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A New Vision for Personal Transportation

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[INNOVATION]

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BY WOLFGANG GRUEL AND FRANK PILLER

Transportation is one of the largest sectors of the global economy. It is also one that is changing rapidly. Smartphones and Internet-based technologies have helped launch and enable new business models like Uber, Lyft, and car2go. Even self-driving cars are no longer science fiction. But the future of transportation — what we call mobility — will go far beyond these developments.

This article is based on our research and experience in mobility and customization. One of the authors (Gruel) initiated and led the development of new mobility services as part of Daimler AG's business innovation team. In that role, he helped grow these services and was head of product management for the car-sharing service car2go and the route-planning tool moovel. The other author (Piller) has investigated the success factors for mass customization in many case studies and quantitative analyses. His research on strategic capabilities is based on several large-scale benchmarking studies, like the MC500, a survey of 500 leading mass-customization companies in the consumer sector.

From Planning to Traveling

Intermodal routing is nothing new. It simply means you're using more than one mode of transportation — car, bus, bike, walking, train, subway, plane, or anything else — on a given route. You might use intermodal routing because it's faster or cheaper or more convenient. Likewise, municipalities and governments have a

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vested interest in intermodal routing, which has the potential not only to reduce traffic (and therefore reduce automotive emissions) but also to radically reshape the transportation infrastructure that governments have traditionally provided.

Recent advancements enable intermodal routing to be realized on a large scale and in real time. Consider OpenTripPlanner, an open-source platform for journey planning that combines public transit, walking, cycling, and car travel. The project has attracted attention from developers and users and is supported by public agencies, startups, and consultancies.

Large automotive companies have also joined the game. Moovel, a route-planning tool developed by Daimler, the German automotive company, sorts through offers from diverse mobility providers to transport users between their chosen starting points and destinations. It presents alternative routes in a transparent and comparable way and includes services like public transit, taxis, shared cars, or shared bicycles.

Tools like these display an advanced understanding of intermodal routing. But they only pertain to the planning of a trip, not to its execution. Passengers following an intermodal itinerary must still obtain separate tickets for every leg of the journey. The passengers also need to be familiar with the details of every mobility option. For example, they must know that public transit fees are fixed, whereas taxi fees may vary and require tipping.

Further, the operators of transportation services generally act independently, rather than collaboratively. For them, intermodal routing platforms are just an additional sales channel. For some of them, such platforms introduce new competition as well. To provide customers with a seamless experience that includes not just planning, but traveling itself, these independent systems will have to adopt a more holistic perspective. They will have to find a way to combine planning, integrated usage, pricing, and payment, all of which is easier said than done. Nonetheless, here are our suggestions for how these many independent systems could move forward.

Toward Mass-Customized Mobility

Our big idea is to design systems that utilize and aggregate the needs of millions of individual users, taking into account their specific context, to create personalized solutions, yet with the efficiency associated with mass-produced ones. This concept is known in other industries as mass customization or mass personalization.

Today mass customization has found a large-scale application in portions of the apparel industry, and also in sectors like media, through services such as Pandora and Spotify. In the mobility sector, mass customization is a common product model for many European cars, starting with the personal configuration of each car by its purchaser, followed by an on-demand manufacturing process and personalized services.

Our vision for mass-customized mobility goes beyond the vehicle, however. Before a trip, a customer would express his or her preferences. For example, in the case of an upcoming business trip, the customer could indicate that punctuality is more important than price — but also that the mode of transportation should accommodate a heavy bag and not risk exposure to rain. The connected system — since it would be familiar with current conditions on the route — might suggest a convenient, dynamically routed bus that transports the customer from his or her front door to a roofed subway station. After riding the subway for nine stops, the customer could then be picked up by a limousine service for the last mile of the journey. The bus and limousine would be synchronized with traffic conditions and the subway schedule. That way, transfers would be seamless and without delay.

The creation of an integrated ecosystem like this would require mass-customized mobility services to master two challenges.

(Continued on page 22)

A New Vision for Personal Transportation
(Continued from page 21)

First, companies have to identify personalization opportunities that create customer value. Instead of offering infinite choices, they have to determine which options matter most — and which limitations customers will accept. Second, they need to establish robust production (fulfillment) processes that can handle an almost infinite variety of intermodal combinations.

Beyond these loom further obstacles that any providers of mass-customized products will have to overcome, including (but hardly limited to): the difficulty of contract negotiations due to the different interests and business models of the mobility providers, legal liabilities that emerge from a connected value network (for example, if the train is late and you miss the plane, who is going to pay for that?), agreements on pricing, the processing of payments across currencies, and the labor relations complexities that would inevitably arise from a radical reorganization of routes and schedules.

Choice Navigation

Existing trip-planning tools give their users options regarding the services offered by the mobility providers but do not consider specific needs of individual users. Creating any kind of customized mobility service will require developing a reasonable solution that considers the individual preferences of customers during the trip configuration process. These preferences can sometimes be explicitly expressed in a trip-planning tool — in other words, a configurator for upcoming trips. An ideal solution would also make reasonable assumptions, based on known characteristics of the user.

Smartphones and Internet-based technologies have enabled new business models such as the one used by the ride-sharing service Lyft.

Here is the good news: It is now possible to learn about a person's mobility preferences from data generated by his or her smartphone. Google Now already tries to predict where a person might want to go next and suggests how to get there. The use of customer input and sensor data from smartphones — used in combination with data from calendar apps and weather apps — allows service providers to learn more about the underlying variables in route choice behavior — and, eventually, offer relevant configuration options.

Handling Volume and Variety

The second challenge presented by mass-customized mobility is to develop efficient fulfillment processes that can handle the large amount of variety resulting from customization. For this to take place, we believe it is necessary to rewire mobility systems dynamically, based on customers' current needs. This process demands a number of enabling building blocks: protocols and application program interfaces (APIs) to exchange real-time information across single mobility systems, new means of transportation such as shared self-driving city vehicles, improved physical interfaces such as train stations or airports, and new service offerings utilizing up-to-date technologies.

Consider once more our example of an ideal business trip within a city in the near future. A dynamically routed bus would pick up a customer and bring him or her "just in time" to a train station, so there is little waiting time at the platform. The subway trains could also be operated differently. Instead of having one huge train that commutes only a few times an hour, public transit might consist of smaller, flexible units that react on demand. At a train station close to the destination, the passenger could take an autonomous electric vehicle. To save energy and road space, this vehicle might team up with other vehicles driving in the same direction.

We are aware that this example still sounds like a visionary story from a 1950s edition of the magazine *Popular Mechanics*. Nevertheless, startups and established companies are already developing parts of this system. For example, Boston-based Bridj is a startup piloting a dynamic bus system that optimizes routing in response to demand. Other

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projects try to make the interfaces among different modes of transportation much smarter and more convenient. For example, Düsseldorf Airport in Germany is piloting a robotic parking system. Users just have to drop off their cars, which are then parked automatically. Customers neither have to look for a parking spot nor remember where they have parked. They save the cost and wait associated with a valet service. In Hamburg, Germany, a private-public partnership between the city and private enterprises has created mobility hubs where users can switch between bus, rail, bicycle, taxi, shared cars, or rental cars.

Another part of the system could make use of self-driving cars. At the MIT Media Lab, we are working on a shared autonomous vehicle system that can move people to and from public transit. This system is also potentially capable of moving goods.

These are promising developments, but we are still, admittedly, some years away from the fully realized and customized intermodal system envisioned above.

Toward a Single Standard

One of the most important enablers of mass-customized mobility is the variety of different initiatives for mobility exchange protocols such as standards and APIs that allow the exchange of real-time demand and capacity information among all elements of a system. TransXChange, for example, is a U.K. data standard for the interchange of route and timetable information. The Service Interface for Real Time Information (SIRI) is an XML protocol developed by several European countries that allows distributed computers to exchange real-time information about public transportation services and vehicles. Google's General Transit Feed Specification (GTFS) protocol has a similar objective.

These protocols and interfaces are the glue that binds together the individual elements of a mass-customized mobility system. As one executive at a large European ride-sharing site told us, "My partnership decisions are nowadays becoming mostly driven by the ability of the APIs of potential partners." The intensification of data interchange will lead to the emergence of a "mobility Internet." Mobility-oriented objects like vehicles will not only send data; they will also become programmable. Applications can be created for this network. New ecosystems will develop and new business opportunities will emerge — and information technology and data will be the core building blocks.

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A New Mindset for Managers

We believe that every manager should be aware of the emergence of this new mobility system. We anticipate that mass-customized mobility systems will become a large source of disruption for current providers of mobility products and services. But they can also become a profit opportunity for new services, business processes, ownership models, and vehicles.

What's more, the new mobility systems could change your company, even if you work in a different industry. For example, the attractiveness of a company's location today is often influenced by the availability of nearby parking. Mass-customized mobility will enable people to get to work without using a car that has to be parked when they reach their destination. This change will not only alter land-use patterns, but it will also affect property values.

Furthermore, business travel may change dramatically. Today, air and train trips are often carefully planned and subject to travel guidelines. The itineraries to and from airports are usually not part of any planning process, even if the cost of a taxi ride to an airport may rival the flight's price. Reporting travel expenses still entails great bureaucratic efforts. In the near future, we think planning an entire trip will be done all at once, according to the individual needs of a given customer and to the travel guidelines of his or her company. The traveler will be guided throughout the trip, and payment and expense information will be reported automatically.

This new system also offers opportunities to redesign supply chains and distribution methods. For example, it may be more efficient for retailers or distributors to place packages in passenger vehicles that pass the points of delivery anyway — as opposed to creating a bespoke delivery journey for a single item or unit of cargo. Local retailers are already using these opportunities. They offer home delivery by building on same-day-delivery services offered by mobility companies such as Uber, mytaxi, and tiramizoo.

Most importantly, the emerging ecosystem of mass-customized mobility will provide a template for similar changes in other industries — in which previously separated systems are connected by a platform for smart services. In the end, the value proposition of such a system is a more personalized, user-centered delivery of services. Therefore, we believe that the concept of mass-customized mobility can become a model and example for other industries to follow.

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