Digital Interaction, Physical Human Interface, Intuitive Behavior & Mega-tall Buildings

The Evolution of Elevators

Stephen R. Nichols

2017 US Frontiers of Engineering Symposium, National Academy of Engineering

United Technologies Research Center; East Hartford, CT; USA
Agenda

SECTION 1: Evolution of Elevators

SECTION 2: Passenger Experience

SECTION 3: Mega-tall Challenges
Since the New York World’s Fair, we have dedicated ourselves to a single goal: moving the world.

We help people make the most of every moment, every connection, and every opportunity — whether it’s our passengers, our customers, or our colleagues.
How do we transport cargo and passengers safely and quickly from one altitude to another?
Elevator Fundamentals
Elevator Fundamentals

FIGHT AGAINST GRAVITY
Elevator Fundamentals

FIGHT AGAINST GRAVITY
Elevator Fundamentals

FIGHT AGAINST GRAVITY
CONTROLLING FRICTION
Elevator Fundamentals

BUILDING INTERFACE
Elevator Fundamentals

BUILDING INTERFACE
Elevator Fundamentals

CONTROLLING FRICTION
Elevator Fundamentals

MANAGING POWER
Elevator Fundamentals
MORE THAN A “BOX ON A ROPE”
Elevator Fundamentals

DON’T FORGET THE PASSENGERS!
Evolution of Elevators

160+ YEARS OF INNOVATION

Safety First
Evolution of Elevators

160+ YEARS OF INNOVATION

Safety First

Passenger & Cargo Lifts with Operator
Evolution of Elevators

160+ YEARS OF INNOVATION

Safety First
Passenger & Cargo Lifts with Operator
Elevator Groups & Steam Propulsion
Evolution of Elevators

160+ YEARS OF INNOVATION

Safety First
Passenger & Cargo Lifts with Operator
Elevator Groups & Steam Propulsion

Hydraulic Propulsion

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Evolution of Elevators

160+ YEARS OF INNOVATION

Safety First
Passenger & Cargo Lifts with Operator
Elevator Groups & Steam Propulsion
Hydraulic Propulsion
Electric Motors & Birdcage Cabs
Evolution of Elevators

160+ YEARS OF INNOVATION

Safety First
Passenger & Cargo Lifts with Operator
Elevator Groups
Hydraulic Propulsion
Electric Motors & Birdcage Cabs
**Gearless Traction & Cab Control**
Evolution of Elevators

160+ YEARS OF INNOVATION

Safety First
Passenger & Cargo Lifts with Operator
Elevator Groups
Hydraulic Propulsion
Electric Motors
Gearless Traction & Cab Control
Automatic Leveling
Evolution of Elevators

160+ YEARS OF INNOVATION

Safety First
Passenger & Cargo Lifts with Operator
Elevator Groups
Hydraulic Propulsion
Electric Motors
Gearless Traction & Cab Control
Automatic Leveling
Automatic Control Begins
Evolution of Elevators

160+ YEARS OF INNOVATION

Safety First
Passenger & Cargo Lifts with Operator
Elevator Groups
Hydraulic Propulsion
Electric Motors
Gearless Traction & Cab Control
Automatic Leveling
Automatic Control

Higher Rises & Speeds, Double Deck
Fingertip Controls

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Evolution of Elevators

160+ YEARS OF INNOVATION

- Safety First
- Passenger & Cargo Lifts with Operator
- Elevator Groups
- Hydraulic Propulsion
- Electric Motors
- Gearless Traction & Cab Control
- Automatic Leveling
- Automatic Control
- Higher Rises & Speeds, Double Deck
- Fingertip Controls

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Evolution of Elevators

160+ YEARS OF INNOVATION

Safety First
Passenger & Cargo Lifts
Elevator Groups
Hydraulic Propulsion
Electric Motors
Gearless Traction & Cab Control
Automatic Leveling
Automatic Control
Higher Rises & Speeds, Double Deck
Fingertip Controls

Control Improvements
Automatic Doors
Operatorless Control
Evolution of Elevators

160+ YEARS OF INNOVATION

Safety First
Passenger & Cargo Lifts
Elevator Groups
Hydraulic Propulsion
Electric Motors
Gearless Traction & Cab Control
Automatic Leveling
Automatic Control
Higher Rises & Speeds, Double Deck
Fingertip Controls

Control Improvements
Automatic Doors
Operatorless Control
Panoramic Observation Cars

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Evolution of Elevators

160+ YEARS OF INNOVATION

Safety First
Passenger & Cargo Lifts
Elevator Groups
Hydraulic Propulsion
Electric Motors
Gearless Traction & Cab Control
Automatic Leveling
Automatic Control
Higher Rises & Speeds, Double Deck
Fingertip Controls

Control Improvements
Automatic Doors
Operatorless Control
Panoramic Observation Cars
Electronic Control

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Evolution of Elevators

160+ YEARS OF INNOVATION

Safety First
Passenger & Cargo Lifts
Elevator Groups
Hydraulic Propulsion
Electric Motors
Gearless Traction & Cab Control
Automatic Leveling
Automatic Control
Higher Rises & Speeds, Double Deck
Fingertip Controls

Control Improvements
Automatic Doors
Operatorless Control
Panoramic Observation Cars
Electronic Control
Remote Service
Evolution of Elevators

160+ YEARS OF INNOVATION

Safety First
Passenger & Cargo Lifts
Elevator Groups
Hydraulic Propulsion
Electric Motors
Gearless Traction & Cab Control
Automatic Leveling
Automatic Control
Higher Rises & Speeds, Double Deck
Fingertip Controls

Control Improvements
Automatic Doors
Operatorless Control
Panoramic Observation Cars
Electronic Control
Remote Service
Linear Motors
Evolution of Elevators

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Gearless Traction & Cab Control
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Automatic Control
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Control Improvements
Automatic Doors
Operatorless Control
Panoramic Observation Cars
Electronic Control
Remote Service
Linear Motors

Machineroomless
Destination Dispatching

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PASSENGER EXPERIENCE: CREATING A MORE PERSONAL, CONNECTED WORLD

We deliver the personalized experiences people expect in today’s fast-paced, connected world by constantly pushing the limits of technology.

Natural interaction with building ecosystem for a safe, secured, efficient, convenient and personalized experience.
Return of the Personalized Experience

EVOLUTION OF ELEVATOR PASSENGER EXPERIENCE
Passenger Experience Themes

Experience

- Location
- Intent
- Access & Identity
- User Communication

Efficient Building Flow
Passenger Experience
BASIC ELEVATOR EXPERIENCE JOURNEY MAP

Enter Building
- Entrance
- Traverse Lobby
- Find Elevators

Elevator Call
- Push Button
- Button Response
- Wait for Elevator
- Enter Car

Elevator Ride
- Select Floor
- Wait for Destination

Destination
- Arrive on Desired Floor
- Exit Car

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CHALLENGES FOR VERTICAL TRANSPORTATION & MEGA-TALL BUILDINGS

Our world is smaller than ever. Life is faster and more connected. We live in high-rise buildings that were once unimaginable, and rely on a complex network of transport to keep us moving. At the heart of this urban landscape are elevators.
On a mile-high building...

“Now that we have the means, why don’t we go higher up in the air?”

- Frank Lloyd Wright, August 1956
On Elisha Graves Otis...

“When he invented the elevator, [he] invented the upended street, and when the street became upended who should say where it should stop?”

- Frank Lloyd Wright, August 1956
Elevator Fundamentals

REQUESTIONING THE BASIC FUNCTIONS FOR MEGA-TALL
Elevator Fundamentals
REQUESTIONING THE BASIC FUNCTIONS FOR MEGA-TALL

Fight against gravity becomes more difficult at higher rises.
Elevator Fundamentals
REQUESTIONING THE BASIC FUNCTIONS FOR MEGA-TALL

Fight against gravity becomes more difficult at higher rises.

Controlling friction becomes more difficult at higher speeds.
Elevator Fundamentals
REQUESTIONING THE BASIC FUNCTIONS FOR MEGA-TALL

Fight against gravity becomes more difficult at higher rises.

Controlling friction becomes more difficult at higher speeds.

Building interfaces become more complicated.
Elevator Fundamentals
REQUESTIONING THE BASIC FUNCTIONS FOR MEGA-TALL

Fight against gravity becomes more difficult at higher rises.

Controlling friction becomes more difficult at higher speeds.

Building interfaces become more complicated.

Managing and transferring power becomes more complex.
Elevator Fundamentals
REQUESTIONING THE BASIC FUNCTIONS FOR MEGA-TALL

Fight against gravity becomes more difficult at higher rises.

Controlling friction becomes more difficult at higher speeds.

Building interfaces become more complicated.

Managing and transferring power becomes more complex.

New Challenges:
Ride Quality (Noise & Vibration)
Elevator Fundamentals

REQUESTIONING THE BASIC FUNCTIONS FOR MEGA-TALL

Fight against gravity becomes more difficult at higher rises.

Controlling friction becomes more difficult at higher speeds.

Building interfaces become more complicated.

Managing and transferring power becomes more complex.

New Challenges:

- Ride Quality (Noise & Vibration)
- Seismic Requirements
Elevator Fundamentals
REQUESTIONING THE BASIC FUNCTIONS FOR MEGA-TALL

Fight against gravity becomes more difficult at higher rises.

Controlling friction becomes more difficult at higher speeds.

Building interfaces become more complicated.

Managing and transferring power becomes more complex.

New Challenges:
- Ride Quality (Noise & Vibration)
- Seismic Requirements
- Aerodynamics
Elevator Fundamentals
REQUESTIONING THE BASIC FUNCTIONS FOR MEGA-TALL

Fight against gravity becomes more difficult at higher rises.

Controlling friction becomes more difficult at higher speeds.

Building interfaces become more complicated.

Managing and transferring power becomes more complex.

New Challenges:
- Ride Quality (Noise & Vibration)
- Seismic Requirements
- Aerodynamics
- Building Sway
Elevator Fundamentals
REQUESTIONG THE BASIC FUNCTIONS FOR MEGA-TALL

- Fight against gravity becomes more difficult at higher rises.
- Controlling friction becomes more difficult at higher speeds.
- Building interfaces become more complicated.
- Managing and transferring power becomes more complex.

New Challenges:
- Ride Quality (Noise & Vibration)
- Seismic Requirements
- Aerodynamics
- Building Sway
- Rope Stretch
Elevator Fundamentals
REQUESTIONING THE BASIC FUNCTIONS FOR MEGA-TALL

Fight against gravity becomes more difficult at higher rises.

Controlling friction becomes more difficult at higher speeds.

Building interfaces become more complicated.

Managing and transferring power becomes more complex.

New Challenges:
- Ride Quality (Noise & Vibration)
- Seismic Requirements
- Aerodynamics
- Building Sway
- Rope Stretch
- Building Settling
Return to the Experience

ELEVATOR EXPERIENCE JOURNEY MAP

Enter Building
- Entrance
- Traverse Lobby
- Find Elevators

Elevator Call
- Push Button
- Button Response
- Wait for Elevator
- Enter Car

Elevator Ride
- Select Floor
- Wait for Destination

Destination
- Arrive on Desired Floor
- Exit Car

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Building Traffic

PASSENGER JOURNEY

Office

From the elevators

In the elevator

From / to the sky lobby elevators

In front of elevators

In the elevator

Enter Building

Traverse Lobby

Through access control

To the elevators

In front of elevators
Congratulations, Jane!

[Redacted Text]

TEXT MESSAGE:
Future Experience
NEW ELEVATOR EXPERIENCE JOURNEY MAP

Enter Building
- Entrance
- Traverse Lobby
- Go to Elevators

Elevator Call
- No Wait
- Floor Auto-selected

Elevator Ride
- Travel to Destination

Destination
- Arrive on Desired Floor
- Exit Car
“Now in our day comes again the great change, fundamental change concerning everything connected with life.”

- Frank Lloyd Wright, May 1956
Made to move you
Thank you

Stephen R. Nichols
Associate Director, Passenger Experience Segment, Global Engineering
Otis World Headquarters; Farmington, CT; USA
Otis Legacy

Since the New York World's Fair, we have dedicated ourselves to a single goal: moving the world.

Our cities are reaching new heights. Our customers are demanding new solutions. Our world is becoming more connected. For more than a century-and-a-half, we've been pushing the world onward.
Stephen R. Nichols

PASSENGER EXPERIENCE SEGMENT, OTIS ELEVATOR

Cross-functional team leader delivering high impact global products and incubating innovative concepts which enhance passenger experience and satisfaction.

Products and concepts developed by the team focus on:

- Digital interaction
- Physical Human Interface
- Intuitive Behavior

Work spans the disciplines of engineering (software, electrical, mechanical and systems), marketing, UI/UX design and information technology. The teams work focuses on the intersection of human experiences and people centered design with traditional vertical transportation technology and building ecosystems.