	-	774	1248	-
Utilisation (%)	63.2	63.0	53.5	53.3	55.7	69.1	-	61.9	56.4	50.0
1971-72										
Actual Train KMs (Lakhs p.a)	637	558	754	300	184	567	462	559	727	-
Capacity Train KMs (Lakhs p.a)	1041	1007	1000	599	346	923	720	1117	1253	-
Utilisation (%)	61.2	55.4	75.4	50.0	53.0	61.5	64.1	50.1	53.0	60.2

Sources: Zonal Railways Annual Reports, Supplements and Official Records of Railway Boards.

Notes : 1) N.A. = Not Available.
2) Weighted average of Zonal Rlys. utilisation ratios, Weights being Running Track Kilometrage.
3) Data for 1951-52 are not available.

(for which data are available) was calculated separately and are aggregated with the running track kilometrage weights. The overall utilisation ratios for the years 1956, 1961, 1966 and 1972 are plotted on a graph and are interpolated by linear segments to know the trend. Since data for 1951-52 are not available, we have assumed a similar percentage of utilisation in 1951-52 as that of 1955-56. Such assumption is not unrealistic in view of almost constant rate of utilisation of engine and vehicle capacity in 1951-52 (engine and vehicle capacity utilisation are discussed in paras 4.19 to 4.21 below).

4.18 Table 4.1 gives Zonal and overall track capacity utilisation ratios for the aforesaid selected years. It is evident from the table that track capacity utilisation varied between 60-70%. The track was better utilised in the earlier period than in the later years. The reason for such a drop is suggested in foot note 10 of this chapter. Since our interest is on aggregate capacity, an inter-comparison of figures for different zones was not attempted.

Engine Capacity:

4.19. To estimate engine capacity, total engines of each Zone as on 31st March of each year were taken. Statistics pertaining to average daily percentage of engines in repair are available which account for about 15% of the total engines. By subtracting the engines in repair from the stock of total engines, net engines available for use are obtained. From this, engines used for shunting service are subtracted. Broadly, there are 3 types of engines — steam, diesel and electric.

Table 6.2

ENGINE CAPACITY — UTILISATION RATIOS

	Central Rly.	Eastern and North-Eastern Rly.	Northern Rly.	North-East Frontier Rly.	Southern Rly.	South-Central Rly.	South-Eastern Rly.	Western Rly.	Total Indian Rlys.
1951-52									
Actual Train KMs (000s per day)	169	333	58	-	160	-	-	124	-
Capacity Train KMs of Engines(000s perday)	237	655	118	-	271	-	-	250	-
Utilisation (%)	67.0	50.8	48.7	-	59.0	-	-	49.6	54.5
1955-56									
Actual Train KMs (000s per day)	174	207	152	-		-	90	125	-
Capacity Train KMs of Engines(000s perday)	285	447	275	-		-	171	261	-
Utilisation (%)	61.2	46.3	55.4	-		-	52.6	47.9	54.0
1960-61									
Actual Train KMs (000s per day)	195	198	178	37	179	-	102	162	-
Capacity Train KMs of Engines(000s perday)	354	429	281	92	323	-	214	332	-
Utilisation (%)	55.2	46.0	63.3	39.7	55.3	-	47.7	48.9	52.5
1965-66									
Actual Train KMs (000s per day)	222	238	202	51	199	-	131	193	-
Capacity Train KMs of Engines(000s perday)	421	467	359	123	393	-	277	373	-
Utilisation (%)	52.8	50.9	56.2	41.4	50.5	-	47.4	51.7	51.3
1971-72									
Actual Train KMs (000s per day)	174	234	206	50	155	126	153	199	-
Capacity Train KMs of Engines (000s perday)	346	460	329	114	311	173	316	387	-
Utilisation (%)	50.3	50.9	62.7	43.9	49.8	73.0	48.4	51.4	54.2

Source: Supplements.

Notes : 1) Weighted average of Zonal Rlys. utilisation ratios, weights being Running Track Kilometrage.
2) Certain portions of North-Eastern Rly.(NER) are operated by Eastern Rly.(ER). Hence, NER figures are combined with ER.

From interviews held with the operating branch, it is known that steam, diesel and electric engines can be used for 12,20 and 21 hours in a day respectively. The actual speed of an average goods and passenger train works out to 21 KMPH.[11] Thus on an average a steam engine can perform 12 X 21 = 252 engine KMs per day. Assuming one engine is sufficient to operate an average train, engine KMs become synonymous with train KMs. Thus, the capacity output of a steam engine works out to 252 train KMs per day, and this multiplied by net steam engine stock gives total capacity train KMs of all steam engines. Similarly, the capacity train KMs of diesel and electric engines can be worked out. Thus, Zone-wise, for the selected years, we have calculated the capacity train KMs of of engines and expressed the actual train KMs as percent to capacity train KMs of engines to work out capacity utilisation. The zonal capacity utilisation figures are combined by running track KM weights to derive overall capacity utilisation of engines of the Indian Railways.

4.20 Table 4.2 presents the engine capacity utilisation ratios. It is noticed that the utilisation of engines capacity is fairly stable around 54%.

<u>Passenger Vehicle Capacity:</u>

4.21 Actual vehicles on line in terms of 4-wheelers are

11. For details of speeds of goods and passenger trains on different gauges, see K.G.S. Iyer,'Increase in Line Capacity on Single Line', International Railway Congress Association, Feb. 1966.

Table 4.3

PASSENGER VEHICLES (4-WHEELER) CAPACITY — UTILISATION RATIOS

	Central Rly.	Eastern and North-Eastern Rly.	Northern Rly.	North-East Frontier Rly.	Southern Rly.	South Central Rly.	South Eastern Rly.	Western Rly.	Total Indian Rlys.
1951-52									
Actual Vehicle KMs (000s per day)	1506	2959	708	-	1603	-	-	1232	-
Capacity Vehicle KMs (000s per day)	2264	7281	1704	-	3971	-	-	3392	-
Utilisation (%)	66.8	40.6	41.6	-	40.4	-	-	36.3	44.4
1955-56									
Actual Vehicle KMs (000s per day)	1631	2031	1474	-	1636	-	737	1295	-
Capacity Vehicle KMs (000s per day)	2710	6089	2898	-	4295	-	1817	3028	-
Utilisation (%)	60.2	33.4	50.9	-	38.1	-	40.6	42.9	44.3
1960-61									
Actual Vehicle KMs (000s per day)	1796	2164	1848	410	1728	-	800	1716	-
Capacity Vehicle KMs (000s per day)	3281	6411	4123	1563	5034	-	2187	4833	-
Utilisation (%)	54.8	33.8	44.8	26.2	34.3	-	36.6	35.5	39.5
1965-66									
Actual Vehicle KMs (000s per day)	2310	2497	2147	507	2036	-	997	1992	-
Capacity Vehicle KMs (000s per day)	4489	7364	4572	2105	5580	-	2643	5705	-
Utilisation (%)	51.7	33.9	44.1	24.1	36.5	-	37.8	34.9	39.1
1971-72									
Actual Vehicle KMs (000s per day)	2054	2759	2344	571	1762	1262	1159	2231	-
Capacity Vehicle KMs (000s per day)	3229	7843	4877	2376	5042	2763	3321	6211	-
Utilisation (%)	63.6	35.2	48.1	2400	35.1	45.7	34.9	37.5	41.5

Source: Supplements.

Notes : 1) Weighted average of Zonal Rlys utilisation ratios weights being Running Track Kilometrage.

2) Certain portions of North-Eastern Rly.(NER) are worked by Eastern Rly.(ER). Hence, NER figures are combined with ER.

taken into account. On an average 15% of the vehicles will be under repair and 3% of the available vehicles will be in the yard for getting cleaned.[12] The vehicles in repair and cleaning are deducted from the total stock of carriages to obtain net carriages which can be used for 24 hours per day. The actual average speed of a passenger train is 30 KMPH.[13] Thus a vehicle can perform 30 X 24 = 720 vehicle KMs per day which is its capacity output. 720 multiplied by net stock of vehicles gives total capacity vehicle KMs. The actual vehicle KMs (in terms of 4-wheelers) are expressed as percent to capacity vehicle KMs (in terms of 4-wheelers) to calculate utilisation ratio. The zone-wise capacity utilisation ratios are combined with running track KM weights to determine overall utilisation ratio.

Table 4.3 gives capacity utilisation ratios of vehicles. It is evident from the table that the utilisation ratio varied between 39 and 44 percent and there is a slight drop over the years.

Wagon Capacity:

4.22 Actual number of wagons (in terms of 4-wheelers) on line are considered. From the interviews held with the Railway Officers, it is learnt that the safe percentage of wagons under repair may be assumed to be 15% on a day. By applying this percentage, we calculated the net number of wagons available for service for 24 hours per day. The lowest actual speed of an

12. This information is inferred from interviews held with the Railway Officials.

13. K.G.S. Iyer, op.cit.

Table 4.4

WAGON (4-WHEELERS) CAPACITY — UTILISATION RATIO

	Central Rly.	Eastern and North-Eastern Rly.	Northern Rly.	North-East Frontier Rly.	Southern Rly.	South-Central Rly.	South-Eastern Rly.	Western Rly.	Total Indian Rlys.
1951-52									
Actual Wagon KMs (000s) per day	2360	6965	586	-	1857	-	-	1776	-
Capacity Wagon KMs (000s) per day	6626	24996	2698	-	5989	-	-	5848	-
Utilisation (%)	35.6	27.9	21.7	-	31.0	-	-	30.4	29.5
1955-56									
Actual Wagon KMs (000s per day)	3197	4145	2606	-	2076	-	2125	2227	-
Capacity Wagon KMs (000s per day)				-	6798	-	6627	7496	-
Utilisation (%)				-	30.5	-	33.3	29.7	32.4
1960-61									
Actual Wagon KMs (000s per day)	4078	4708	3594	844	2636	-	2832	3408	-
Capacity Wagon KMs (000s per day)	8869	18543	8037	3929	9014	-	10690	8392	-
Utilisation (%)	46.0	24.3	44.7	21.5	29.3	-	26.2	40.6	35.2
1965-66									
Actual Wagon KMs (000s per day)	5020	6158	4559	1247	3052	-	4463	4504	-
Capacity Wagon KMs (000s per day)	12590	20927	12430	5564	12010	-	14460	10730	-
Utilisation (%)	39.9	29.4	36.7	22.4	25.5	-	30.9	42.0	33.6
1971-72									
Actual Wagon KMs (000s per day)	4456	5556	4956	1221	2467		5675	4699	-
Capacity Wagon KMs (000s per day)	10400	25485	14140	5468	8596		15950	11330	-
Utilisation (%)	43.7	21.8	35.1	22.3	28.7		35.6	41.5	33.6

Source: Supplements.

Notes : 1) Weighted average of Zonal Rlys' utilisation ratios weights being Running Track Kilometrage.
2) Certain portions of North-Eastern Rly.(NER) are worked by Eastern Rly.(ER). Hence, NER figures are combined with ER.

Table 4.5

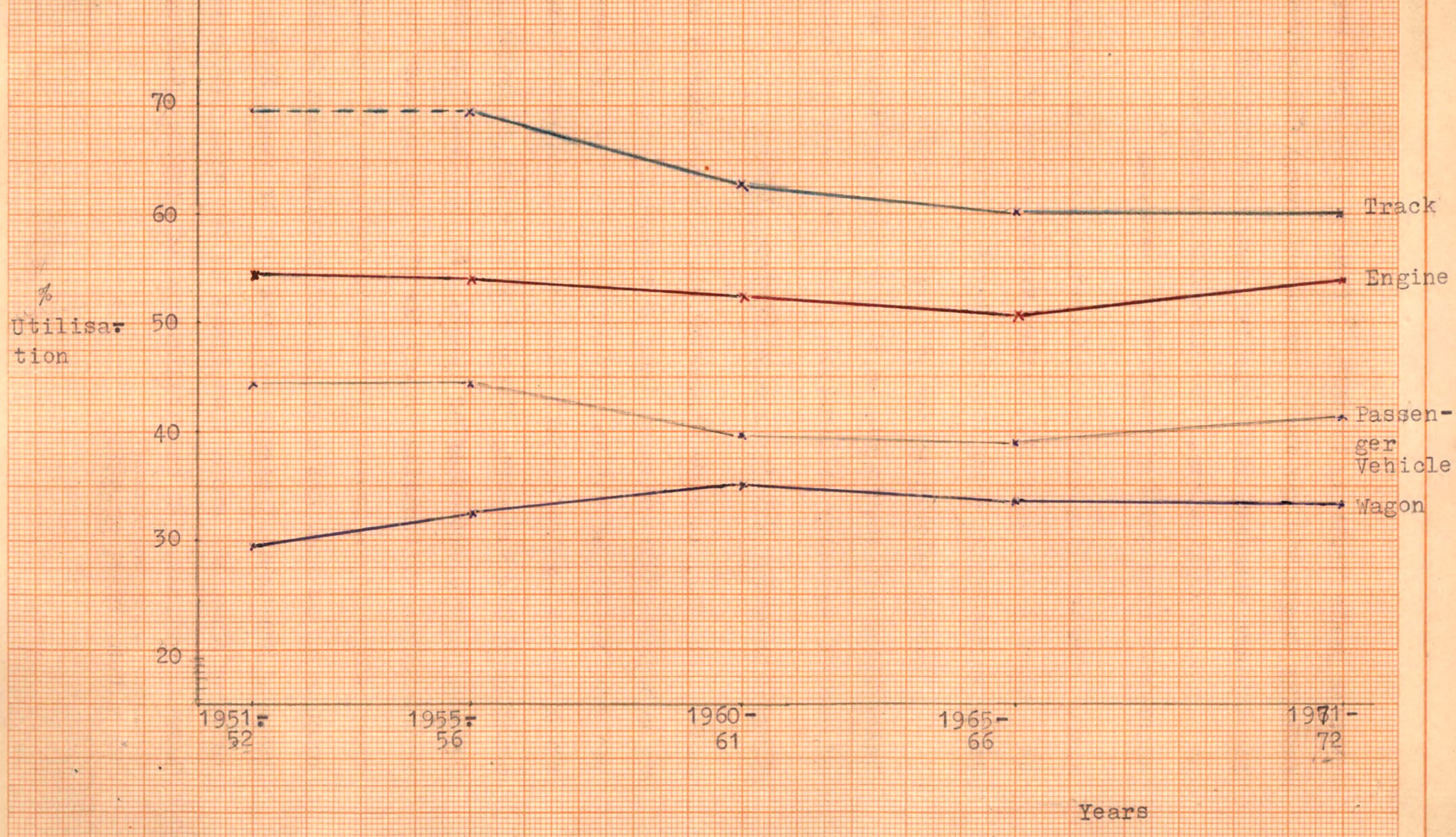
CAPACITY UTILISATION — TRACK AND ROLLING STOCK

Years	Percentage		Utilisation of	
	Track	Engines	Passenger Vehicles	Wagons
	1	2	3	4
1951-52	69.5 @	54.5	44.4	29.5
1955-56	69.5	54.0	44.3	32.4
1960-61	63.0	52.5	39.6	35.2
1965-66	60.0	51.3	39.1	33.6
1971-72	60.2	54.2	41.5	33.6

Source: Tables 4.1, 4.2, 4.3 and 4.4

Note : @ 69.5% is the assumed figure

LEVELS OF UTILISATION



average goods train is 11 KMPH.[14] Thus 11 X 24 = 264 represent capacity wagon KMs per day. The actual wagon KMs (4-wheelers) per day are compared with capacity wagon KMs per day to arrive at ratio of utilisation. The zone-wise utilisation ratios are aggregated with running track KM as weights.

4.23. Table 4.4 gives the utilisation ratios of wagons. It is noticed that wagon utilisation varied around 30-35%. There is an improvement in utilisation ratios over the two decades.

Having calculated the utilisation ratios of track, locomotives and carriages, we turn to the discussion of estimation of overall capacity utilisation of the Railways capital.

Overall Capacity Utilisation of Capital Stock:

4.24 So far, we have discussed the methods adopted to estimate the capacity utilisation of four important types of capital assets. An analysis of the utilisation ratios of 4 types of assets enables us to determine the overall capacity utilisation of stock of capital of the Railways. These 4 ratios are presented in Table 4.5 and in the accompanying graph. It is clear from the graph that highest utilisation (about 60-70%) was achieved in respect of track while it is lowest (30-35%) in the case of wagons. The problem is to find out a single utilisation ratio to indicate how far the capital assets had been put to use. It can be inferred from the graph that track is the main bottleneck to increase output. If the utilisation of rolling stock goes on

14. K.G.S. Iyer, op.cit.

improving, track capacity utilisation will first reach to saturation i.e. 100%. Once track capacity is utilised to the maximum, eventhough rolling stock has still unutilised capacity, it cannot be used since unutilised track capacity is not available. We are aware that capacity of a track is a somewhat nebulous concept. Within certain limits it can be increased with innovations in signalling and tele-communication equipment. This factor has been taken into account while calculating track capacity. Hence, under the existing technology, rules governing their operation and other constraints, track is the main bottleneck and track capacity utilisation can be assumed to represent overall capacity utilisation of the Railways capital. Future innovations may change the whole picture but it is extremely difficult to conjecture. We have used this percentage of underutilisation to deflate the actual capital in use to determine the technologically necessary capital in the next chapter.