

At UPS, the Algorithm is the Driver --- Turn right, turn left, turn right: Inside Orion, the 10-year effort to squeeze every penny from delivery routes

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ABSTRACT

Orion consists of many components, including a "traveling salesman" algorithm, a familiar tool that calculates the most efficient path between a variety of points, and geographic mapping. [...]management and information technology expert Thomas H. Davenport, a distinguished professor at Babson College near Boston, believes Orion is the largest deployment of operations research, and that UPS spent \$200 to \$300 million to develop it.

FULL TEXT

TIMONIUM, Md. – Here's a math problem for you. Each United Parcel Service Inc. driver makes an average of 120 stops per day. There are

[illegible]

Which option is the most efficient, after considering variables such as special delivery times, road regulations, and the existence of private roads that don't appear on a map?

Even if an optimal answer exists, the human mind will never figure it out. And while experts at UPS have been giving the problem their best shot for more than a century, the company is shifting that work over to a computer platform called Orion, which is 10 years and an estimated hundreds of millions of dollars in the making. "Can a human really think of the best way to deliver 120 stops? This is where the algorithm will come in. It will explore paths of doing things you would not, because there are just too many combinations," says Jack Levis , senior director of process management at UPS.

The 1,000 page Orion algorithm is an exercise in heuristics, written by a team of 50 UPS engineers in Timonium, Md. Instead of searching for the optimal, or best possible answer, heuristics is the search for the best answer one can find, the results continually refined over time, based on experience. Orion consists of many components, including a "traveling salesman" algorithm, a familiar tool that calculates the most efficient path between a variety of points, and geographic mapping. What makes Orion unique is the way it puts these elements together, striving for a balance between an optimum result and consistency, according to Mr. Levis. "Customers and drivers like consistency. Orion has to know when to give up a penny to make the results more stable," Mr. Levis said.

None of the solutions that Orion spews out are big or dramatic. It is all about saving a dollar or two here and there.

But in a network with 55,000 routes in the U.S. alone, that adds up. "In our business, small things mean a lot. If you can reengineer process, the gains will be greater than you think," Mr. Levis said.

Such savings matter to UPS, which is struggling with a tighter-margin business and a union workforce that is compensated at the high end of the industry scale. Its challenges are unique. Rival FedEx Corp. uses an independent contractor model for its ground network, so it's not ultimately responsible for miles driven to most of its residential stops.

A Changing Business E-commerce has shifted more and more of UPS's delivery stops to residences, and those packages are expected to make up half of all deliveries by 2018. It's a radical change from 15 years ago, when drivers would drop off several packages at a retailer. Now, they make scattered stops to drop off one package at houses in a neighborhood, driving further and taking up more time.

On Nov. 13, UPS CEO David Abney said he expected Orion to save the company \$300 million to \$400 million a year, once it is fully implemented in 2017. The more than 40% of the company's 55,000 U.S. routes already using the software at that time had been reduced by an average of between seven and eight miles, the company said. The company can save \$50 million a year by reducing by one mile the average aggregated daily travel of its drivers. Those savings are critical as UPS tries to boost earnings growth, which has been in the 5% range in recent years and dipped in 2014, as low-margin deliveries related to e-commerce become more prevalent and the company scrambles to figure out how to manage its holiday season.

While Mr. Abney cautioned that at least some of Orion's gains would be offset by rising costs related to delivery of its customers' e-commerce orders, he is targeting per-share earnings growth of more than 50% over the next five years. The company lowered its 2015 outlook earlier this month.

UPS won't say how much money it has invested in Orion. But management and information technology expert Thomas H. Davenport, a distinguished professor at Babson College near Boston, believes Orion is the largest deployment of operations research, and that UPS spent \$200 to \$300 million to develop it.

How Orion works

A driver – in this case, let's use the example of Tim Ahn, who has been a full-time driver for 20 years, currently with a route in Gettysburg, Pa. – would use his UPS tablet, known within the company as a delivery information acquisition device, or DIAD, to punch in at the beginning of his shift, as he does now. The DIAD would show him two possible ways to make his deliveries, one using Orion, and one using the current combination of work rules, procedures and analytic tools that are used to establish the order of package deliveries. He can choose to work in either way, but if he decides not to use Orion, he will be asked to explain the decision.

Orion already has been at work for hours, though. It may have reordered Mr. Ahn's schedule of stops for the day hundreds of times, as packages were added to the list assembled before he arrives at work, and as customers used the company's My Choice self-service platform to change the time or location of their deliveries. UPS says My Choice membership has grown steadily since its launch in 2011 to 12.9 million today.

At one point, Mr. Ahn was scheduled to start his route at 8:45 a.m., making 125 deliveries and traveling 117.85 miles during the day. But now Customer 1 wants a package delivered between 11 a.m. and 1 p.m. That stop was originally scheduled by Orion for 1:25, so Orion has to recalculate. It considers up to 200,000 of the best options before settling on one. The package will now be delivered by 12:30 p.m., adding 1.39 miles to the day's route, at a

cost to UPS of \$1.99. It takes Orion and the network about eight seconds to return an answer.

Now, Customer 2 specifies that a package that Orion originally scheduled for delivery by UPS at 3:51 p.m. must take place between 4:30 p.m. and 6:30 p.m. Orion considers a range of options before settling on a delivery order that arranges the delivery for 4:46 p.m., adding 1.64 additional miles and \$2.77 in cost.

Orion is a useful tool, according to Mr. Ahn. "Orion had me do things in the morning I would not think of doing, and it saved me miles later in the day," he said.

Rough Patches

The deployment of Orion isn't always so smooth, though. That is where Mr. Levis comes in. As project manager, he is responsible for getting people and machines to work together. During the earlier stages of writing the Orion algorithm, it was Orion that had to learn to accommodate people.

"The project was nearly killed in 2007, because it kept spitting out answers that we couldn't implement," Mr. Levis recalls. The earliest versions of Orion focused on getting the best mathematical results, with insufficient regard for the interests of the driver or the customer, who value some level of routine. For example, regular business customers who receive packages on a daily basis don't want UPS to show up at 10 a.m. one day, and 5 p.m. the next. And a customer who is expecting a shipment of frozen food needs delivery as soon as possible, even if efficiency demands that someone gets priority.

To get the project back on track, UPS chief scientist Ranga Nuggehalli turned to Bob Santilli, a senior project manager, asking him to describe a perfect route. Several weeks later, Mr. Santilli came back with the results of his effort, which produced a model plan of stops for drivers on a route in Lancaster, Pa. The engineering team extracted proprietary rules from the Santilli route and built them into Orion.

"By April or May of 2007, he had the first working version of Orion, which balanced consistency and optimality. It had to do with keeping the driver in a path. The route should flow. That is what we learned. That is what brings consistency. Orion can make exceptions to the flow, but it has to do so in an intelligent manner and it can't make an unlimited number of exceptions," Mr. Levis said.

The process of balancing Orion's logic with the real-world experience of drivers is built into the rollout of the project. A team of 700 trainers is working its way through all 55,000 U.S. routes, deploying Orion to one UPS facility at a time, a process expected to be more than 70% complete by the end of the year.

It takes about six days to train a driver. The first day of training is spent fixing maps, as the trainers pour over satellite images and talk to drivers about minute details of their routes. On the third day, the trainers ride the route themselves in a rental car. On the fourth and fifth day, the trainers ride with the driver, and try to figure out what Orion is getting wrong about the route. More revisions are made on the fifth day, and a final ride-along occurs on day six.

Driver reaction to Orion is mixed. The experience can be frustrating for some who might not want to give up a degree of autonomy, or who might not follow Orion's logic. For example, some drivers don't understand why it makes sense to deliver a package in one neighborhood in the morning, and come back to the same area later in the day for another delivery. But Orion often can see a payoff, measured in small amounts of time and money that the average person might not see.

One driver, who declined to speak for attribution, said he's been on Orion since mid-2014 and dislikes it, because it strikes him as illogical. He said that while a colleague who drives a rural route saves more than 20 miles a day using Orion, the program actually added miles to his urban routes when it reduced the total number of routes and combined them. He says the program calculates routes with more left turns and assumes he'll be backing up – two things UPS drivers are taught to avoid to keep safe. And he doesn't like it when Orion tells a driver to deliver to a neighborhood but skip some houses, leaving some stops in the area for another driver.

A second driver who started on Orion this year echoed similar concerns.

A UPS spokeswoman said that drivers are also supposed to use their own judgment in following Orion, and that the program does not direct them to violate safety rules.

For example, drivers could refrain from using Orion if there is a traffic event that the system can't factor. But the company maintains that a driver together with Orion is better than each alone.

Like it or not, more automation is coming to UPS.

"Orion . . . is not an endgame; it is part of a platform," Mr. Abney, UPS's CEO, said. "[T]hese initiatives, along with others, will reduce our delivery costs and provide economic value to our customers and our shareholders."

UPS engineers are already enhancing Orion so it will update delivery schedules while drivers are on the road. Upcoming versions also will include turn-by-turn driving instructions – not yet part of the system.

At some point, Orion may coincide with the rise of driverless vehicles. While true self-driving cars won't be on the road any time soon, the idea of connecting a few driverless trucks in a platoon with one driver in a vehicle at the front isn't far-fetched, according to Mr. Davenport.

"What must be scary is that there will be automated vehicles at some point, although my guess is that it will not happen any time soon," he says. "The driver will have less and less to do."

Credit: By Steven Rosenbush and Laura Stevens

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