IDEA

Innovations Deserving
Exploratory Analysis Programs

Transit IDEA Program

Smart Parking Lot with just-In-Time Shuttle-bus Service

Final Report for
Transit IDEA Project 21

Prepared by:
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Corvallis, OR

June 2001

TRANSPORTATION RESEARCH BOARD
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Innovations Deserving Exploratory Analysis (IDEA) Programs Managed by the Transportation Research Board

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SMART PARKING LOT WITH JUST-IN-TIME SHUTTLE-BUS SERVICE

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EXECUTIVE SUMMARY

In our Transportation Research Board (TRB) Transit IDEA Project 21 entitled "Smart Parking Lot with Just-In-Time Shuttle-Bus Service" (SPLITS). We have developed from concept to bench-top demonstration a smart parking lot system that assigns spaces to customers. In particular, we have: 1) devised a generic computer program that rationalizes the parking process in a large lot that requires travelers to use a shuttlebus, optimizes the routing of that bus, does accounting, and enhances security; 2) adapted that computer program to the specific case of the Economy Parking Lot (EPL) at Portland International Airport (PDX) which has 6,999 spaces; 3) computer simulated operation of both the generic and the specific systems; 4) adapted five personal computers to play the roles of: the central control computer, the lot entrance information kiosk and ticket spitter, the device that interacts with the driver of each bus, the device at the terminal that interacts with returning travelers just before they board the bus, and the device that checks-out vehicles at the exit gate of the lot; 5) connected these five personal computers (with cables that could be replaced with wireless links); and 6) demonstrated the system to a Regional Experts Panel to their satisfaction. The panel included EPL management, an Oregon Department of Transportation (ODOT) researcher, Port of Portland and Tri-Met officials.

We concluded that SPLITS would benefit both travelers and the bus operation. When the EPL is nearly full, SPLITS could save the average entering traveler more than 20 minutes getting to the terminal and save the worst-case traveler much more. SPLITS would reduce the time and fuel required for the bus by about 20% when the EPL is half full even if it goes to the traveler's space, instead of to stations as is the present system. If the bus were to go only to the present stations, the saving for the bus would be much more and the cost to the average traveler would be about 1 minute. We are confident that we can interface personal computers with the hardware in use at the PDX EPL and with any hardware that will be installed there, or at similar lots, in the near future. It was clear that the personal computers, which run at only 233 MHz, operated the system faster than a real system for the EPL would require.

As envisaged and simulated, our system would have the bus meet each vehicle's travelers at its specific space, which would afford a major increase in convenience and security to the travelers, but the route distance and time for the bus would be less than for the existing system at EPL, for which busses follow either of two fixed routes to 20 stations, due to the allocation of spaces for the convenience of the bus and to the fact that the bus would not go where not needed. If our system were to be modified so that the travelers had to walk (with their luggage) between their assigned space and one of the existing bus stations, then the efficiency of the busses would be improved substantially more. Whereas travelers now may spend nearly 45 minutes locating a parking space when the EPL is nearly full, the worst case would be less than 3 minutes to reach an assigned, open space with directions to it. When the EPL is 99% full, we found the average benefit in finding a space to be more than 15 minutes. While this benefit is less when the lot is less full, it is still a few minutes even at 50% occupancy. Travelers would also benefit by a few minutes from the improved efficiency of the bus; this benefit could be larger when the lot is less full. We find that the total time from lot entrance to terminal for an average traveler would be 15 to 25 minutes less with our lowest level "smart" system than for a typical "stupid" method (by which the driver searchers each pod of spaces starting at that closest to the entrance) when occupancy ranges from 50 to 99.9%. SPLITS would make it practical to operate at 100% occupancy and even a little beyond 100% because the system would know when returning travelers board at the terminal which spaces will soon be available.

SPLITS also would effectively eliminate the problem of stolen tickets. (The stolen ticket problem occurs when someone takes a ticket from the spitter but backs out of the entrance gate, so he does not park, and then sells the fresh ticket to some traveler who has left his car parked for a long time.)

We are convinced that the only significant problems with the implementation of SPLITS are human factors problems; we have developed and discussed fixes for all such problems that we have recognized.

PHYSICAL CONCEPT

Our physical concept is that: Each in-coming driver will either swipe a credit-card to start the transaction for a parking fee or will take a magnetically encoded smart-card from a lot entrance information kiosk, credit card reader and ticket spitter (LE). LE will ask the driver to input the number of travelers in the party and make a digital photograph of the rear of the vehicle. A central control computer (CC) will then inform, via LE, each in-coming driver that it has assigned her or him to a specific space and that the bus will meet her or him there. LE will also give each in-coming driver a map of the lot, which will display clearly the entrance point ("You are now Here.") and the location of the assigned spot ("Park here; this is where the shuttle will meet you.") and perhaps other information about the smart lot. Before they board the bus at the terminal out-going travelers will swipe at a terminal kiosk, card and ticket reader (TC) either the same credit card or the smart-card that they got from LE at the entrance. TC will ask the card/ticket holder the number of travelers in the party and count travelers as they board the bus. (For reasons of security we would transmit information about credit cards only on protected land-lines, not by the bus's radio.) CC will combine information about the out-going travelers on the bus (which spaces will soon be vacant) with its current list of vacant spaces and with its list of spaces to which it has already assigned in-coming drivers who have not yet boarded a bus. With this combination of information, CC will determine a near to best route for the bus and a near to best assignment of spaces for new in-coming drivers. Then, via LE, CC will assign the spaces; and via an information console in front of each bus driver (BC), CC will direct the bus. BC will inform the bus driver the number of persons expected to board and leave at each stop. The bus driver will also use BC to report problems such as travelers rejecting their assigned spaces, snow drifts, broken down vehicles, etc. At the exit gate of the lot, an electronic device equipped to recognize vehicle license plates (GC) will verify that each exiting vehicle is one of the vehicles expected to be exiting, that the parking fee has been paid either by credit car or via the smart card, and that all vehicles that are expected to exit do in fact exit. If GC senses a discrepancy, it will immediately notify personnel at the exit and CC.

We have assumed that each bus has a global positioning system, GPS, which is wirelessly connected to CC so that CC always knows where each bus is.

FIGURE OF MERIT

We sought primarily to reduce the average traveler's incoming intermodal transition time (ITT-In), i.e., the time between entering the lot and arriving on the shuttle-bus at the terminal. It is obvious that we can reduce ITT-In by eliminating the waste of time finding an open space by keeping track of spaces, assigning them to entering vehicles, and giving the drivers a map and directions to them. We also reduce ITT-In by keeping track of the positions and routes of the busses and assigning the spaces in manner that optimizes the efficiency of the busses. With a given set of rules for the calculation, the route that is best for the average traveler is also best for the bus operator. Thus, ITT-In was the figure of merit used to compare options for the assignment of spaces and the routing the busses.

ADDITIONAL GOALS

Our secondary goal was to establish and to reduce the unluckiest traveler's incoming intermodal transition time (X-ITT-In) so that the lot's management can assure pending travelers, perhaps via a variable message board outside the entrance, of the worst case time for them to get to the terminal if they choose to park in this smart lot. When spaces are assigned and directions given there is little variation in the time travelers require to get to their space; we found by driving with a stopwatch that we could reach any of the 6,999 spaces at the Economy Parking Lot (EPL) at Portland International Airport (PDX) in 2.5 minutes. Thus, X-ITT-In is determined primarily by the rules imposed in the computer program that calculates the route and can be adjusted by adjusting the rules. We could reduce the number of runs the bus makes between lot and terminal by having it wait until it is full at both, but that would increase X-ITT-In greatly, so we imposed a limit on the length of time any traveler can be made to wait on any bus before it leaves for the terminal.

With SPLITS the difference between X-ITT-In and ITT-In will be only a few minutes (due mostly to time on the bus). With the existing system the difference between X-ITT-In and ITT-In is virtually unbounded due to the vast amount of time that it might take an unlucky traveler to find a space.

Our tertiary goal was to reduce the average traveler's outgoing intermodal transition time (ITT-Out), i.e., the time between boarding the shuttle-bus at the terminal and exiting from the lot. We consider X-ITT-In to be more important than ITT-Out because travelers are often very concerned that they arrive at the terminal in time to board their flight, but they are more relaxed about the time that they return to their vehicle. ITT-Out and the unluckiest traveler's outgoing time (X-ITT-Out) are strongly affected by the limit set on the length of time that the bus can wait at the terminal to board more passengers.

It is important to note that our ideal SPLITS would provide a benefit in convenience and in safety because the bus picks-up and leaves-off travelers at their parking spaces so that they do not carry their luggage between their space and a bus stop and, when in-coming, do not wait for a bus at a station. This would be particularly important for travelers needing crutches or wheelchairs and for the blind. At present only some of the busses are equipped to handle wheelchairs; they board and leave travelers only at the existing 20 stations.

METHODS

We have considered a few smart systems and four "stupid" systems. We have developed realistic computer simulation programs for the lowest of the smart systems and the lowest of the stupid systems. We here report results from this simulation adapted for the specific case of the Economy Parking Lot (EPL) at PDX.

The lowest of the smart systems assigns spaces independently from one to the next without consideration of opportunities to bunch in-coming travelers to allow more than one to board the bus at one stop. However, the lowest level smart system does some inadvertent bunching. If there are more spaces near the space that the central control computer (CC) has just chosen for the vehicle A and if vehicle B enters the lot soon enough after A that the bus's position has not changed much, then CC will select the second spot because it is still the most convenient location for the bus. Efficiency will be lost only when CC picks an isolated space when there is a cluster of open spaces not much further away and when there is another vehicle close behind.

To bunch the assignments deliberately we would wish to have vehicle sensors at the entrance to inform CC how many vehicles will enter in the next minute or so, but we might use – also or instead – information on the historical average rate of vehicles entering as a function of time and date or information provided by the lot's management.

The highest level smart system would access the travelers' itineraries so that CC can optimize for the return route, as well as for the out-going route. However, when more than one traveler makes a trip for the same reason, e.g., to attend a convention, there is some correlation between their out-going trip and their return. Therefore, the lowest level smart system inadvertently creates clusters of spaces that will become vacant at nearly the same time in the future.

The lowest of the four "stupid" systems, which is the one that the large majority of travelers now use, is to search for a space from one pod of spaces to the next starting at the entrance and continuing until the traveler finds the first empty space.

The best of the "stupid" systems is to drive immediately from the entrance toward the far end of the lot where there are almost always many spaces available, even near the far end bus stops. Because the present-art bus goes to all the stops in its now-fixed route, a passenger who boards at the far end of the lot will reach the terminal at the same time as one who boards the same bus at the first station. Also, because customers often pass busses, the customer may be able to board an earlier bus at the far end. One might think that travelers would recognize the advantage of going to the far end by simply looking out the window of the bus as it goes around the far end. However, as the bus drivers will attest, only a small fraction of repeat travelers learn this lesson. Note that if we install a smart system in a particular lot, then the advantage of first driving to the far end will go away.

A midlevel system would be to go immediately to the place where the busses leaves the lot to go to the terminal and then to start the search there. This would reduce the traveler's time on the bus in the lot. However, because the bus's exit gate is located close the traveler's entrance gate (at least at EPL and many other shuttle bus lots), we found at EPL the occupancy rate near the bus exit to be much higher than the occupancy rate for the lot as a whole. Thus, the benefit of this system over the lowest level stupid system would not be large given the now prevailing situation in EPL at PDX. Also, by interview and by observation, we found no one using this system.

With another midlevel stupid system entering travelers find a shuttle bus and follow it until a traveler gets off and then follows the traveler to her/his space. This can be a relatively efficient tactic when the out-going person is a business traveler with little luggage and the weather is good. However, one of the travelers that we interviewed on the bus during a snow storm in the Christmas rush said that she had spent 30 minutes waiting for a family with much luggage to get from the bus stop to their car, load up, remove the snow and ice, and, finally, to leave. Also, with this method the in-coming travelers have no chance to board the same bus that the out-going travelers left. With all SPLITS systems it should often be possible to off-load and take-on travelers with one stop of the bus at their common space or at adjacent spaces.

During Stage 3 we have adapted our simple generic simulation program of Stage 2 to the specific situation at the EPL at PDX. This has 6999 spaces in 168 "pods," i.e., 25 ± 10 pairs of perpendicular spaces separated by an "aisle," and some strings of parallel spaces, mostly around the perimeter of the Lot. There are now 20 bus stops within the lot, which are connected by the "main road" which is the only route that the busses now use. There are also "feeders," roads that connect the pods to the main road and thus to the bus stations.

For the data of this report we set the following parameters in the program: acceleration and deceleration for the busses and cars is 20% of the earth's gravitational acceleration (0.2 × g = 6.4 ft/sec.E2); their maximum speed on aisles is 15 mph; their maximum speed on feeders is 20 mph; their maximum speed on main roads is 30 mph; their time to turn 90 degrees is taken to be just the time to come to a complete stop and then to accelerate again; and the bus travels for 6 minutes each way to go between the Lot and the Terminal. We set these values after riding the bus around the lot with a stop watch to make estimates and driving our own auto around the entire lot. They are not precise. Of course, it would be a simple matter to change these parameters and to run the program again. We would be able to adapt the program to changing conditions (e.g., due to changes in weather) in any given lot and to adapt the program to new lots.

Mr. Jeff Cushman, the manager of the Lot, gave us a detailed map of the parking spaces in it. With this map and the above parameters, Mr. Venkatappa generated two semi-permanent look-up tables. The larger table is 168 × 168 and gives the time it would take the bus to go from the entrance of each pod to the entrance of every other pod in the Lot. To get the time to drive from any particular space to any other particular space in the Lot, we add to these values a simple estimate of the time to drive from the entrances of either pod to a particular space in that pod. This is the same for the bus and for the travelers and for both the smart and the stupid systems. The user can change the values in the appropriate look-up table to correct any misunderstanding re particular spaces. The smaller look-up table is 1 × 168 and gives the time a traveler would use to drive from the Lot's entrance to each of the pods. We use this information to ensure that the bus will not need to wait long for the travelers to arrive at their assigned spaces. (By timing ourselves doing it, we determined that a well-informed traveler can drive from the entrance of the Lot to any space within 2.5 minutes.)

For our lowest level smart system, which we report here, SPLITS #1 directs busses and assigns spaces to in-coming travelers one at a time with the following rules:

a) Travelers that board the bus at the terminal must be left at their spaces in the lot. (We can not take them back to the terminal.)

b) Whenever a bus at the terminal is too full to take-on more travelers, it starts-out for the lot.

c) Whenever a bus in the lot has left-off all the travelers from the terminal and is too full to take-on more travelers, it starts-out for the terminal. (The busses at EPL at PDX can carry 28 passengers.)

d) We can not make any in-coming traveler wait on the bus in the lot more than X minutes before starting for the terminal. (The lot's management will set the value of X.) We have assumed X = 10 minutes.

e) We can not make any traveler wait on the bus at the terminal more than Y minutes before leaving for the lot. (The lot's management will set the value of Y.) We have assumed Y = 2 minutes.

Now, Rule a) implies that the bus must go to a list of known spaces in the lot. While the bus is at the terminal, this list will be up-dated whenever new travelers board the bus. Once the bus leaves the terminal, this list is frozen. The computer uses this information to determine one of the fastest routes, Route 1, to visit these spaces and the expected time, Time 1, to complete it. For the results reported here, we have used a simple heuristic algorithm that the bus goes from the entrance of the lot to the closest space that it needs to visit, from there it goes to the next space that is closest to its present location, and so on. In the future we would wish to see if incremental improvement or simulated annealing methods could improve the smart systems significantly.

The number of busses serving EPL at PDX varies with the traffic level; it is typically 4, which is what we have assumed. From the time it loads travelers at the terminal until it leaves the lot to go to the terminal every bus has a route that the central control computer (CC) has dictated and can change. When a traveler enters the lot, CC will first determine if one of the busses already in the lot could pick up the traveler at an available space near its existing route and within the rules and allowing for the time that the traveler would spend driving to that space. If so, then CC assigns the traveler that space and informs the bus driver's information console (BC) on the appropriate bus of the change in its route. In some cases the incoming driver takes the space just being vacated or an adjacent space.

If no bus already in the lot can pick up the just entering traveler within the rules, then CC considers the present routes, R1s, of busses at the terminal or coming from the terminal. It identifies and assigns the space that will increase the time for that route, T1, by the least amount.

RESULTS

For the Stupid #1 and Smart #1 systems we started with a distribution of spaces evenly divided among all the pods and let the simulation run with a turn-over rate of 2160 per day, 1.5 per minute, on average but fluctuating randomly, for both in-coming and out-going, so that the fill-factor remained essentially constant. CC selected the out-going travelers randomly so that there was no correlation between incoming and outgoing travelers. As noted above, in the real world there is some correlation, but we do not know how much for any particular lot. After 2 days of simulated time we found that the distributions were near a steady-state that was different for the smart system than for the stupid system. The smart system tends to a distribution that appears to be random. The stupid system packs the filled space near the entrance and packs the empty space at the far end.

We then ran the simulation for 5 simulated days with a constant fill-factors of 50% to 99.9% to take the data for our statistical analysis.

In Fig. 1 we show the average time for a traveler to drive to a parking space as a function of the fill-factor, i.e., the percent of filled spaces in the lot, for Smart #1 and Stupid #1. The values for Stupid #1 also contain the time for the traveler to walk, with any luggage, from the parking space to the bus stop. We have assumed that this time is a constant 1 minute. There is no such walking time in the Smart #1 values because the bus comes to the space.

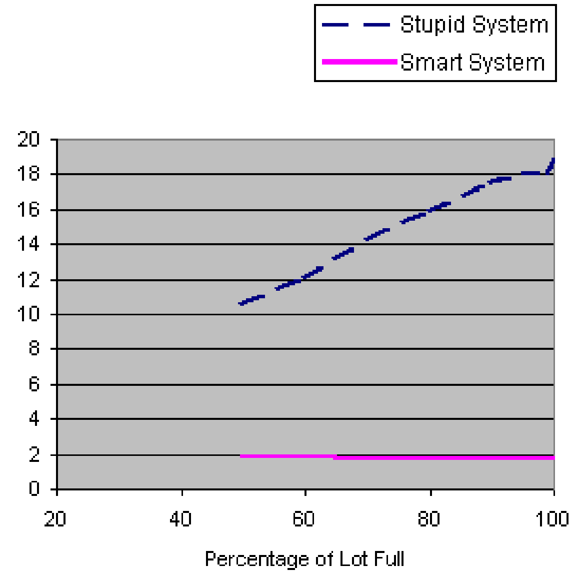
We see that the Smart #1 values are almost constant, they increase from 1.10 to 1.31 minutes going from 50% to 99.9% full. We understand this because we have determined by doing it that a driver who knows where he/she wants to go can reach any space in the lot from the entrance in a maximum of only 2.5 minutes and also that the Smart #1 system transforms any initial distribution of empty spaces into an almost random distribution of empty spaces as the simulation runs for several days of simulated time when there is no correlation among travelers.

On the other hand, the Stupid #1 times are as long as they are partly because, as we noted above, the Stupid #1 system transforms any initial distribution of empty spaces into one that has most of the empty spaces far from the entrance.

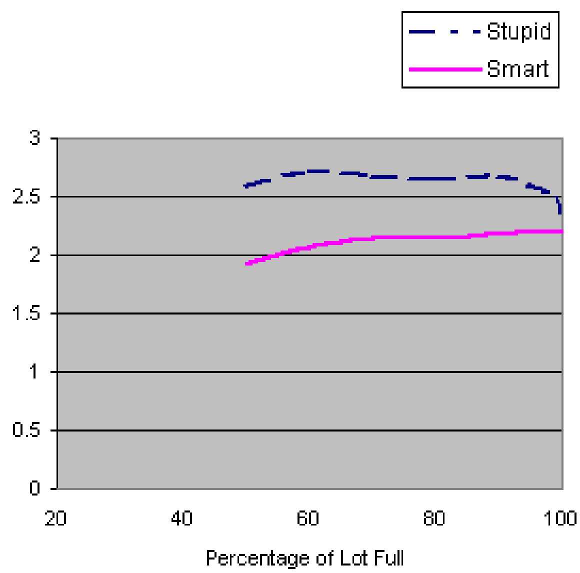
In Fig. 2 we show the average time that a traveler would wait for a bus at the bus stop for Stupid #1 or at her/his space for Smart #1. Here the values for Stupid #1 are almost constant; they vary between 2.82 and 2.90 minutes in our simulation, which may just be statistical fluctuation. The interval between busses at PDX is now 5 minutes. The values for Smart #1 vary between 1.57 and 2.78 minutes. The Smart values are less than the Stupid values partly because the Smart system does not send the busses to stations where there is no one to leave off or to pick up.

In Fig. 3 we show the average time that the traveler would spend on the bus. This is the sum of the time on the bus within the Lot and the 6 minutes going from the Lot to the Terminal. For the Stupid system these values range from 16.7 to 14.1 minutes. For the Smart system they range from 9.4 to 8.4 minutes. The advantage of the Smart system is partly because the Stupid system travelers board the bus closer, on average, to the entrance and partly because the Smart system busses do not waste time going where they are not needed.

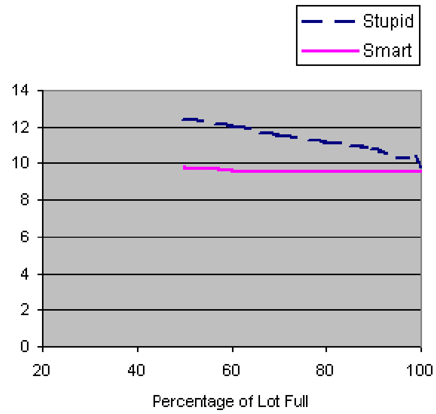
In Fig. 4 we show ITT-In, the average time between entering the Lot and arriving at the Terminal. Again the Smart values are almost constant and 15 to 25 minutes less than the Stupid values.



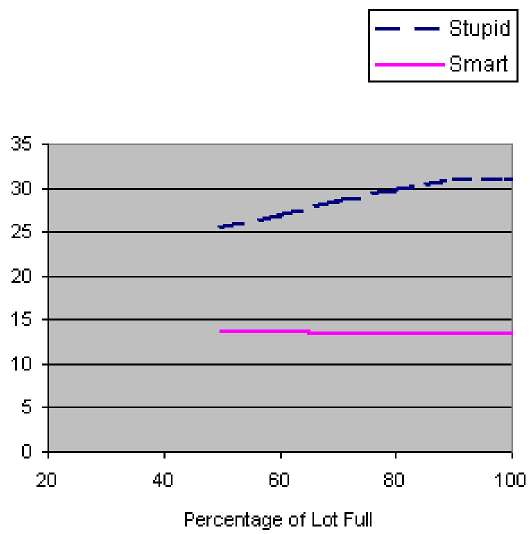
Average time to Park (fig 1)



Average time Waiting for Bus (fig 2)

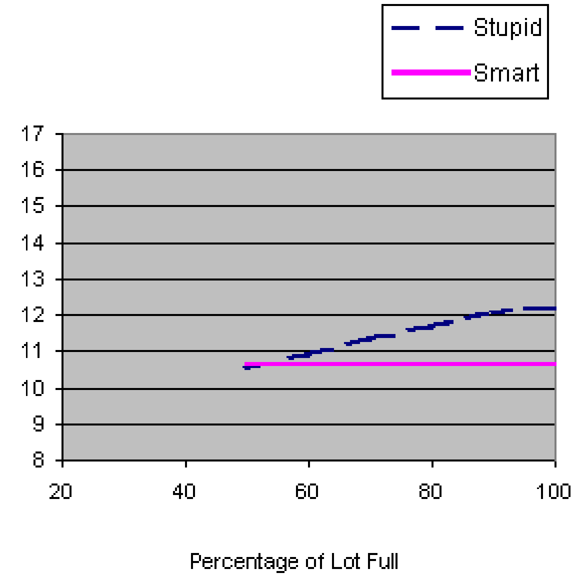


Average time Spent on Bus by outgoing travelers (fig 3)



Average Time taken to reach the Terminal (fig 4)

In Fig. 5 we show ITT-Out, the average time for the travelers to get to their spaces from the Terminal, i.e., the 6 minutes from Terminal to Lot entrance plus the time on the bus in the Lot, and for the Stupid only, 1.0 minutes to walk with luggage from the bus stop to their vehicle. The Stupid values increase, if not by much, 11.1 to 12.6 minutes as the lot fills from 50 to 99% because the traveler's space trend away from the entrance as the lot fills. The Smart values fluctuate, if not by much, between 10.1 and 10.7 minutes.



Average Time Taken to get to the space in Lot from Terminal (fig 5)

HUMAN FACTORS

We think that a major reason that such a concept has not been implemented long ago has been fear that too many drivers would disregard the assignment of a space. We expect to overcome such an inclination of in-coming drivers by impressing upon each of them the facts that they must ride the bus to reach the terminal and that the bus will meet them at their assigned space. If a driver wants to reject the assigned space, he or she should wait at it until the bus arrives and explain the reason to the bus-driver, who will communicate the problem to the central control computer (CC). CC would then assign a new space and inform the lot's management of the problem. The in-coming driver will then follow the bus to the newly assigned space.

We think that it might help to persuade travelers to park where they are directed if the busses were to be fitted with bright LED lights of various colors on whip-antennas. We would inform the traveler that it is the red/orange/yellow/blue constant or flashing bus that will meet them at their assigned space and they could see that bus and where it is going. They would understand that they are being asked to drive to intersect that bus. LEDs are now available in all colors and so bright that this would be easy and inexpensive to do.

We think that, once travelers understand the SPLITS System and its benefits, they will embrace it passionately and follow its directions. We expect newspaper, news-

TV and radio coverage of the innovation to inform a large fraction of air travelers.

CONNECTION TO EXISTING ELECTRONICS IN PARKING LOTS

We had hoped to obtain the loan of a ticket spitter, credit card machine, and any other existing electronics commonly found in parking lots so that we could effect the connection to the corresponding PC through a real-world interface. Unfortunately, this did not occur. Therefore, we did a simple web search and identified the Amoano Cininnuti corporation as a vendor of the appropriate equipment and contacted them requesting the specifications for the interfaces of their equipment. We held an extensive telephone conversation with a person who turned out to be one of their sales executives in which we described SPLITS and our results in great detail. However, at the end of this discussion, he declined to provide the interface specifications and suggested that Amoano Cininnuti might provide a complete turn-key SPLITS system. Thus, we were not able to complete the interface work as planned, but that is a minor task once the specifications are known.

FUTURE WORK

If we manage to obtain follow-on funding, we will commence a real-world demonstration project, perhaps at the EPL at PDX. We will connect PCs to appropriate equipment to dispense tickets and maps, read credit cards, global positioning systems and wireless communication systems, and gate exit equipment.

We will obtain the information re number of vehicles about to enter the Lot either with sensors or other means and affect the Smart 2 calculation system, i.e., consider deliberately opportunities to cluster the assignment of spaces. It would require a modest amount of programming to convert from Smart #1 to Smart #2.

If we have still not found information re the correlation between in-coming and out-going vehicles, we will analyze the data that we collect and determine how much more Smart #3 could improve the routing over what Smart #1 does inadvertently in the real-world and what Smart #2 does. We think that we can improve ITT-OUT significantly if we obtain information about the return flights of the travelers as they enter the lot. Where there is a correlation between the travelers going out and the travelers coming back as a function of time, we would assign spaces so that the bus could also leave off clusters of travelers with one stop. Correlations occur, e.g., when many travelers are going to the same conference or sporting event or vacation tour. This would have a beneficial effect of creating more clusters of empty spaces so that we would improve ITT-In also. The information that we would need is, of course, in the Airline Flight Reservation Data Bank. With access to that data, we could have the central control computer (CC) use its slack-time computing capacity to estimate who will want to park in the lot and to leave it at which times. If the traveler uses a credit card at the entrance, then the CC can search its list of possibles in very little time and decide whether or not to direct this particular traveler to one of the pre-planned clusters.

We also want to consider any real-world effects that are not included in our present simulations. For example, Ken Turner of Trimet, a member of our Regional Experts Panel, told us at our meeting in April of 2000 that people board busses much more rapidly when the bus is nearly empty than when it is nearly full. He suggested that the computer should take account of this fact and therefore should drop off many of the out-going travelers before picking up in-coming travelers. The effect may be particularly strong when travelers have much luggage, as occurs at major holidays. We plan to survey this effect and adapt our programs accordingly.

If we do leave off out-going travelers before we pick up any in-coming passengers, then it would often be advantageous to assign the parking spaces identified in Route 1 to in-coming travelers who arrive after the bus has entered the lot. These in-coming passengers would then park in the spaces vacated by the out-going travelers. Then we would simply reverse the route of the bus.

CONCLUSIONS

We have developed our computer program to the point that it could save out-going travelers as much as 25 minutes of intermodal transition time at the Economy Parking Lot at PDX, and perhaps more importantly, could avoid most of the anxiety that travelers experience while trying to get onto flights.

The computing is being accomplished with a midrange personal computer (INTEL Pentium 233 MHz). We are confident that we can adapt the present computer program to real parking lots like the PDX Lot. We are confident that we can interface personal computers with the hardware in use at the PDX Lot and any hardware that will be installed there in the near future.

Because the SPLITS accounting system would keep track of all tickets, park space assignments, and discrepancies, SPLITS would eliminate the stolen ticket problem. (The stolen ticket problem occurs when someone takes a ticket from the spitter but backs out of the entrance gate, so he does not park, and then sells the fresh ticket to some traveler who has left his car parked for a long time. This is a major problem in some lots.)