3D Printing for Civil Infrastructure Construction

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Architecture

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Construction Science

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TEXAS A&M UNIVERSITY

Henry Ford moment in the auto industry

Los Angeles, 1902

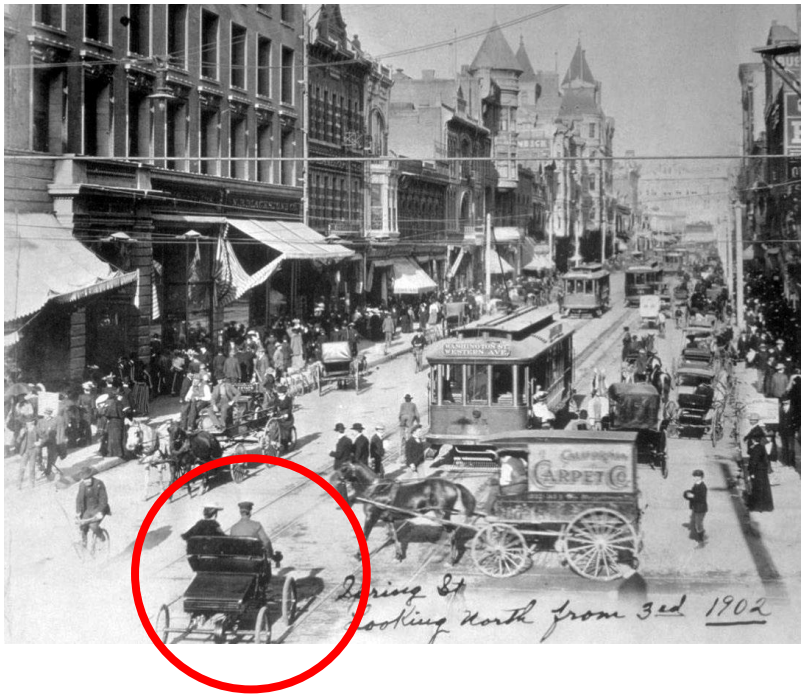
Source: Water and Power Associates
http://waterandpower.org

Los Angeles, circa 1920

Source: Martin Turnbull
http://martinturnbull.com

Henry Ford moment in the auto industry

Los Angeles, 1902



Source: Water and Power Associates
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Los Angeles, circa 1920

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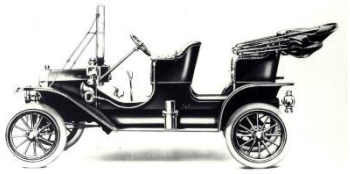
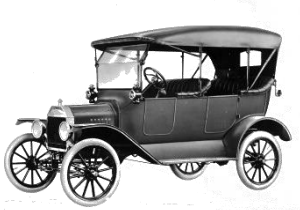
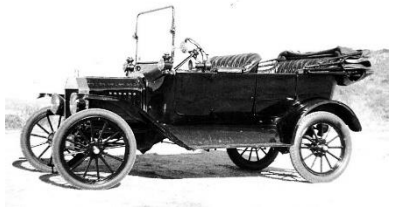
Societal impact

Automobile Unit Price





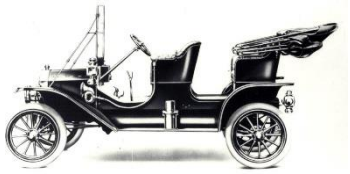


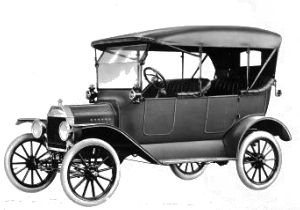
Year	1909	1913	1915	1925
USD (2018)	$22,471	$12,999	$9,434	$3,628

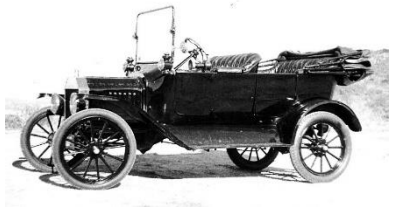
~ 84% decrease

Societal impact

Automobile Unit Price







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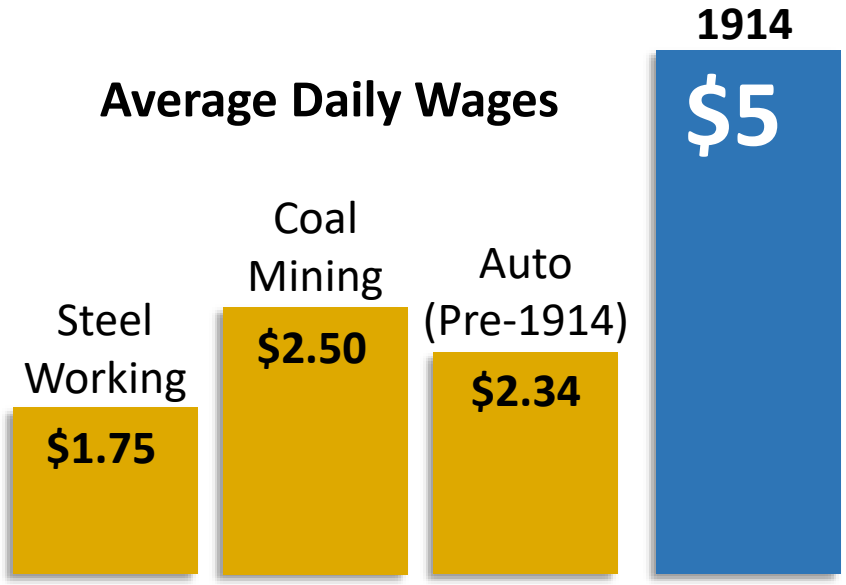
Average Daily Wages



Source: Martha Thierry/ Detroit Free Press

Construction is due for a Henry Ford moment!

Higher productivity in the construction industry could:

- *create **$1.6 trillion additional added value** per year*
- *boost global GDP by **2%***

McKinsey Global Institute 2017

Source: McKinsey & Company

Problem exacerbated in U.S. construction

- U.S. construction: stuck at the same level since 1960s
- Other sectors: up to 1500% productivity boost

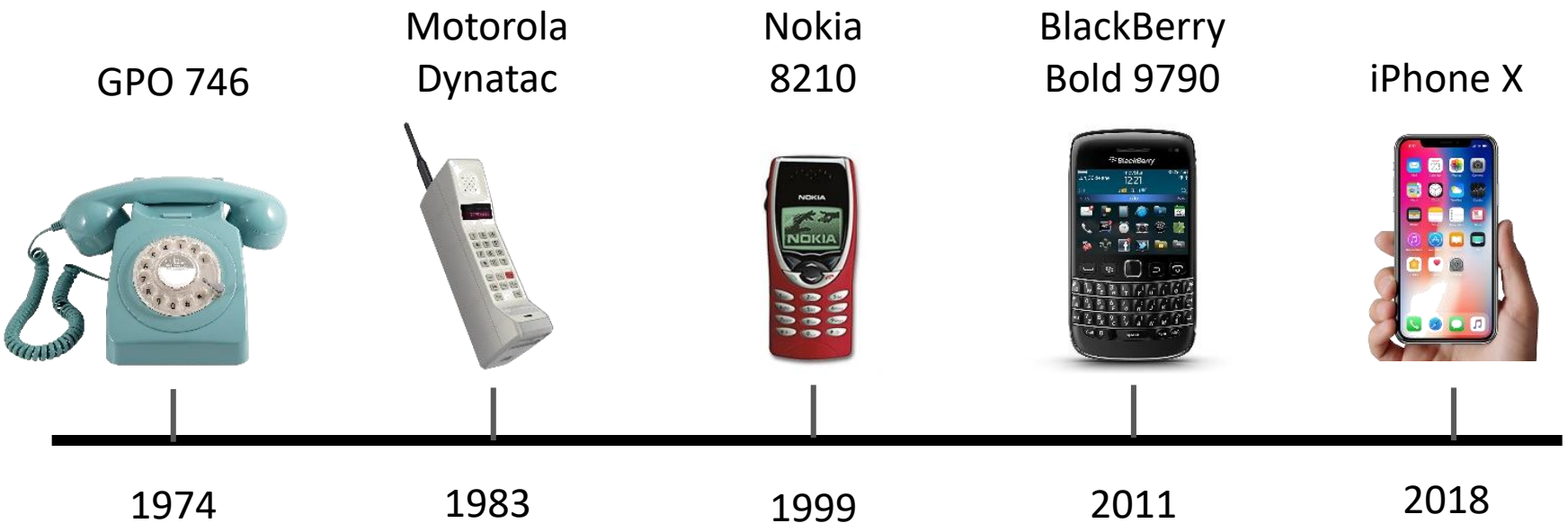
America's Infrastructure Score:

Source: American Society of Civil Engineers

Economic consequences by 2025

- **$3.9 trillion** losses to GDP
- **$7 trillion** lost business sales
- **2.5 million** lost American jobs

Lack of innovation in construction



Lack of innovation in construction

GPO 746

1974

Motorola Dynatac

1983

Nokia 8210

1999

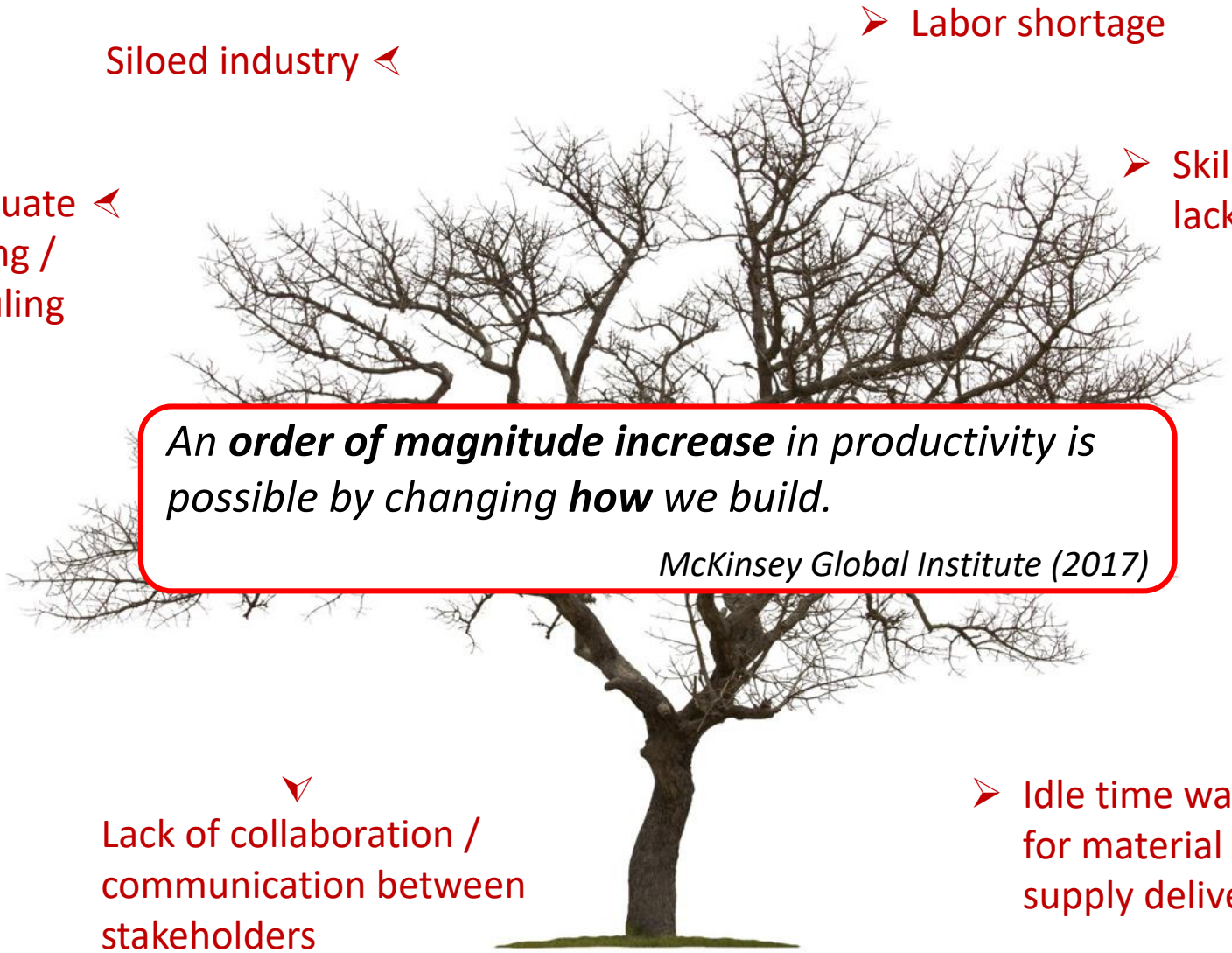
BlackBerry Bold 9790

2011

iPhone X

2018

A transformative approach is needed



Labor shortage

Siloed industry

Skill shortage / lack of expertise

Inadequate planning / scheduling

*An **order of magnitude increase** in productivity is possible by changing **how** we build.*

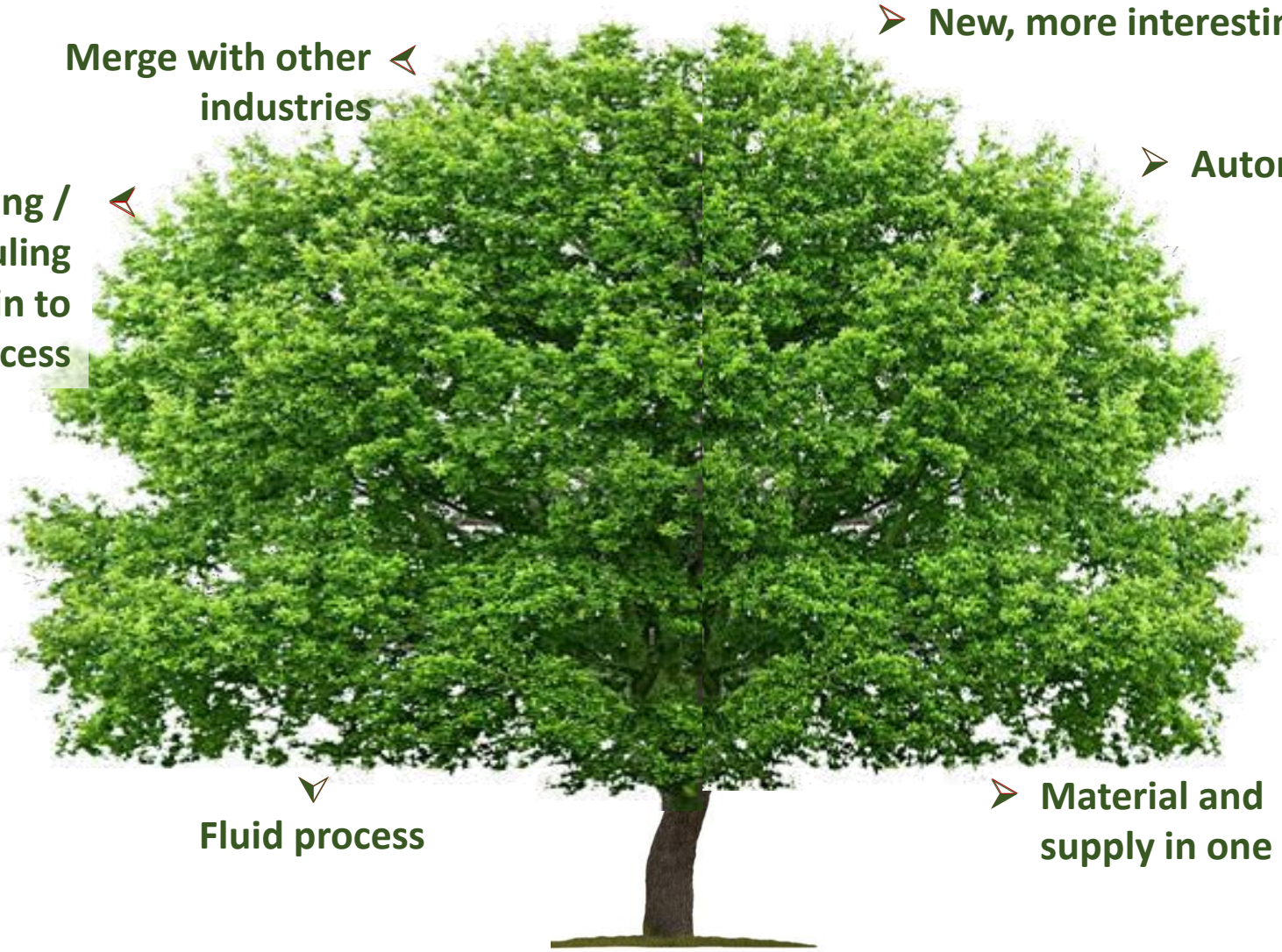
McKinsey Global Institute (2017)

Lack of collaboration / communication between stakeholders

Idle time waiting for material / supply delivery

Current Construction Practice

A transformative approach is needed




A global leader has yet to emerge
Number of 3D Printing Companies Involved with Construction
0
1-10

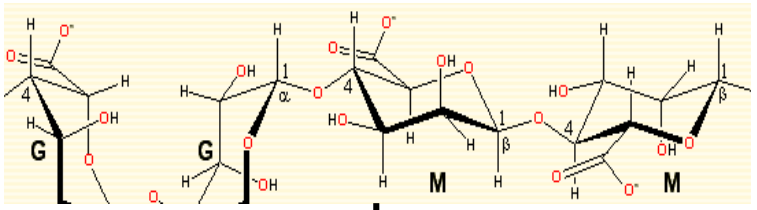
Research needs

*What **must be done** to enable the Henry Ford moment in construction?*

Hardware & software

Industrial scale 3D printers

New materials



Logistics

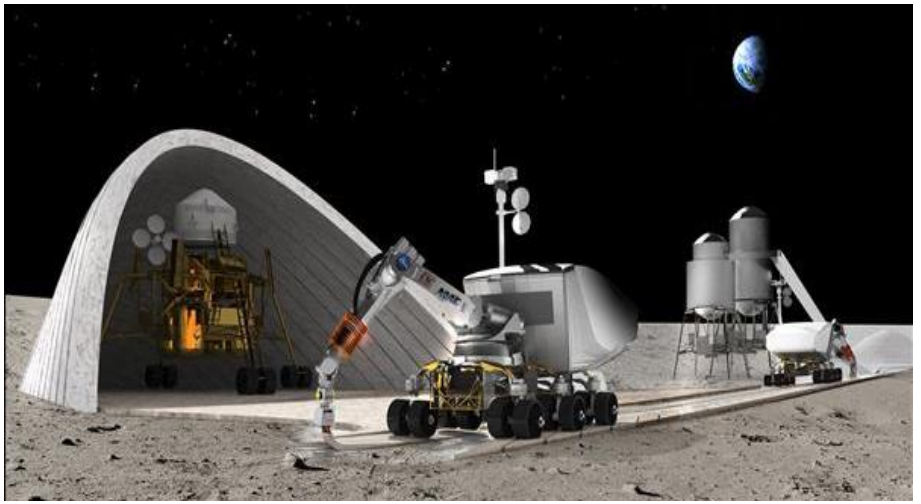
Design

Architectural/structural

Vision: 3D printing for construction

Eliminate construction traffic jams

Enable extra-terrestrial exploration



Enable unmanned military construction