

8 Timetabling and operational control

Planning

8.1. The Ulsterbus and Citybus approach to planning the operation of services consists of three elements:

- (a) the timetable;
- (b) the organisation of buses to provide that timetable; and
- (c) the organisation of staff to operate those buses.

The procedures in use within Ulsterbus and Citybus are similar in principle. The differences arise from the contrasting needs of urban and rural bus services.

Timetabling

8.2. Changes to the bus services published in the timetable can be made on the authority of each Area Manager as soon as it becomes apparent that there is a need or advantage to be gained in making the changes. Timetables are produced to a high standard using traditional typesetting and page make-up procedure. Ulsterbus has identified a need for single-sheet timetables covering one or two routes, and is examining ways, including desk-top publishing, for achieving this.

8.3. Sixteen different bus timetables are published by headquarters in accordance with an agreed production programme. Timetables are laid out in conventional style, using the 24-hour clock, with an index to the places served. Citybus timetables show the terminus and city centre departure times with the frequency of service. Most Ulsterbus timetables also show the times for intermediate stopping points. A system map is published separately, on an infrequent basis.

8.4. The timetable results from planning services to meet the travel requirements of passengers. These include the requirements of schoolchildren, shoppers and people travelling to business. The review processes which are used to match supply of services to demand for services are described in Chapter 10.

8.5. Two main types of service are identified within the timetable:

- (a) regular and frequent services usually used in urban areas; and
- (b) irregular and less frequent services characteristic of long-distance or rural services.

Thus most Citybus services fall under (a) whilst (b) applies to most Ulsterbus services.

8.6. The volume or quantity of service required on a given route is called the frequency and is expressed either as 'buses per hour' or as 'minutes between buses' ('headway'). The frequency required is determined from the demand experienced or anticipated.

8.7. There are a number of factors which regularly cause the companies to change the timetables. In September many alterations are made to accommodate changes in school traffic. In Northern Ireland parental choice plays a part in determining selection of secondary schools providing the headteacher can take the pupil. It is not unknown for headteachers to compete for new students and to use the availability of particular bus services or specials as a 'selling' point. Similarly, changes occur at the end of June when school requirements cease.

8.8. To avoid having to provide school buses that do only one journey schools may be asked to adjust their own starting and finishing times, although this is often not agreed. It is generally correct to say that all school buses run in the peak periods and are a significant component of the peak.

8.9. School traffic has an important effect on bus requirements, and because of the heavy school traffic, many bus journeys cater almost exclusively for this specialised demand. However, many of these services are included in the published timetables.

8.10. In Belfast, provision of special school buses started in the early 1970s when bus traffic was declining because civil disorder and sectarian problems necessitated bus journeys over non-standard routes to avoid taking children through hostile areas. The Belfast Education and Library Board provides the companies with a list of term dates and school closures.

8.11. As far as possible timetable alterations are avoided during the two months prior to the end of the school session (May and June). During this time schedulers visit local schools to try to assess their transport requirements for the session commencing in the following September. Special summer duties operate during July and August when the schools are closed.

8.12. In Belfast demand for bus transportation declines sharply after 6.00 pm. In November advance notice is received from the Belfast Chamber of Trade giving details of any additional changes to shopping hours. Saturdays before Christmas also generate extra demand for bus transportation. Such data are used to determine demand for bus services.

8.13. In August 1988 Belfast city centre shops introduced late opening hours on Tuesdays (late opening on Thursdays had been instituted a few years earlier). This required adjustments to evening bus services.

Bus scheduling

8.14. The next stage in planning is to organise buses into bus trips to give effect to the timetables. The treatment of this problem depends upon the nature of the service required.

8.15. If buses are to be operated along a number of routes at reasonably high frequencies, as is the case for Citybus, the scheduler can take advantage of relationships between routes to achieve efficient linking of arrivals and departures at terminals. The resulting bus schedules will involve little dead running time (ie buses scheduled to run empty), or wasted time at terminals. In rural situations where journeys are scheduled for a wide variety of routes, often with relatively infrequent services, the problem is to produce a bus schedule which minimises the amount of dead running. Most of the Ulsterbus services require this type of schedule.

8.16. In practice most of the services shown in the published timetable remain unchanged from issue to issue. The exceptions such as school bus services requiring alteration, may, however, result in extensive recompilation of bus workings.

8.17. Infrequent opportunities arise to develop a bus schedule from scratch. For example, in 1986 the bus schedules for the Newtownabbey area received a major reorganisation. The next opportunity for a basic reorganisation will occur in 1990 when the interactions of services between Citybus and Ulsterbus will be investigated and new integrated bus schedules prepared.

8.18. As part of the scheduling process the scheduling inspector prepares a chart for each depot showing the schedule of each bus against time. This chart of the vehicle workings, which is prepared

manually, enables the scheduler to calculate the number of buses required for each time period and to determine the maximum number of buses required to operate the schedule. Most charts show two main peaks, one from 08.00 to 09.30 and the other from 15.30 to 16.30. The scheduler may make some adjustment to the bus schedule in order to flatten these peaks and hence reduce the maximum number of buses required to run the services. Each analysis is performed manually.

Staff scheduling

8.19. Having established vehicle workings for the given timetable, the next step for the scheduler is to split the vehicle running times into staff duty workings. There are generally several possible alternative sets of duties and the scheduler chooses one which is satisfactory with respect to a number of aims which are not always fully reconcilable with each other. Considerable local knowledge is required to compile a set of staff duty schedules. The final result is almost always a form of compromise (often negotiated) between the various aims. We were told that there were the following five aims:

- (a) minimising the number of staff;
- (b) minimising the operating cost (especially wages payable) of working the timetable;
- (c) honouring the conditions of the Trade Union Agreement and legislation;
- (d) optimising working conditions and hours for the staff; and
- (e) anticipating and satisfying the criticisms of the local shop stewards.

8.20. Having established a set of duties for each day of the week, the next task is to build these into a duty roster for the week. These rosters need to allow for staff rest days, equitable working periods and conformation with agreements. The resulting rosters are written down in conventional form for presentation to staff. Hours payable are calculated and supplied to the wages office. Details are also passed to headquarters for mileage calculations to be performed by computer.

Operational control

8.21. In order to exercise control the companies need to check the time and location of buses against the published timetable. In addition to the responsibility for timekeeping placed upon each driver, there are stand inspectors in depots and at termini, and road inspectors who travel on the buses.

8.22. In Ulsterbus the stand inspectors check the time each driver reports for duty. They also record any significant delay in the departure of any bus from the depot, noting the cause. The stand inspectors also observe the arrivals at depots, and would expect to log any significant lateness and its cause. Road inspectors check the timekeeping on routes.

8.23. Within Belfast city centre Citybus has two mobile car duties and four control points manned by inspectors throughout the day. Ulsterbus has two control points in its Belfast depots and one in Bridge Street. Citybus and Ulsterbus inspectors and the radio cars report incidents directly to the radio control centre located at Oxford Street bus depot, where they are logged and control action initiated.

8.24. We note that the operational data generated by the operational monitoring procedure are not retrieved and analysed on a routine basis. Each request for data is treated as a special project which requires the extraction of data from handwritten records.

8.25. We discuss quality of service with respect to punctuality and cancellations in Chapter 11. Measures of scheduling efficiency

8.26. Scheduling efficiency is measured in the context of the objectives set for the scheduler. For example, this might be to provide a bus schedule with the required headways which minimises:

- (a) the number of buses;
- (b) the number of bus-hours;
- (c) the dead trip mileage; and
- (d) the standing time at termini (called 'layover');

or a combination of these measures. Clearly any algorithmic approach to bus scheduling needs to be given an unambiguous objective. The objectives set for the schedule alterations in the Newtownabbey area referred to in paragraph 8.17 provide an example:

- (a) eliminate dead mileage between Laganbank Road and Bridge Street whenever possible whilst still retaining essential connections;
- (b) provide a more competitive challenge to Black Taxi operation by getting the buses to stand at and depart from the same point as the Black Taxis;
- (c) regularise frequencies especially along roads where routes were common;
- (d) introduce new routes linking Monkstown Estate, Rathcoole, Mossley with Abbey shopping centre and Valley leisure centre;
- (e) provide express services to the University of Ulster, Jordanstown; and
- (f) achieve a saving in operating resources and costs.

8.27. The schedulers produced a new timetable to meet these objectives and achieved the improvements shown in Table 8.1.

TABLE 8.1 **Schedule alterations in Newtownabbey area**

	<i>Before 12 May 1986</i>	<i>New timetable</i>	<i>% reduction</i>
Timetabled journeys	1,522	1,386	8.9
Mileage travelled per week	31,276	28,693	8.3
Duties required	64	43	32.8
Buses required	42	31	26.2

Source: Ulsterbus.

8.28. These results show that using a manual approach to bus scheduling the schedulers in Ulsterbus were able in this case to make significant improvements in the utilisation of bus resources. However, a question that arises with respect to these results is whether the schedulers, had they done further work on this case, would have been able to improve on the results already obtained.

8.29. Schedule statistics are compiled annually in Ulsterbus, and these provide measures of scheduling efficiency, including 'wheel turning time', defined as the percentage of the total duty schedule time that drivers spend actually driving the buses. Values for this expression reveal the extent of waste time in the schedule, whether arising from excess standing time or other causes. Although Ulsterbus has routinely calculated wheel-turning time annually for its schedules, Citybus has not, but did so for our investigation and expects to do so at least annually in future.

Computer-aided bus and crew scheduling

8.30. The search for the elusive algorithm which would enable buses and crews to be optimally allocated to the duties required to provide a given timetable on offer to the public has extended over several years. Conferences dealing with bus scheduling have assumed international status. The companies have continued to monitor developments in computer applications to bus scheduling which have taken place within the industry. They have maintained contacts with other operators and attended meetings on the subject organised by Leeds University. In 1974 Ulsterbus took part in trials of a system called VAMPIRE which was designed to assist schedulers in finding an optimum bus schedule. The trial included nine depots and sub-depots and two types of vehicle, but the results were inconclusive and no subsequent trials have been undertaken. In February 1988 the companies supplied data to a firm of consultants for a demonstration of a computer scheduling system but received no response.

8.31. In 1980 practical applications of computer-aided bus scheduling were few but bus companies showed interest in its potential following its initial academic phase. Eight years later the subject has developed to the point where bus scheduling computer packages can be purchased from consultants, and 20 or so bus companies in the United Kingdom have already made such purchases. However, Ulsterbus and Citybus have not found one which offers real benefits in their context.

Sensitivity of timetable to disruption

8.32. There are a number of events which could cause buses to deviate from the times shown in the timetable. In Northern Ireland these would include:

- (a) bus defects;
- (b) drivers not reporting for work;
- (c) weather and road conditions;
- (d) accidents;
- (e) traffic congestion;
- (f) terrorist activity affecting buses or bus stations; and
- (g) civil disorder.

Management action to minimise the effects of any event is taken as a result of information received through the control system described above or from prior information including items such as the dates and routes of political marches. The management objective is to operate the public timetable to 100 per cent.

8.33. As we show in paragraph 4.12, bus losses due to civil disorder are significant. In 1987/88, 79 of the companies' buses were totally destroyed. For this reason, the companies hold a large reserve fleet. In addition to this, buses are required to be available for service over and above those needed at the peak period, to provide cover for maintenance, or for non-stage carriage work. The total fleets as at 1 October 1988 are shown in Table 8.2.

TABLE 8.2 **Ulsterbus and Citybus: total fleets as at 1 October 1988**

	<i>Peak service requirement</i>	<i>Non-stage carriage</i>	<i>Maintenance cover</i>	<i>Active reserve</i>	<i>Total in-service fleet</i>	<i>Non-active reserve fleet</i>	<i>Total</i>
Ulsterbus							
Buses	779	45	95	23	942	30	972
Minibuses	19	-	2	-	21	-	21
Flexibus	-	39	-	-	-	-	39
Citybus	244	2	40	19	305	22	327

Source: Ulsterbus and Citybus.

8.34. The subject of bus defects is discussed in Chapter 7. To avoid cancelling any journey shown in the timetable, Depot Managers make full use of their reserve fleet. On those occasions when replacement drivers are required, either because a driver has failed to report for work or a driver for a replacement vehicle is needed, spare drivers, inspectors or managers are usually available.

8.35. We were told that weather conditions were not a major source of concern although in the winter a night shift was used in each depot to start up diesel engines during the night in order to keep vehicles warm. If buses needed attention on the road the nearest depot would provide a breakdown service.

CONCLUSIONS AND RECOMMENDATIONS

Timetables

8.36. Present timetables are produced to a high standard using traditional typesetting and page make-up procedure. Ulsterbus has identified the need for single-sheet timetables covering one or two routes, and is examining ways, including desk-top publishing, for achieving this. We recommend that the company should pursue this approach, extending it to Citybus in due course.

8.37. This approach will result in a comprehensive timetable database being held on computer files. This database can have other uses, including comparison with Wayfarer data for punctuality analysis. We recommend that the company should ensure that the timetable database is held in a sufficiently flexible form for such purposes.

Scheduling efficiency and punctuality

8.38. The companies have a satisfactory means of measuring scheduling efficiency through the annual analysis. However, monitoring of actual performance against the timetable is confined to direct supervision by stand and road inspectors, whose reports are not analysed to provide operational statistics. We discuss this further in Chapter 11.

Computer-aided bus and crew scheduling

8.39. General experience of computer-aided bus and crew scheduling has been disappointing up to now. The companies have kept abreast of developments on the mainland, and conducted an experiment.

Bus utilisation

8.40. The companies' bus fleets have two components: the buses in service and the buses held in reserve. As to buses in service, the fleets in service have to be of sufficient size to satisfy the peak demand, with a small margin for normal engineering maintenance. We are satisfied that the companies have sound scheduling procedures which ensure that the number of buses allocated to meet demand is not excessive. These procedures also ensure that staff are effectively utilised (as we have shown in paragraphs 5.11 to 5.14), and that both staff and buses spend as little time as possible on journeys which are not part of a passenger service. We are also satisfied that, as we have shown in Chapter 7, maintenance work is effectively despatched, so that buses are off the road for the shortest possible time. In this way the need for additional buses to provide cover for buses undergoing maintenance is minimised.

8.41. The reserve fleets, made up of second-hand and time-expired buses, are maintained to replace at short notice buses taken out of service unexpectedly. In Northern Ireland the predominant cause of loss of buses is civil disorder. The companies maintain reserve fleets of a size which they judge sufficient, in the light of their experience of bus losses in the past and of their knowledge of the state of the market for second-hand vehicles, to enable them to maintain the service. We note that the policy for replenishment of the reserve fleets through the purchase of second-hand buses has ensured their low cost. We believe that the companies take a correct view of the importance of service reliability, and we conclude that the size of their reserve fleets is acceptable. As we have shown in Chapter 6, this affects the average ages of the fleets, with Citybus buses being somewhat older on average than those of Ulsterbus. We conclude that, under the circumstances, the average ages of the fleets are reasonable.