



# Density, Data and Technology – Perspectives on Urban Last-Mile Logistics

SIOR Spring World Conference – New Orleans

**Matthias Winkenbach, PhD**  
MIT Center for Transportation & Logistics  
*Director, MIT Megacity Logistics Lab*

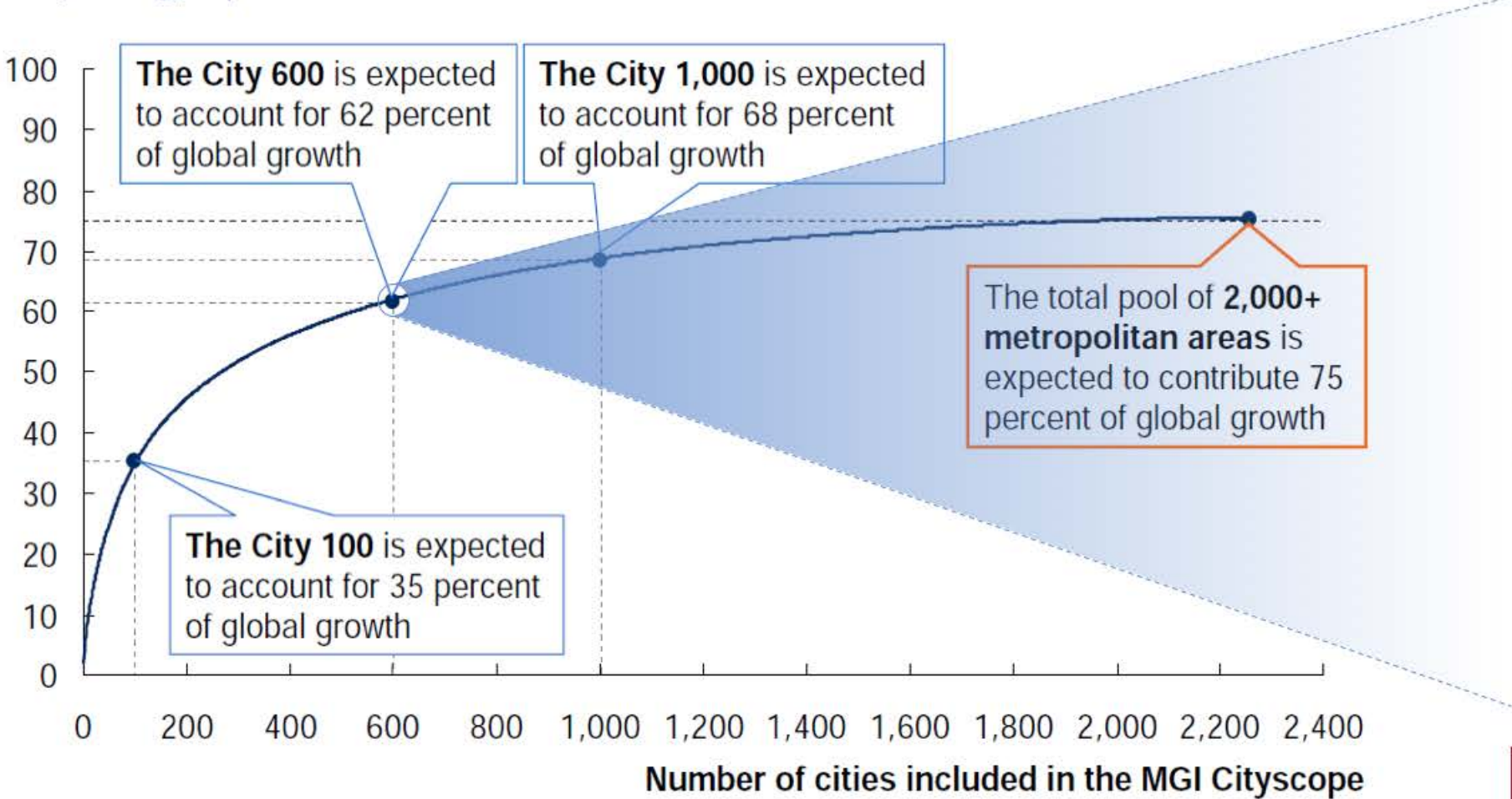
[mwinkenb@mit.edu](mailto:mwinkenb@mit.edu)  
[winkenbach.mit.edu](http://winkenbach.mit.edu)

New Orleans, LA  
April 27, 2017

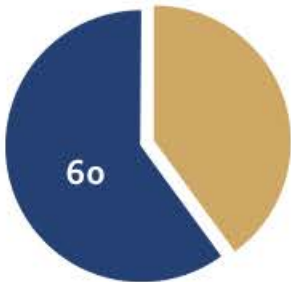
# Urban last-mile distribution has an immediate impact on the future hotspots of economic growth and population



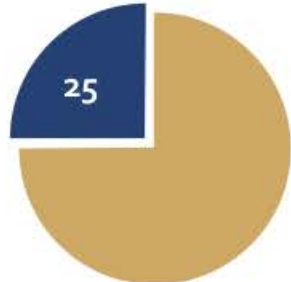
Projected cumulative contribution to global GDP growth  
2007 – 2025, in percent



Global GDP  
2025, in percent



Global population  
2025, in percent



Around 40 megacities with more than 10mn people each by 2025





delivery stops on an average UPS route

possible combinations to sequence these stops

delivery routes in the US per day

of reduction in average route distance results in

of annual cost savings in the US



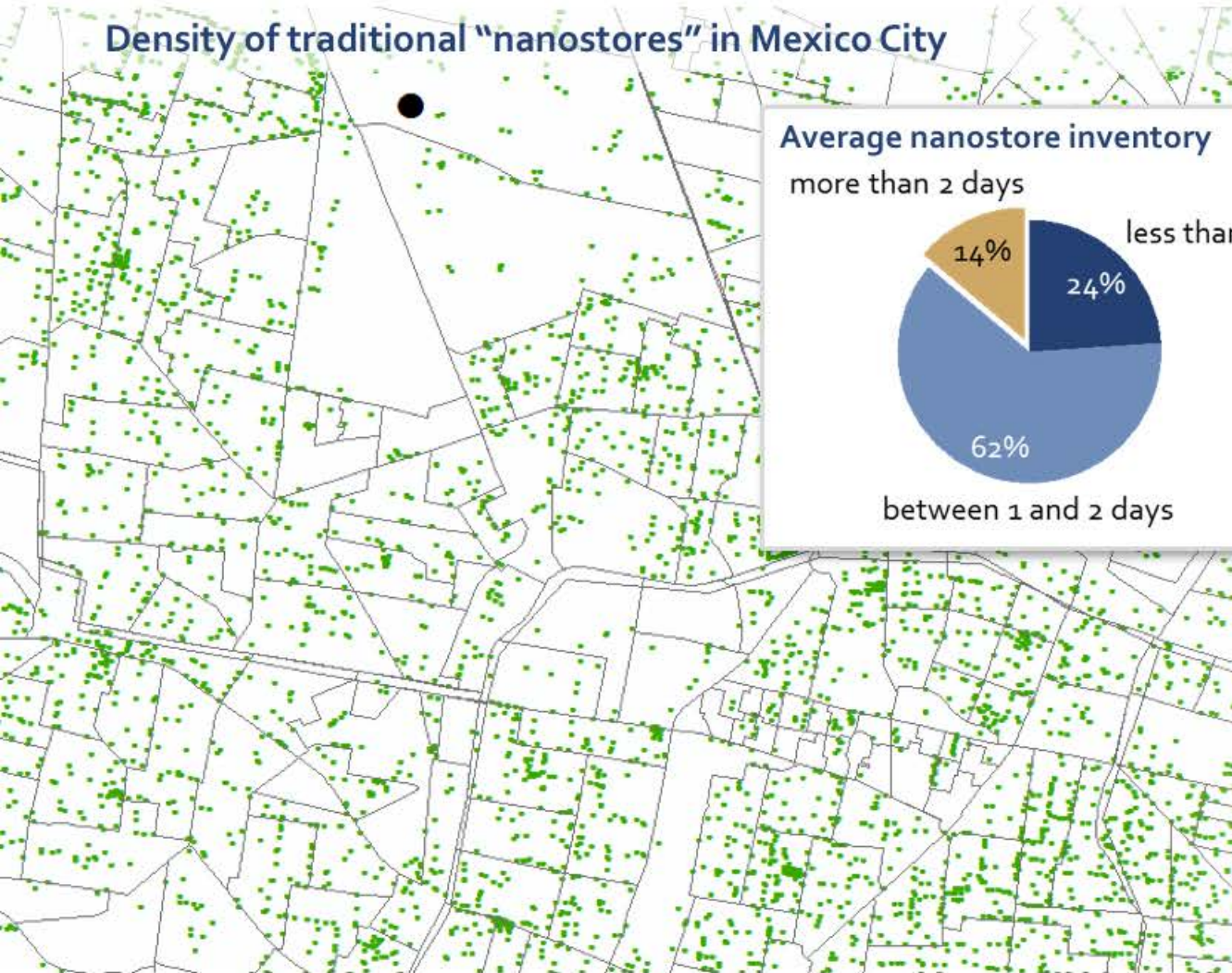
# Emerging market megacities exhibit extreme levels of density

Population density  
Inhabitants / km<sup>2</sup>

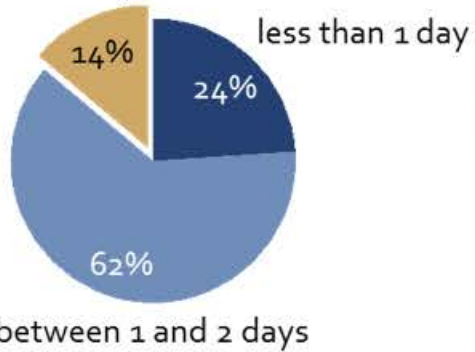




# In many emerging markets, last-mile delivery suffers from high density and **demand fragmentation**



Average nanostore inventory  
more than 2 days



Sources: INEGI 2012, MIT Megacity Logistics Lab, S.A. Caballero (ITESM, 2015)

© 2016 Dr. Matthias Winkenbach | MIT Megacity Logistics Lab – chart no. 5

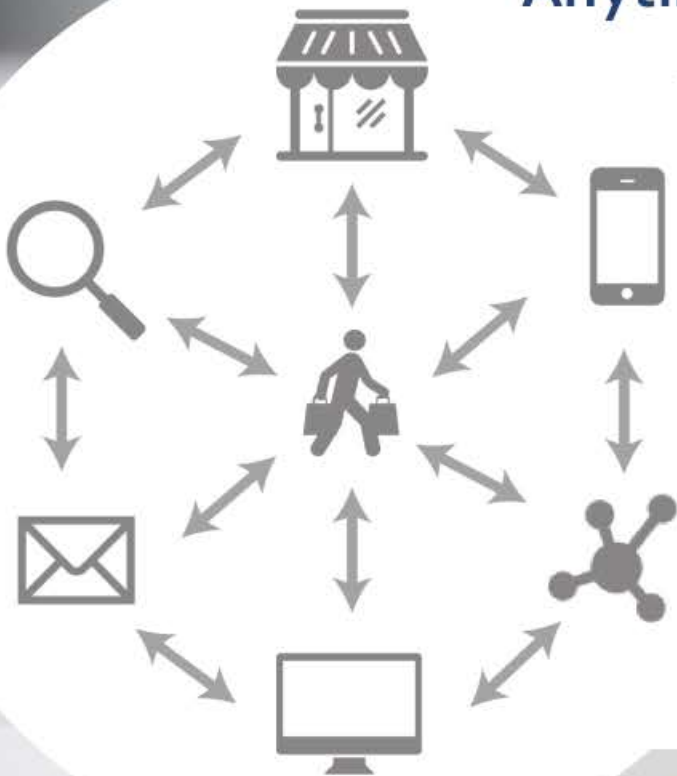


# Customers expect **increasing speed, flexibility, transparency** and **reliability of last-mile delivery** – without having to pay for it

January 9, 2007

The new buying process:

**Anytime, Anywhere**



# Despite the threats of complexity and congestion, **density** is also a key enabler for successful omni-channel retailing

Fast, flexible, customized delivery services are only commercially viable in high-density urban areas...

- Next-day / same-day / instant delivery
- Delivery time windows
- Flexible re-routing
- Flexible re-scheduling
- Convenient returns
- Track and trace
- ...



...because density means reach and scale. Example: Manhattan

10.9 mph  
average daytime speed in NYC

≈

~ 1.27 miles, or 6 km<sup>2</sup>  
are equivalent to a 7 minute radius

×

25,000 people / km<sup>2</sup>  
Manhattan population density

=

150,000 people  
within 7 minutes



# Data, new technologies, and disruptive business models enable new and innovative last-mile delivery models

Cargo bikes



Locker systems



Smart homes / locks



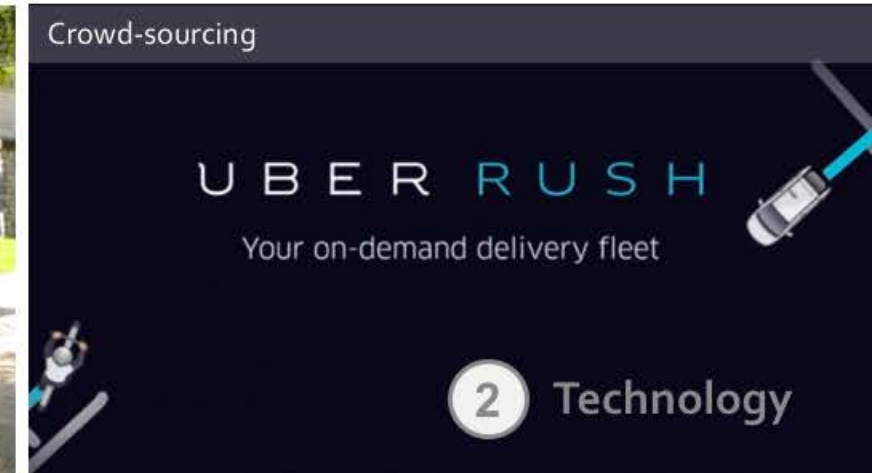
Shared mobility



Mobile / pop-up operations



Crowd-sourcing





# A number of technologies have the potential to **disrupt the way we think about urban last-mile delivery** today

Facility automation



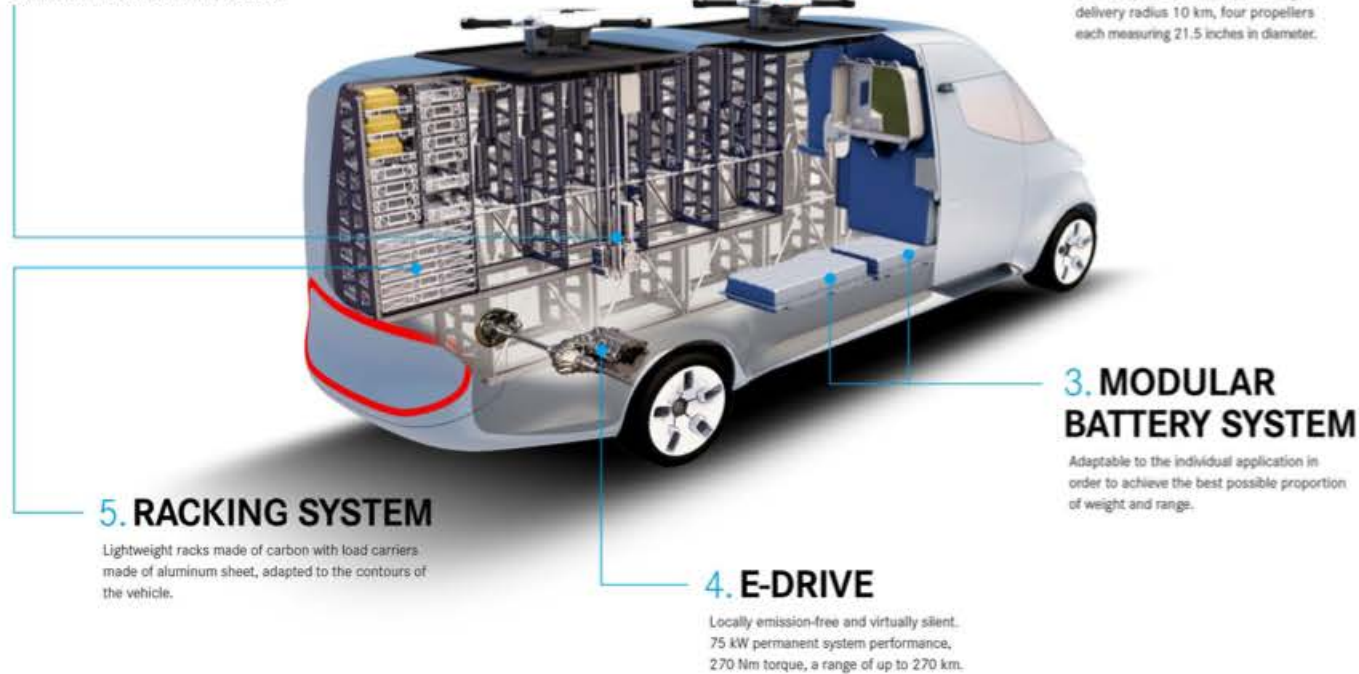
Additive manufacturing



Autonomous, electric “mothership” vehicles

## 1. RACK FEEDER

Transfers parcels to the integrated drones and the deliverer.  
Controlled via IT-based backend-processes.



## 2. DRONES

Fly autonomously on flight routes pre-defined by the system. Payload 2 kg, delivery radius 10 km, four propellers each measuring 21.5 inches in diameter.

## 3. MODULAR BATTERY SYSTEM

Adaptable to the individual application in order to achieve the best possible proportion of weight and range.

## 4. E-DRIVE

Locally emission-free and virtually silent.  
75 kW permanent system performance,  
270 Nm torque, a range of up to 270 km.

## 5. RACKING SYSTEM

Lightweight racks made of carbon with load carriers made of aluminum sheet, adapted to the contours of the vehicle.

Drones



Autonomous ground vehicles



- Robotics can enable more **hyperlocal inventory** in less space
- Additive manufacturing may bring **production back to the city**
- Autonomous delivery needs **compatible infrastructure**
- Shared, smart assets can boost **travel and space efficiency**

Sources: Merchán (2014), MIT Media Lab (2015), BMW, TNT, Mercedes Benz, Amazon, Glue Home, and others

© 2016 Dr. Matthias Winkenbach | MIT Megacity Logistics Lab — chart no. 9



# Cities are highly heterogeneous – there is no one-size-fits all solution to last-mile delivery

Mexico City



New York City

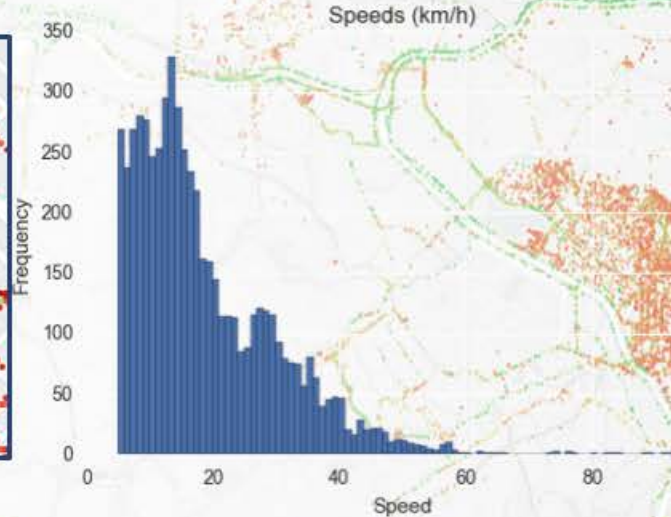
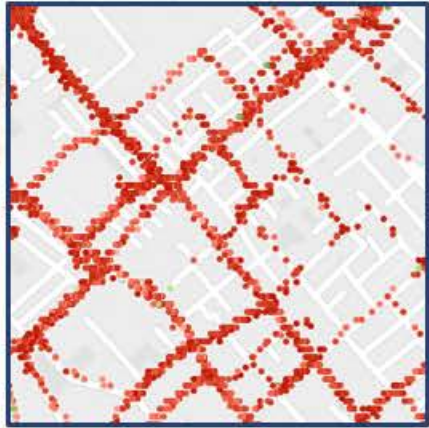




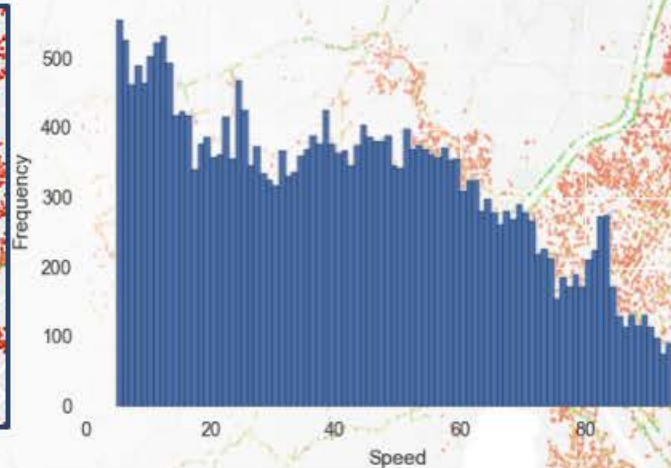
# GPS, cell phone and other movement data can help to understand last-mile operations and bottlenecks

São Paulo

Inter-stop travel

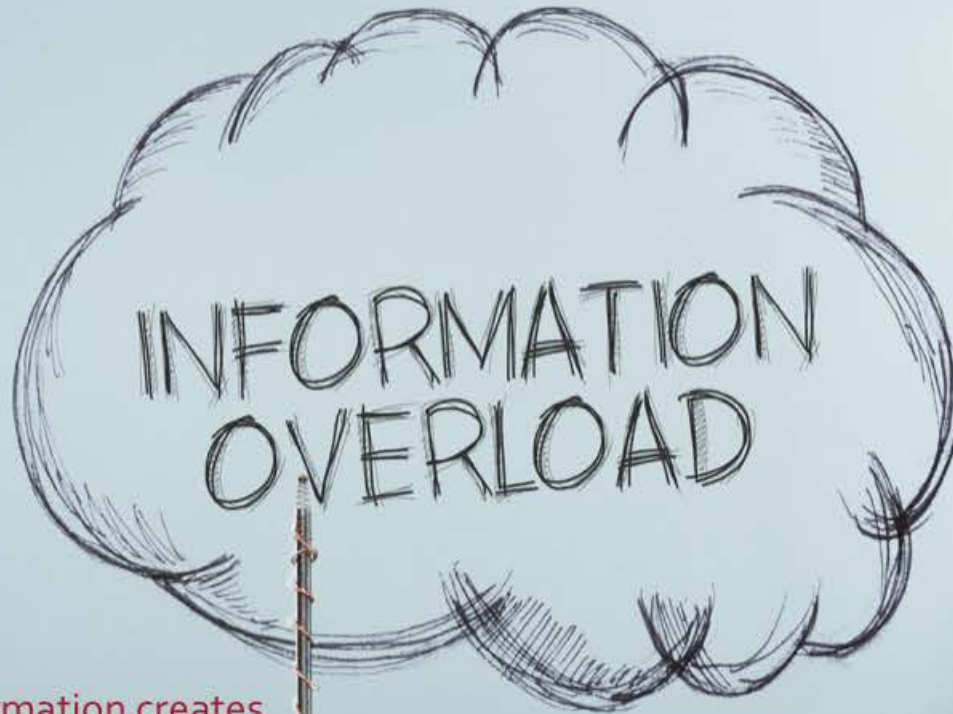


Line-haul travel





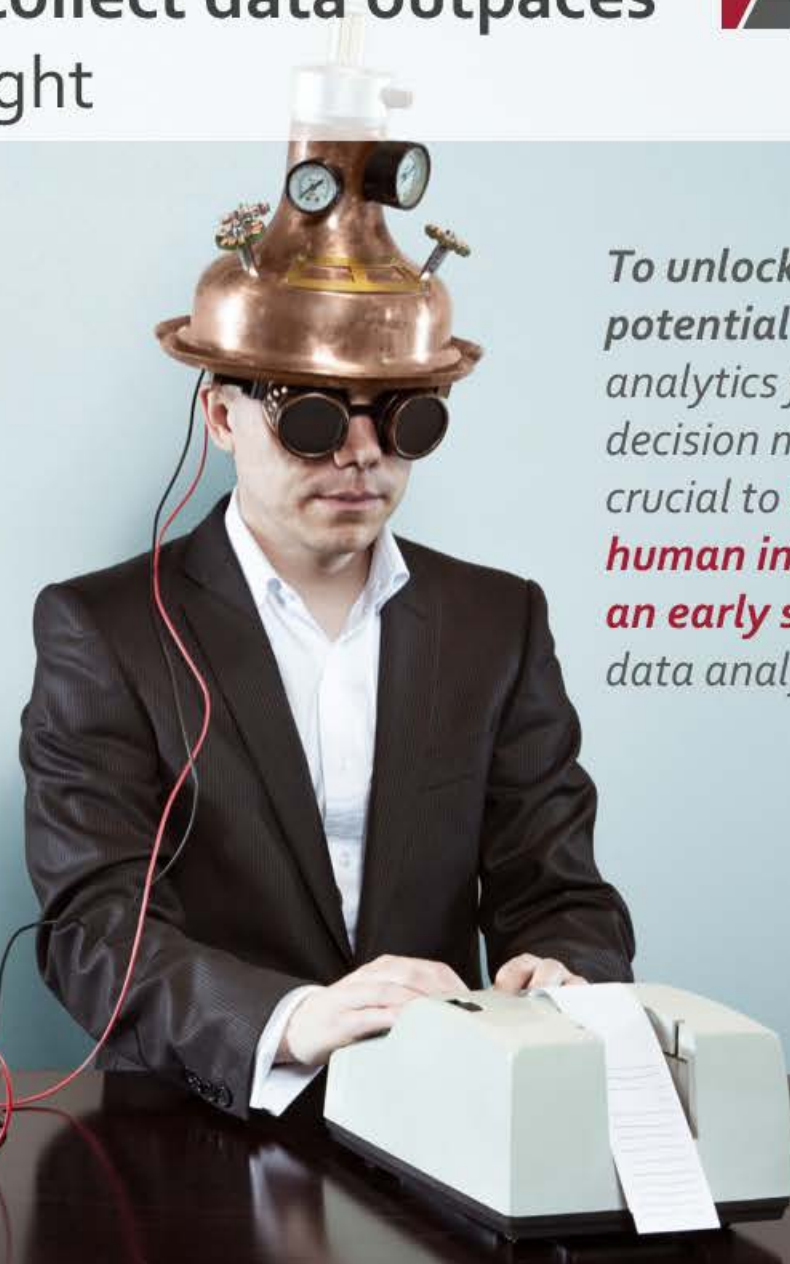
In today's data driven world, **our ability to collect data outpaces our ability to process it** and turn it into insight



"A wealth of information creates a poverty of attention."

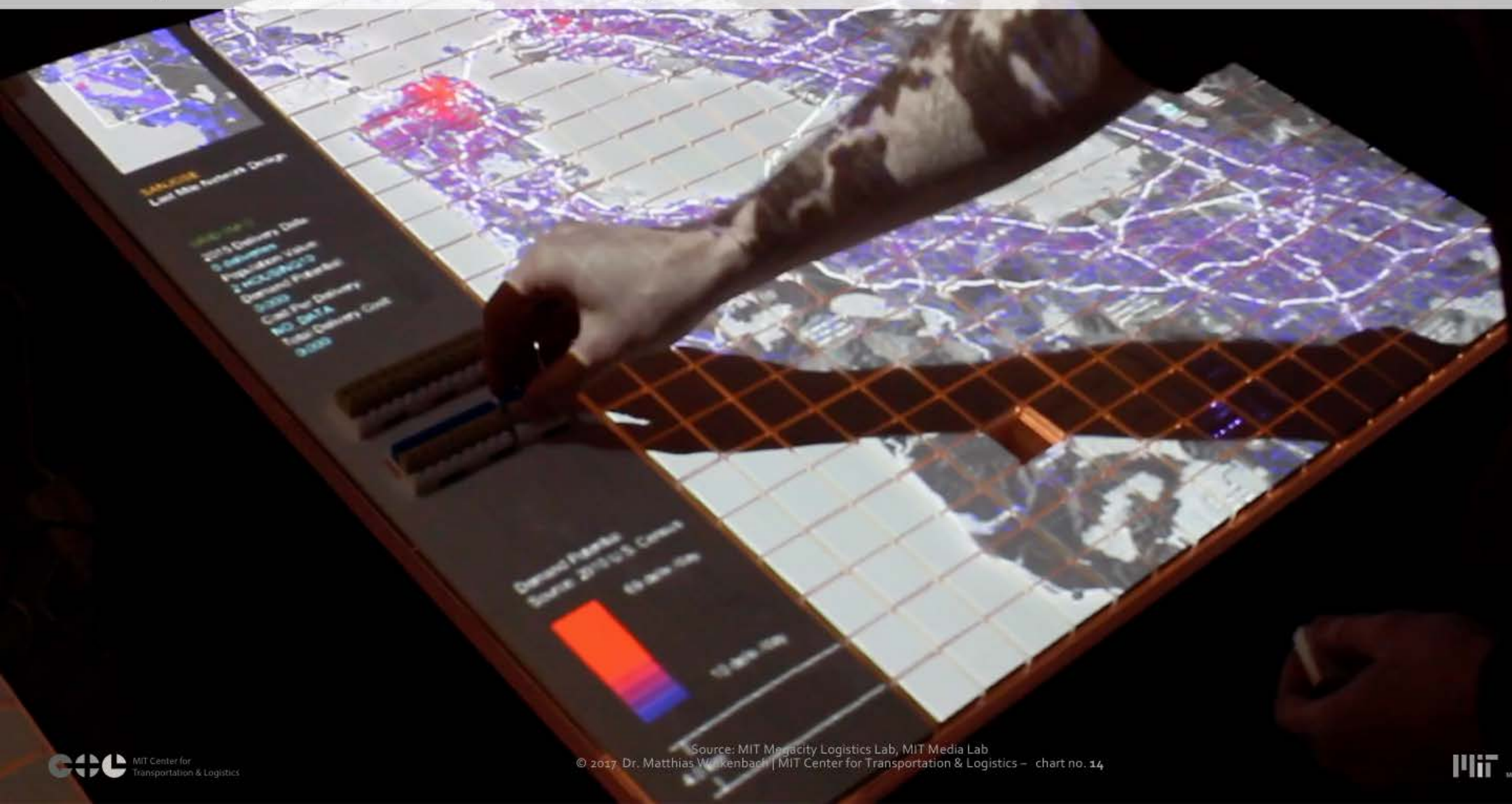
— Herbert A. Simon

*To unlock the full potential of data analytics for corporate decision making, it is crucial to **include human intelligence at an early stage** in the data analysis process.*





In our research, we explore how humans may interact with analytics capabilities through visual interfaces

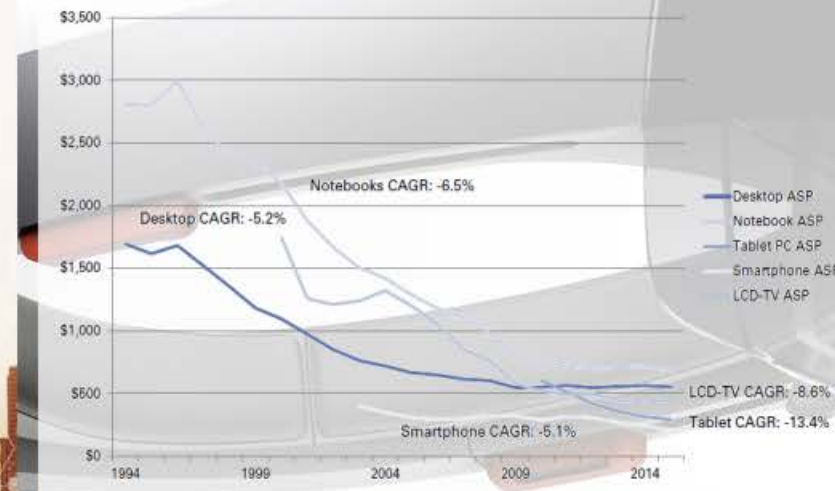




# Augmented Reality will revolutionize design and planning processes for executives as well as policy makers

- **Tactile interfaces** for more intuitive design decisions
- **Immediate audio-visual feedback** to design choices
- Additional levels of high-resolution, **historic and real-time context information**
- **Common platform of communication** for interdisciplinary, multi-stakeholder decision making

**Exhibit 6: HMD price declines could be similar to what we've seen in the past**



Source: Goldman Sachs Global Investment Research.



# Augmented / Virtual Reality will allow decision makers to immerse themselves in any operational environment



- Immersion into real operational environments for better grounded analysis and decision making
- Risk-free, low-cost exposure to realistic operational **experiences for training, education, and innovation** anytime, anywhere, for anyone
- **Faster, cheaper, more flexible experimentation** with alternative design options







# Thank you.

Questions?

**Matthias Winkenbach, PhD**  
MIT Center for Transportation & Logistics  
*Director, MIT Megacity Logistics Lab*

[mwinkenb@mit.edu](mailto:mwinkenb@mit.edu)  
[winkenbach.mit.edu](http://winkenbach.mit.edu)