

Occupational & Environmental Medicine
UCSF Department of Medicine

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UNIVERSITY OF CALIFORNIA

School of
Public Health

COEH
CENTER FOR OCCUPATIONAL
& ENVIRONMENTAL HEALTH

COEH
CONTINUING
EDUCATION

University of California
San Francisco
UCSF
Department of Medicine

Wearable technologies, AI and worker safety: science and ethics.

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Disclosures

- I have no personal financial conflicts of interest to disclose.
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The findings and conclusions in this presentation are those of the author(s) and do not necessarily represent the official position any institutions or organizations that support her work.

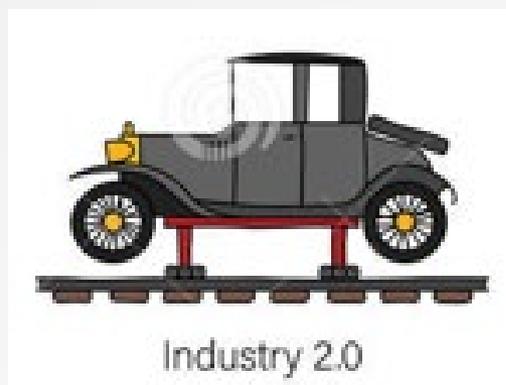


Learning Objectives

- Define Industry 4.0 and its impact on the future of work
- Provide examples on how Industry 4.0 technology is currently impacting the workplace
 - Wearable devices
 - Robots, co-bots and augmentation devices
 - AI
- Discuss our roles as Occupational Health Advocates and the implementation of Industry 5.0



Industry 4.0 & the future of work



1784

INDUSTRY 1.0

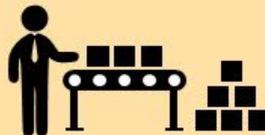
Mechanization, steam power, weaving loom



1870

INDUSTRY 2.0

Mass production, assembly line, electrical energy



1969

INDUSTRY 3.0

Automation, computers and electronics

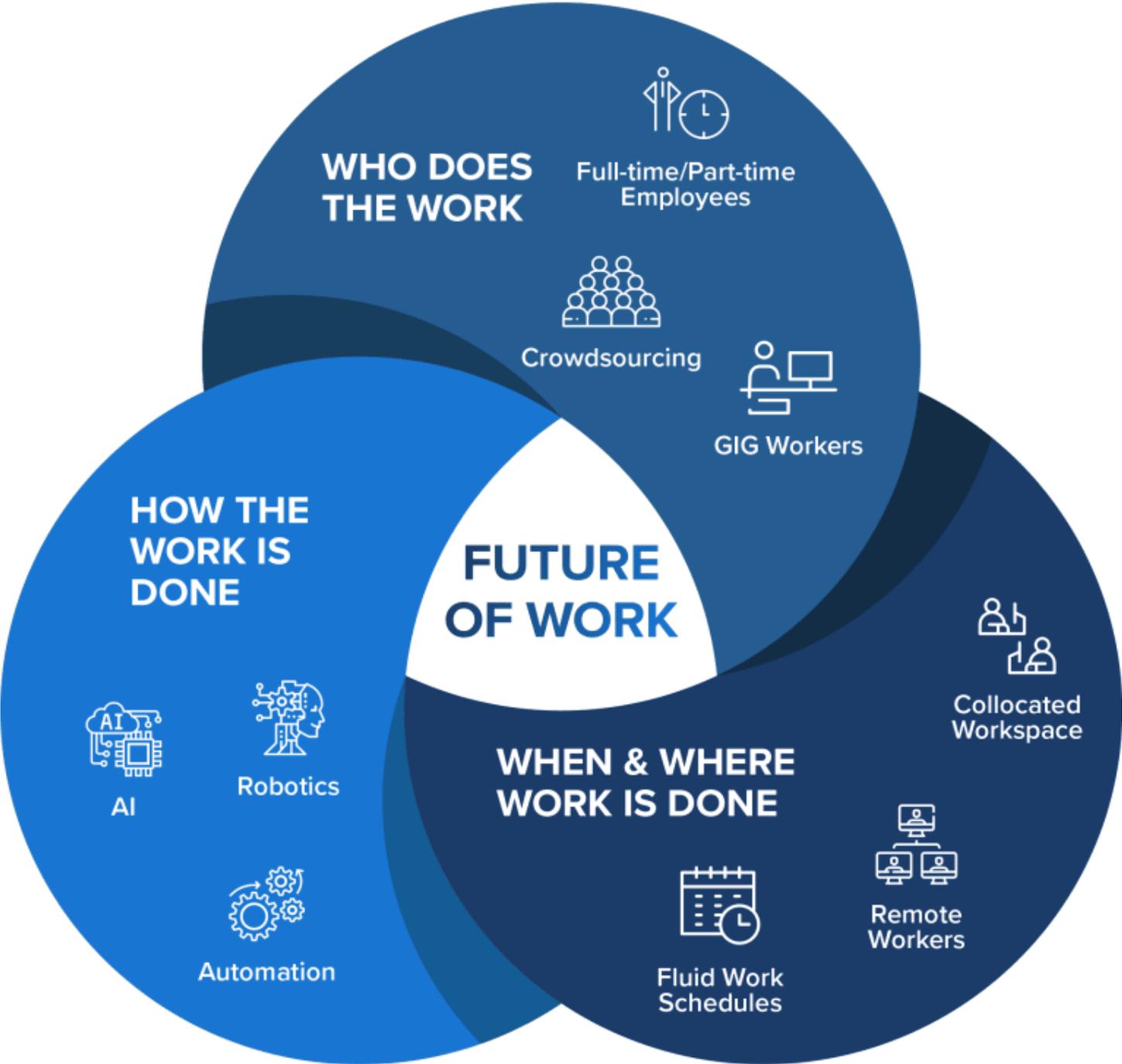


TODAY

INDUSTRY 4.0

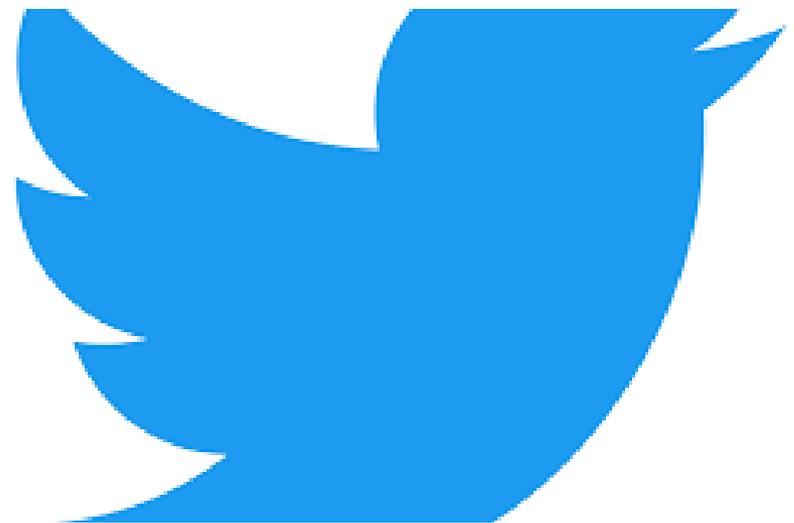
Cyber Physical Systems, internet of things, networks

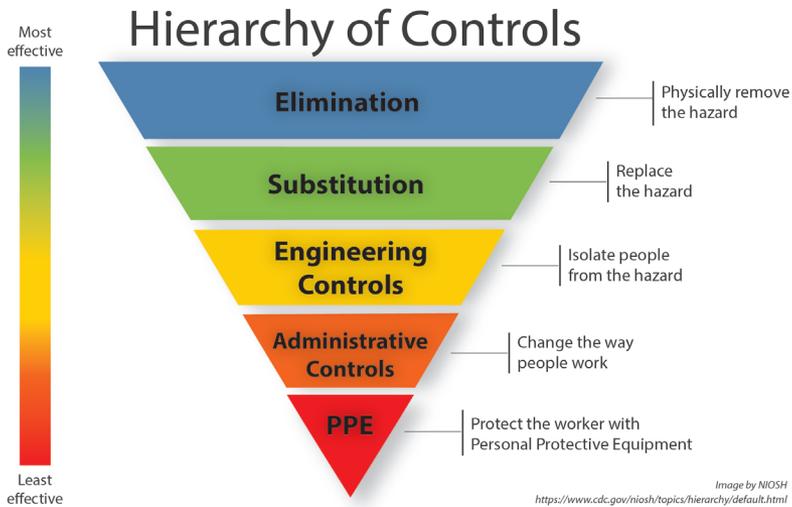




**EVERY TIME THERE'S A
NEW TOOL, WHETHER
IT'S INTERNET OR CELL
PHONES OR ANYTHING
ELSE, ALL THESE
THINGS CAN BE USED
FOR GOOD OR EVIL.
TECHNOLOGY IS
NEUTRAL; IT DEPENDS
ON HOW IT'S USED.**

AVERTU.COM





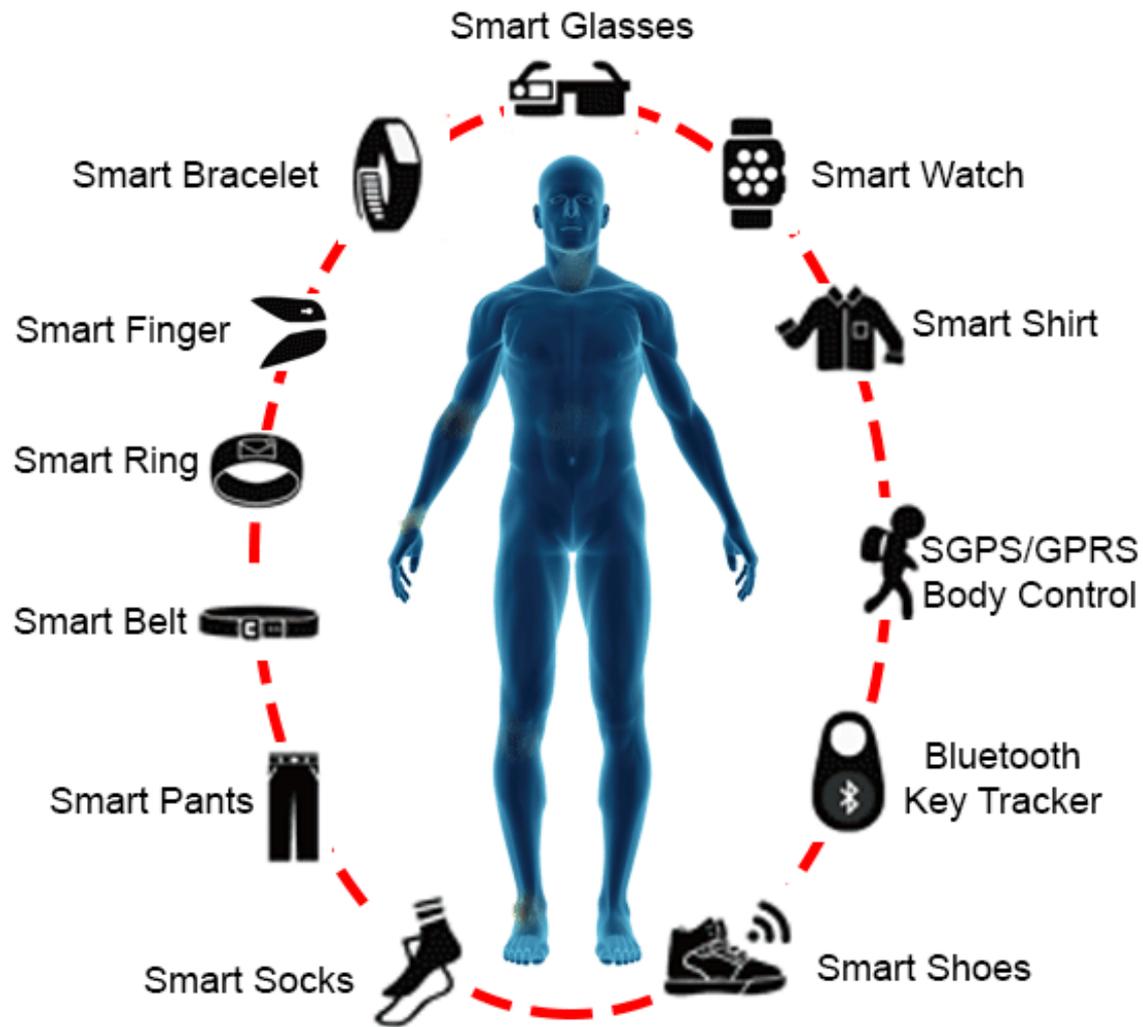
Progress or Pitfall?





Wearable Technology



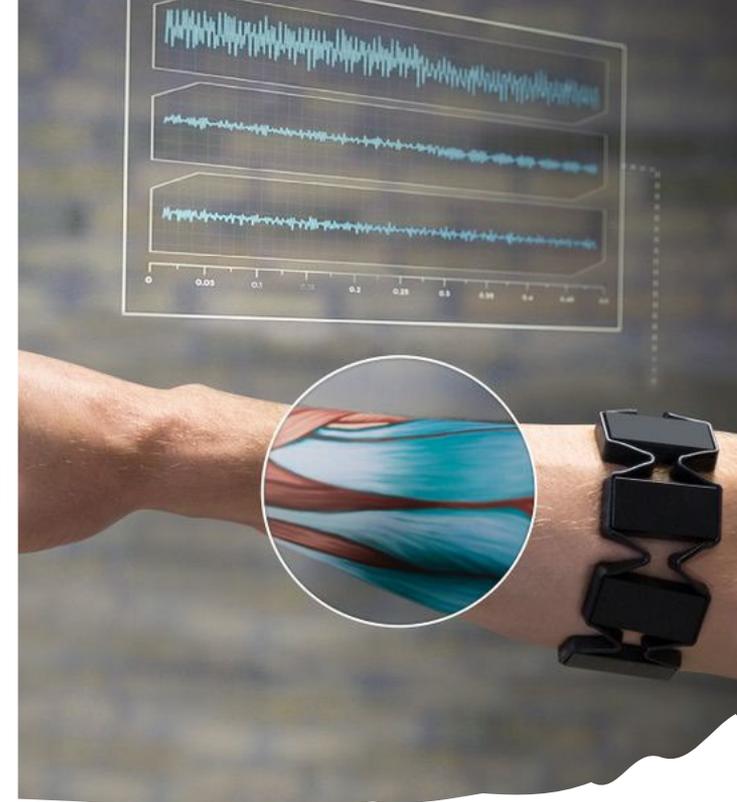


Risk Assessment



Prevention through Design





Hand Posture &
Force Estimation

Manual Material Handling Risk Assessment



Origin



Destination

The origin and destination of a lift



Calculate hand locations (V and H) by IMUs data

Measure hand locations (V and H) by ImageJ analysis and tape measurements

Measurement of vertical hand location:
Error 5.05 cm
Measurement of horizontal hand location:
Error 1.65cm





Risk Engineering

Logged events load into the SafeWork Dashboard and are mapped each day, providing insight into traffic patterns, density, access points and more.

Injury Reduction & Intervention

Real-time vibrational alerts prompt workers to modify behavior before an injury occurs. Actionable reports give management a benchmark for interventions.



Wearables & Safety

AR Safety Goggles

- Detect leading edges
- Identify hazardous material
- Display safety protocols



Smart Hard Hat

- Monitor Fatigue
- Prevent Microsleeps
- Detect Collisions



Power Gloves

- Workers gain increased grip strength and dexterity for using tool and lifting objects



Smart Monitor Features

- Track core body temperature
- Detect harmful gases
- Improve contact tracing



Smart Boots

- Detect pressure from falls
- Sense location
- Charge by walking



Smart Wearable "SoloGuard"

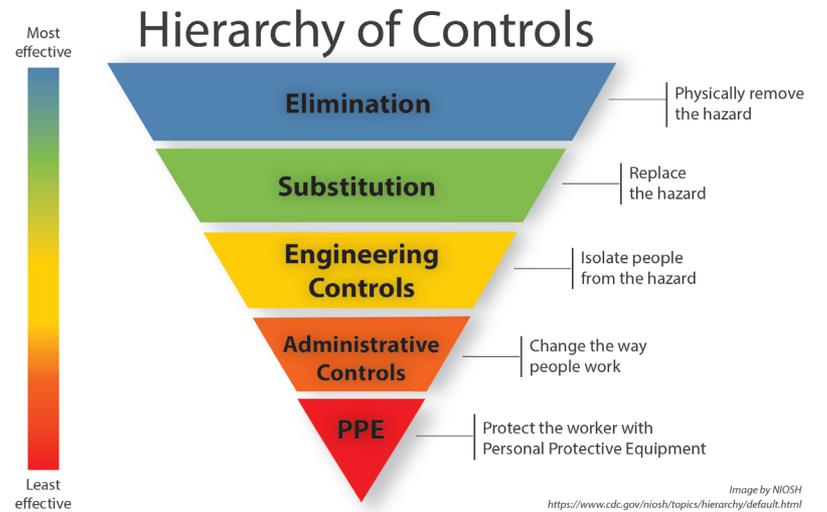
- Monitor health and activity
- Detect falls and send alerts
- Enable hands-free communication



Get in Touch



Photographer: Michelle G





Wearable Technology & Workplace Surveillance

- increases workplace stress
- Promotes worker alienation
- Lower job satisfaction
- quantity is more important than quality

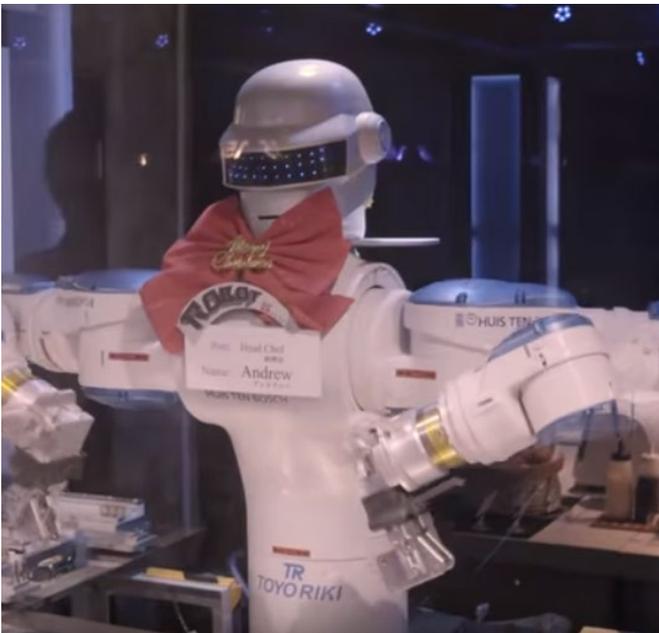


Employee acceptance of wearable technology in the workplace

Jesse V. Jacobs^{a, b} ✉, Lawrence J. Hettinger^a, Yueng-Hsiang Huang^{a, c}, Susan Jeffries^a, Mary F. Lesch^a, Lucinda A. Simmons^a, Santosh K. Verma^a, Joanna L. Willetts^a

Organizations intending to implement wearable technology should

- (a) focus its use on improving workplace safety,
- (b) advance a positive safety climate,
- (c) ensure sufficient evidence to support employees' beliefs that the wearable will meet its objective, and
- (d) involve and inform employees in the process of selecting and implementing wearable technology.



Robots & Cobots



Robots & Cobots Defined

Robots



VS

Cobots



- A **robot** is an actuated mechanism programmed to perform intended tasks
- A **robot** can perform tasks based on current state and sensing, without human intervention

- A **collaborative robot** (cobot) is capable of learning multiple tasks to assist human beings
- A **collaborative robot** is not intended to augment the human worker's capabilities nor take the place of a human worker

Robots versus Cobots

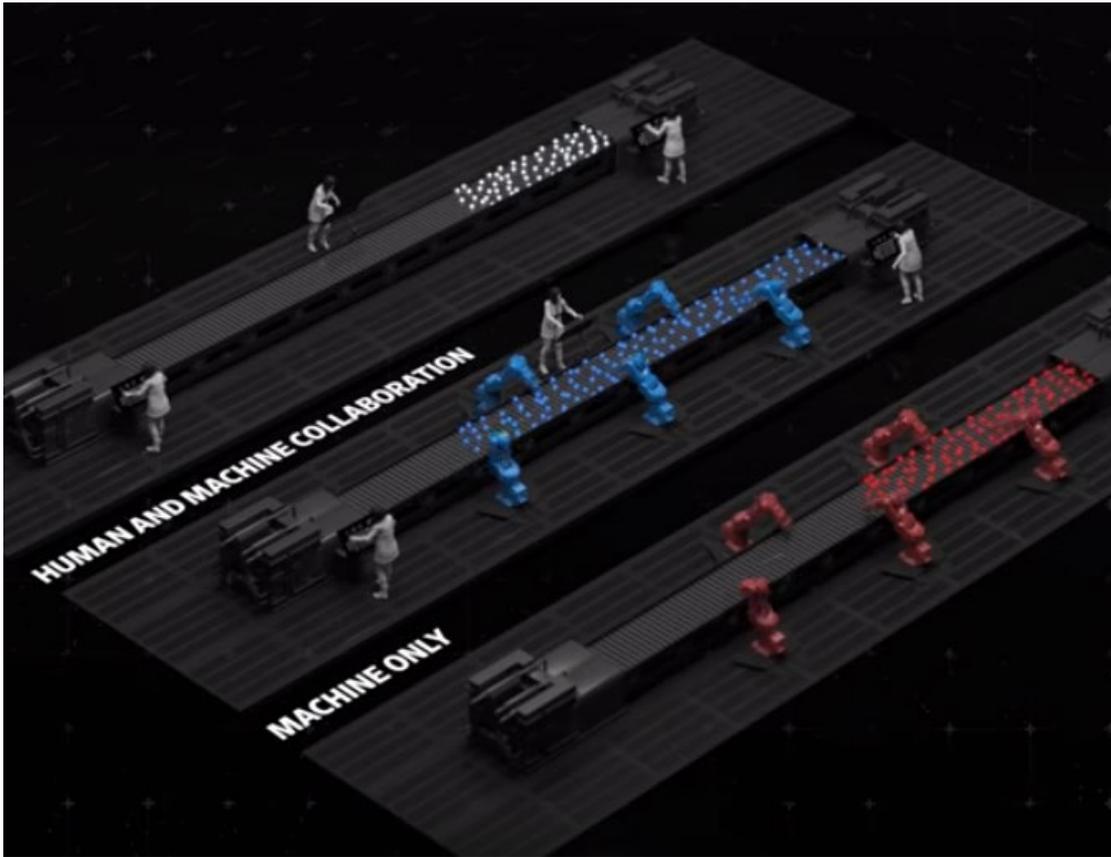


Robots – Accomplish tasks without the human



Cobots – Accomplish tasks with Humans





Impact on the Worker

- Cobots reduced idle time by 85% compared to human alone
- Machine Only – No work for humans!



Robots vs. Cobots

ROBOTS

PROS

- Can perform tasks unsafe for humans
- Increase productivity
- Creates high skilled jobs

CONS

- Replaces the low skilled worker
- Safety risks
- Still expensive

COBOTS

PROS

- Does not replace the human
- Creates high skilled jobs
- Can do the “undesirable” part of the task

CONS

- Still more expensive than cheap labor
- Slower than robots
- Still expensive
- Reduction of idle time may increase workload



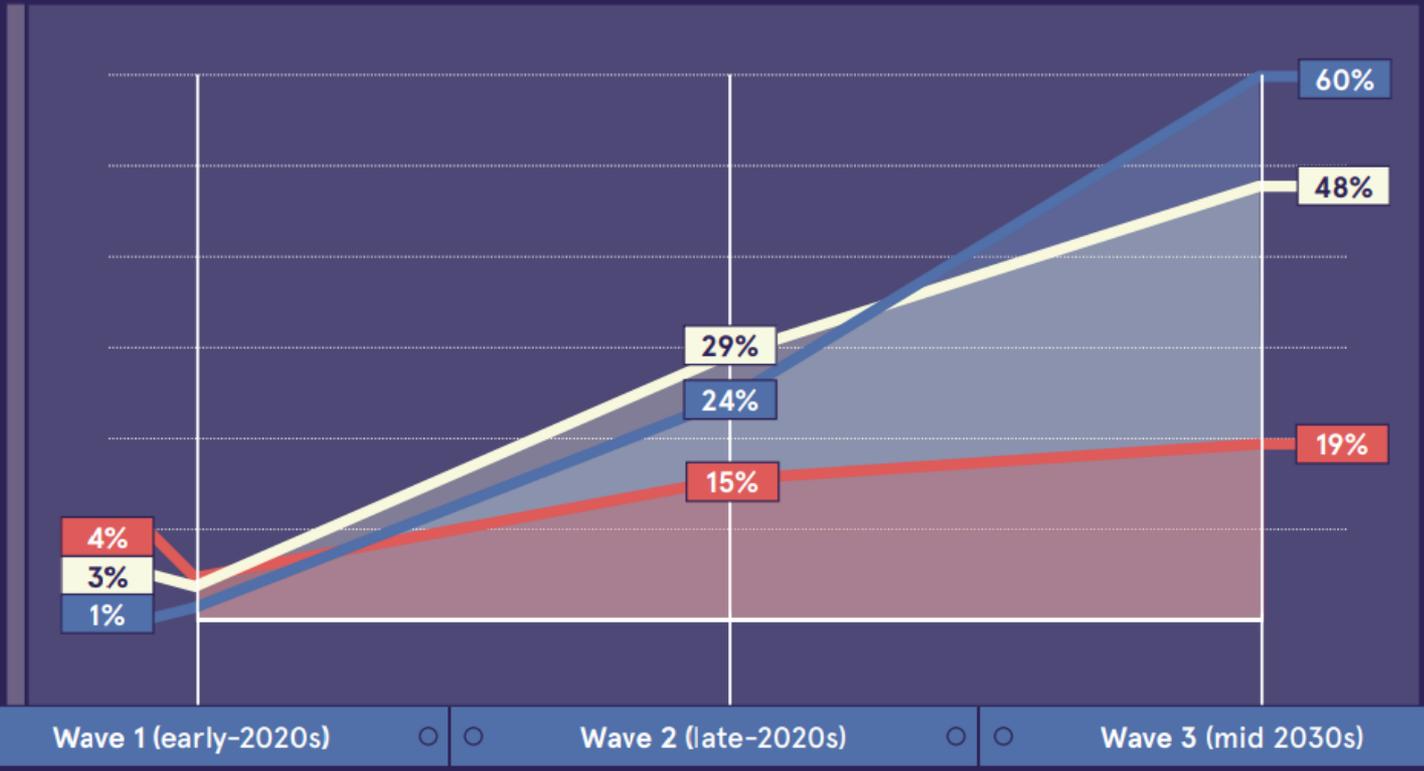
Workforce Skill Gaps

06

LOWER EDUCATED HARDEST HIT AS MANUAL TASKS PHASED OUT

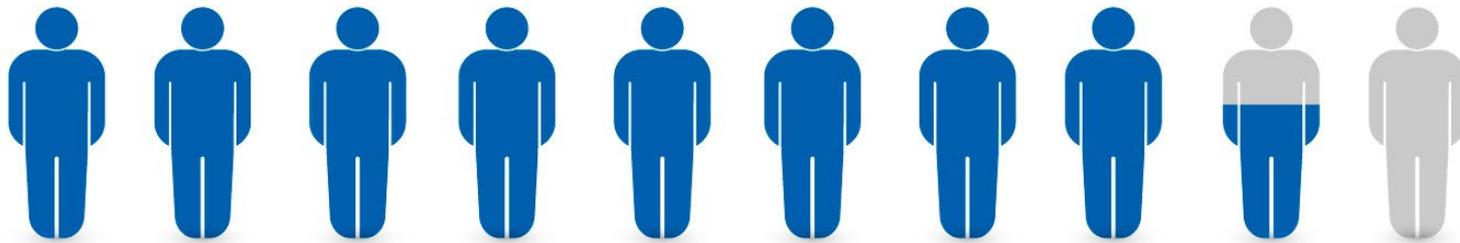
Share of jobs with a high potential of automation by education level

● Low education (GCSE or lower) ● Medium education ● High education (graduates)



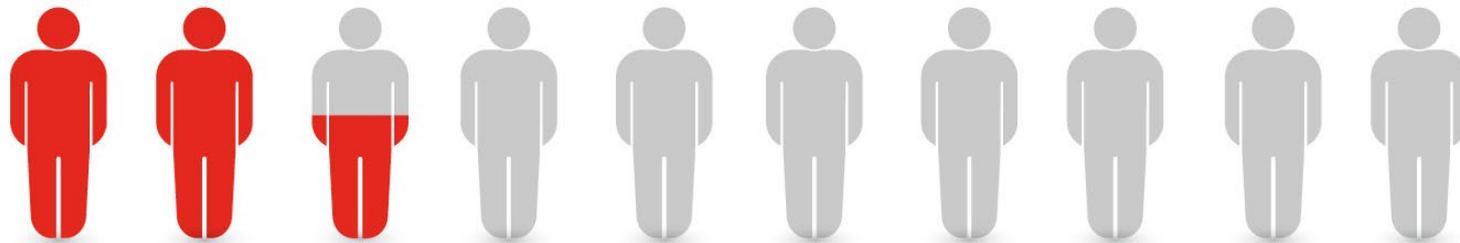
Can we prepare our workforce?

Contradictions in US workforce Industry 4.0 skill sets



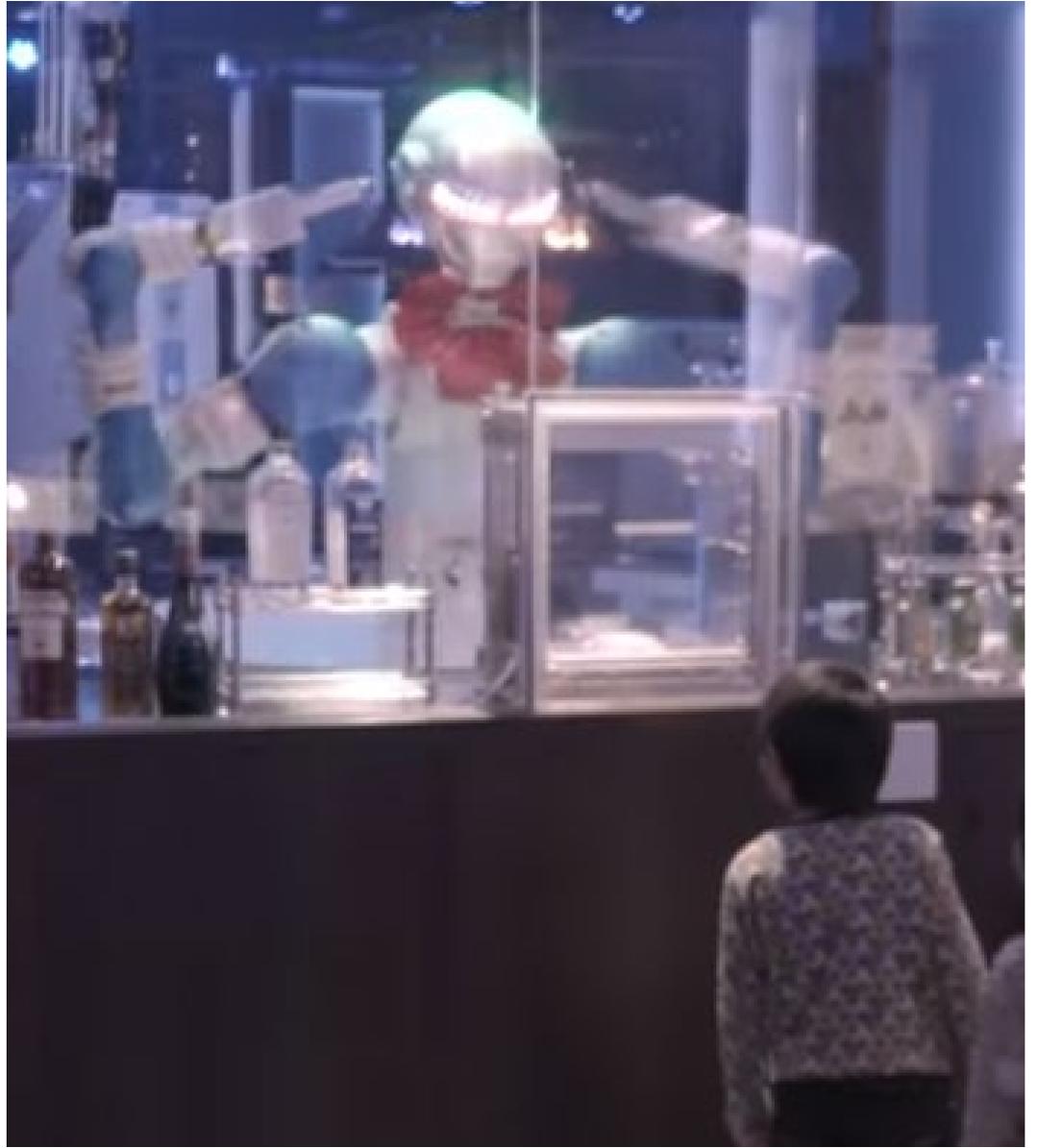
86%

say they are doing everything they can to create
a workforce for Industry 4.0



25%

yet only 25% are highly confident they have the
right workforce composition



Goodbye
everyone!
Artificial
intelligence
fired me
:(



Having more drivers on the road benefits ride-share companies, but drivers profit from surge pricing and scarcity in their ranks.

Ride-share companies, which do not bear the direct costs of drivers being idle, want to have as many drivers available as possible.

MANY DRIVERS, NO SURGE

FEW DRIVERS, SURGE

\$10

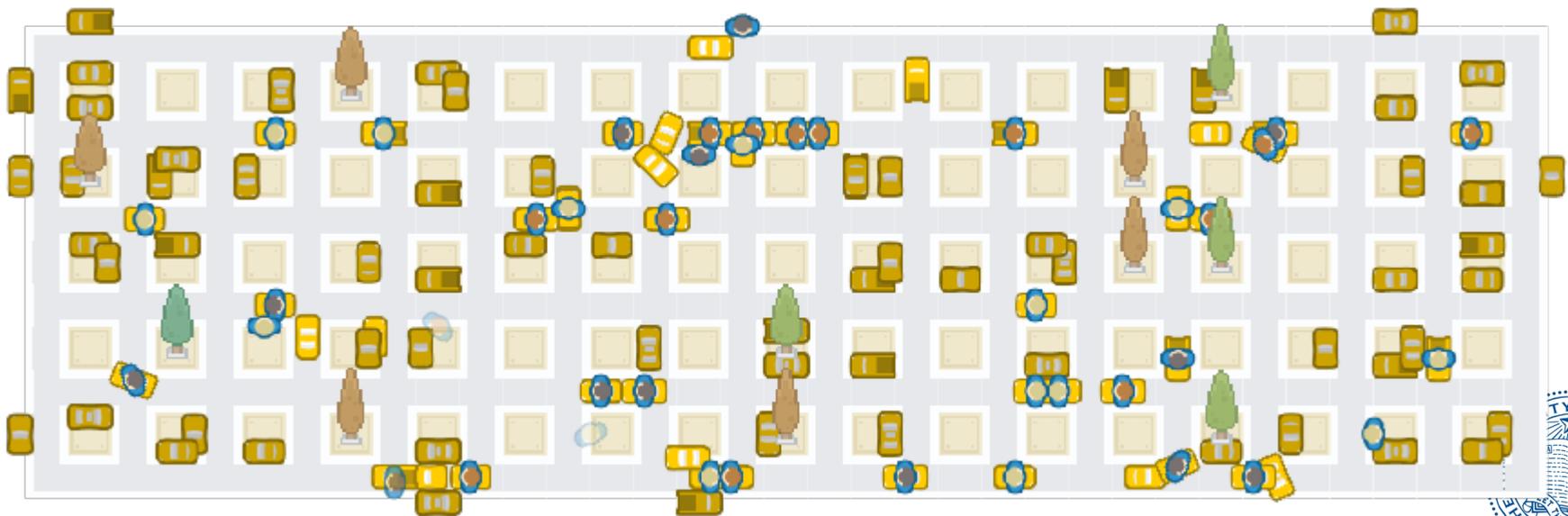
\$687

3

Driver hourly wage

Company hourly gross

Minutes passengers are waiting



Having more drivers on the road benefits ride-share companies, but drivers profit from surge pricing and scarcity in their ranks.

Ride-share companies, which do not bear the direct costs of drivers being idle, want to have as many drivers available as possible.

MANY DRIVERS, NO SURGE

FEW DRIVERS, SURGE

\$42

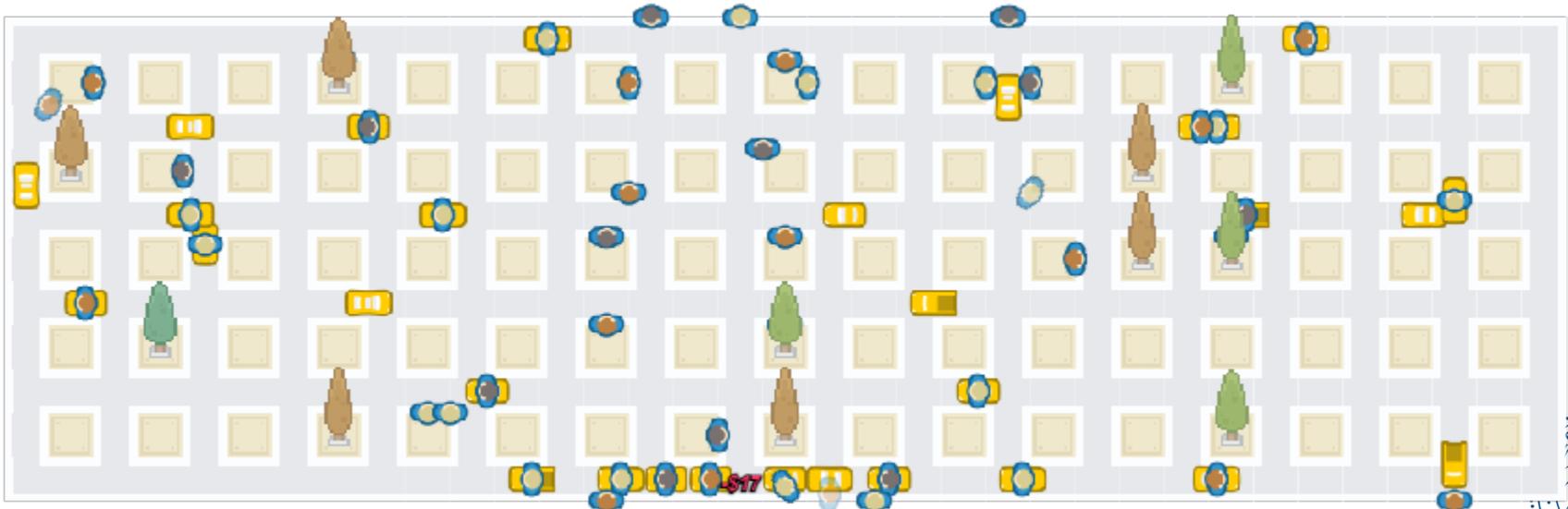
Driver hourly wage

\$543

Company hourly gross

11

Minutes passengers are waiting





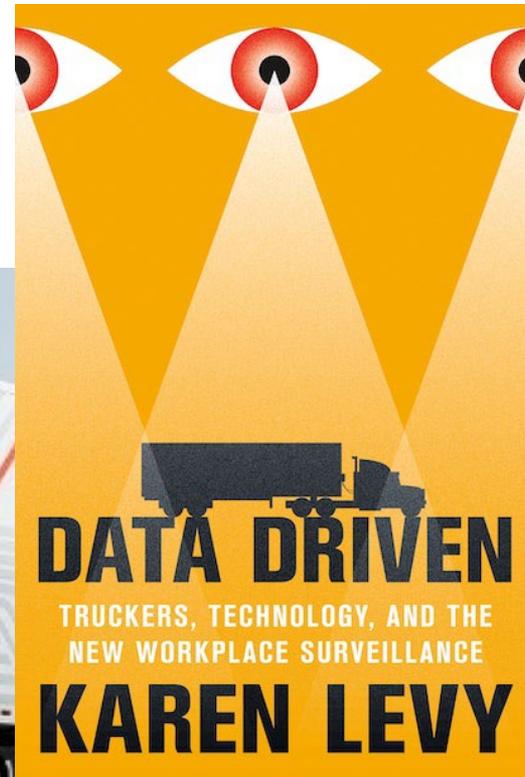
Ed Frantzen, a veteran Uber driver in the Chicago area, said of the company and its messages to drivers, "It was always, constantly, trying to get you into a certain direction." Brittany Sowacke for The New York Times

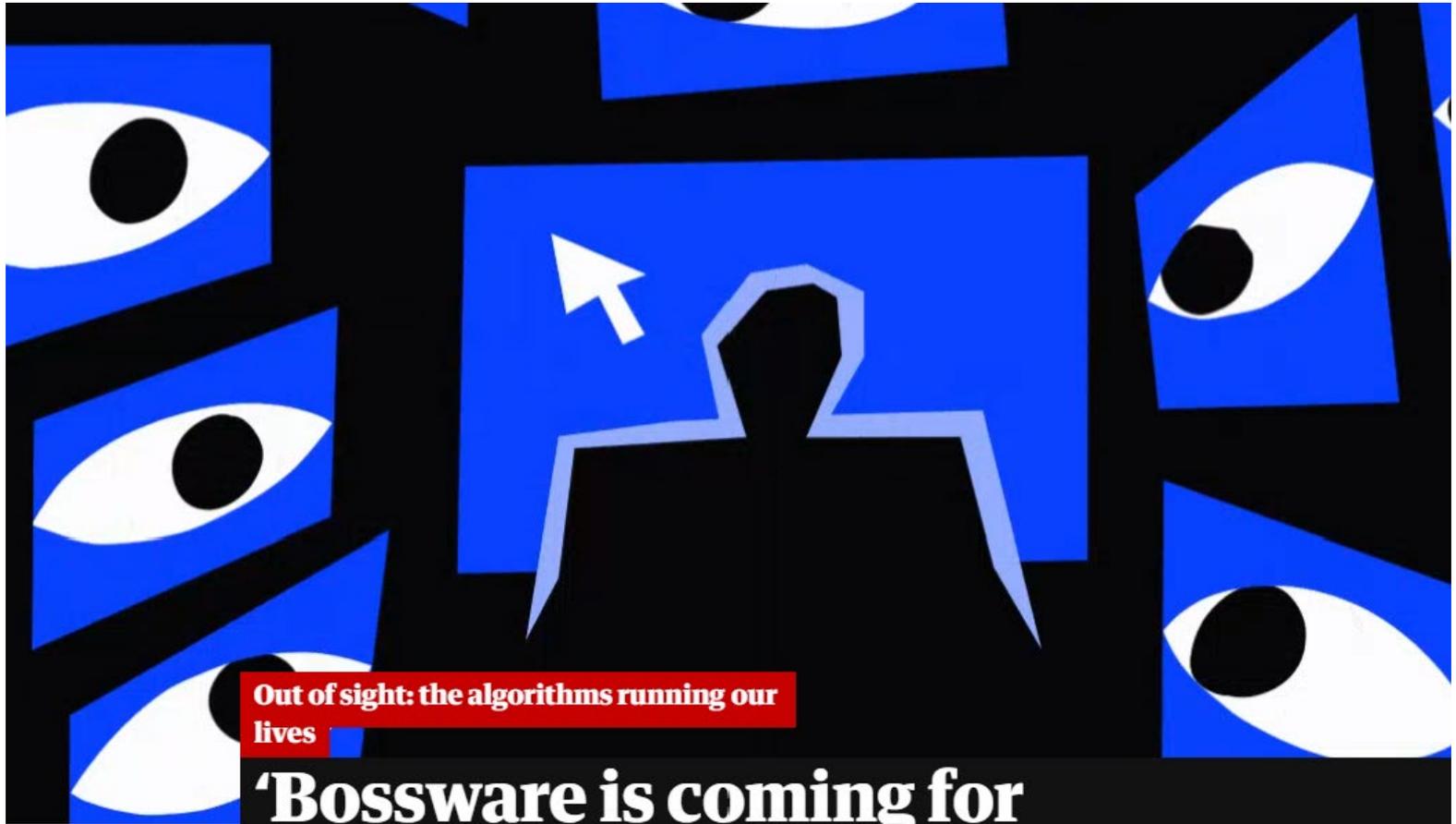


Scott Weber, a driver for both Uber and Lyft in the Tampa area, said he drove full time most weeks last year but struggled to turn a profit. Edward Linsmier for The New York Times

Transportation Study: AI Significantly Reduces Accidents and Safety Incidents

An analysis by KeepTruckin of 5,000 fleets found that the use of AI in commercial vehicles resulted in 22% fewer accidents and 56% fewer unsafe driving incidents





Out of sight: the algorithms running our lives

'Bossware is coming for almost every worker': the software you might not realize is watching you



RESEARCH August 18, 2021

Workplace surveillance is becoming the new normal for U.S. workers

“pervasive and unchecked workplace surveillance fundamentally shifts the dynamics of power in the workplace in favor of firms in ways that harm workers and drive inequitable growth. It ... leads to constant stress for workers who can be fired at any time”

Hey! You've been reading this article for 44 seconds.

Eight of the 10 largest private U.S. employers track individual productivity. And the practice is spreading.

TIME 00:00:44
SCROLLED 8%
CLICKS 0
KEYSTROKES 0
IDLE 00:00:03
ACTIVE 98%

YOUR GRADE
Pending...

Status: Active 

The Rise of the Worker Productivity Score

Across industries and incomes, more employees are being tracked, recorded and ranked. What is gained, companies say, is efficiency and accountability. What is lost?

By [Jodi Kantor](#) and [Arya Sundaram](#)
Produced by [Aliza Aufrechtig](#) and [Rumsey Taylor](#)
Aug. 14, 2022

You're Being Tracked

As you read, a simulation will show you aspects of what it's like to be tracked by productivity software. At the end of the article you'll be graded for your "performance." The results will not be stored. [More about this.](#)





MCDONALD'S

Terrence Wise
Shift manager

When Mr. Wise worked at a Kansas City McDonald's, he said, stations were closely monitored and employees feared "going red," or not moving quickly enough.

Chase Castor for The New York Times



ALLINA HEALTH

The Rev. Margo Richardson
Hospice chaplain

Each morning, Ms. Richardson and her colleagues **had to project how many "productivity points" they would accumulate** during the day's work. **But death defied planning.**

Tamir Kalifa for The New York Times



ALPHABROOK

Patrick Baratta
Research Analyst

Mr. Baratta, who had recently graduated from college, found his computer use tracked so closely that managers inquired about a period when he had been in the bathroom.

Hilary Swift for The New York Times



UNITEDHEALTH GROUP

Megan Polney
Therapist

Ms. Polney's **keyboard activity was closely monitored** when she worked for a division of UnitedHealth Group. She **sometimes accrued "idle time" while discussing cases** with colleagues, affecting her chances of getting bonuses and promotions.

Christie Hemm Klok for The New York Times



CROSSOVER

Federico Mazzoli
Product Manager

Mr. Mazzoli helped create software used to monitor white-collar workers and pay them only for the minutes they were actively working. He later **questioned the accuracy of his creation and called it dangerous.**

Tali Krimelman for The New York Times



ESW CAPITAL

Riti Chaturvedi
Vice President of Marketing

Ms. Chaturvedi said she was unfazed by heavy tracking, including **screenshots taken throughout the day.** "There are people who are honest and people who are not and there's no way to tell the difference," she said.

Adriana Zebrauskas for The New York Times



Matthew Phillip
Copywriter

Mr. Phillip **lost a freelance job after refusing to install Time Doctor**, software that would have taken screenshots of his work. He said he found it intrusive — and potentially misleading, since he often works on paper.

Sarah Blesener for The New York Times



Peter Yang
@petergyang · Follow



Kids are using AI to write essays and get straight As



r/OpenAI · 13 hr. ago
Posted by Urdadgirl69

Artificial Intelligence allows me to get straight A's

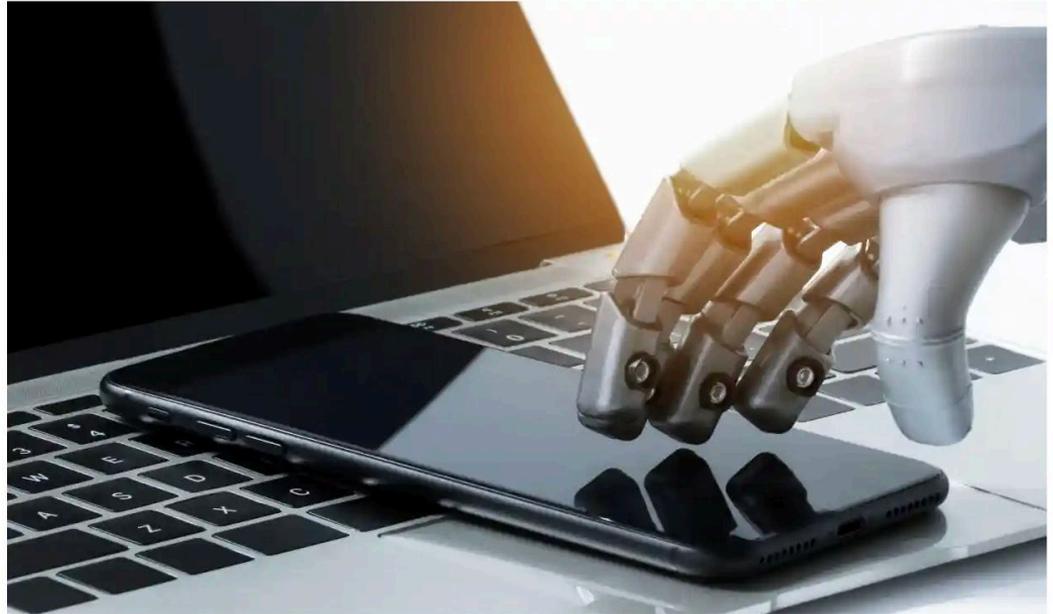
I have been using this tool for quite some time and only recently came up with the idea to use it to write essays, answer questions about movies and books for school projects, and much more. I feel a little guilty about it, but I don't really care that much anymore. For a couple of weeks, I have made \$100 profit by "doing" homework for other classmates and now I am looked at as a genius. What are your thoughts on this? Have you done it yourself?

Yes, this post was rephrased by the AI.

78 115

AI bot ChatGPT stuns academics with essay-writing skills and usability

Latest chatbot from Elon Musk-founded OpenAI can identify incorrect premises and refuse to answer inappropriate requests



The chatbot generated a response to an exam question that an academic said would have resulted in full marks if submitted by an undergraduate. Photograph: Jiraroj Praditcharoenkul/Alamy

MOTHERBOARD
TECH BY VICE

Students Are Using AI to Write Their Papers, Because Of Course They Are

Essays written by AI language tools like OpenAI's Playground are often hard to tell apart from text written by humans.



MEASURING
WELLNESS

ENHANCING
PRODUCTIVITY

IMPROVING THE
EXPERIENCE
OF WORK

ASSESSING
DIVERSITY

BETTER
HIRING

PREDICTION
OF PROBLEMS

IDENTIFYING THE
IMPACT OF
POLICIES

UNDERSTANDING
CULTURE



REGISTER



Summary - Promise & Pitfalls

Implemented irresponsibly, expect:

- Higher workloads on humans
- Increased stress on and off job (replacement)
- Distrust of how data is being used
- Increased safety accidents

Implemented responsibly, expect:

- Better information about the demands of a job
- Harder physical jobs to be replaced by automation- increased job retention
- Job/skill retraining
- Augmentation of physical/ cognitive capacity
- Data driven methods to optimize human wellness
- Reduced safety accidents





HUMAN-CENTERED DESIGN

LEARNER EXPERIENCE

USER EXPERIENCE

SERVICE DESIGN

CREATIVE INTELLIGENCE

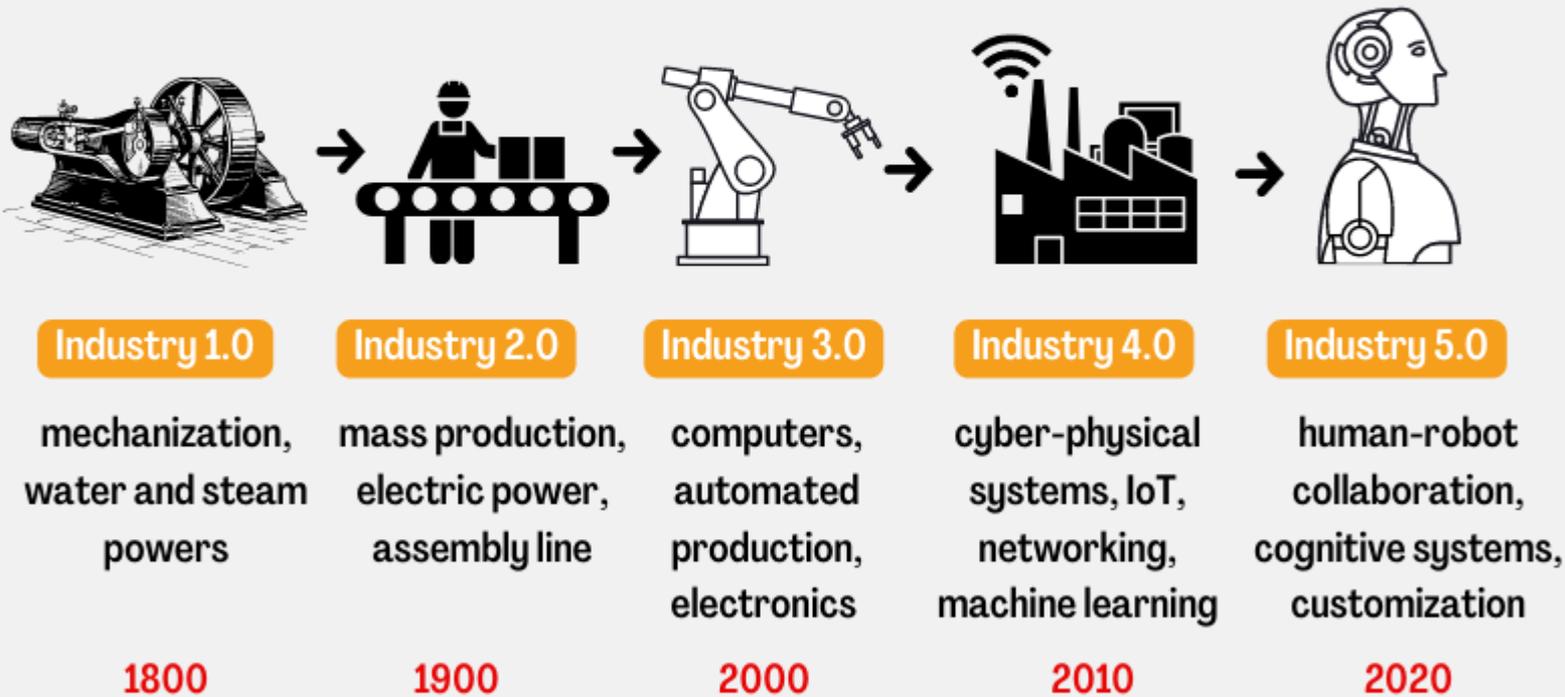
THINKING SYSTEMS

Progressing beyond the Pitfalls

Industry 5.0 & the future of work

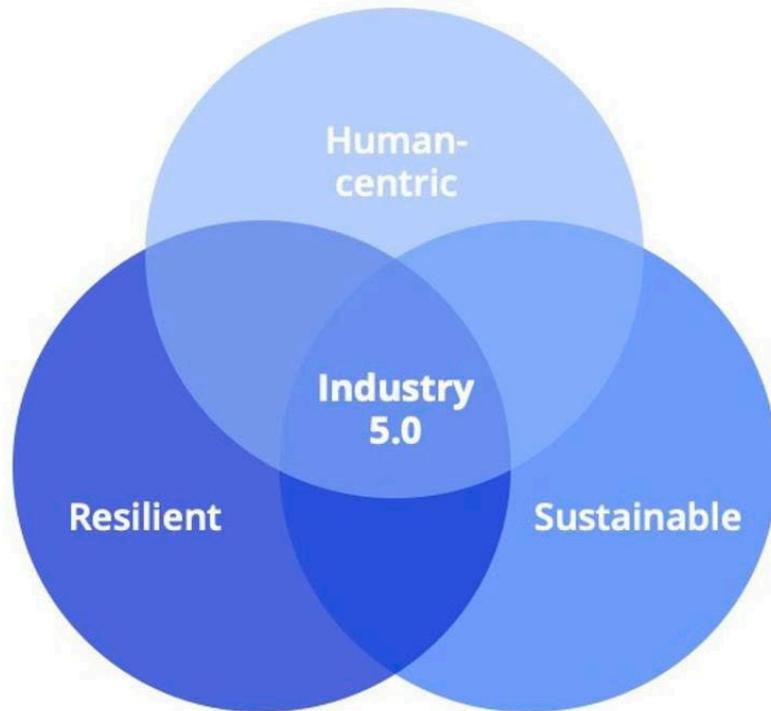


Industrial REVOLUTIONS



INDUSTRY 5.0

“HUMAN-CENTRIC, SUSTAINABLE AND RESILIENT”



<https://www.forbes.com/sites/jeroenkraaijenbrink/2022/05/24/what-is-industry-50-and-how-it-will-radically-change-your-business-strategy/>





- **Robots aren't supposed to supersede humans but co-op with them**
- **Industry 5.0 will bring broader benefits to the marketplace than industry 4.0**
- **Industry 5.0 will create more jobs than eliminate.**
- **Personalisation will lead, not mass production.**
- **Psychology will control technology.**
- **The progress into industry 5.0 is inevitable.**

<https://www.forbes.com/sites/jeroenkraaijenbrink/2022/05/24/what-is-industry-50-and-how-it-will-radically-change-your-business-strategy/>



Questions & Comments

<http://ergo.berkeley.edu>

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