Automation Impacts on the Built Environment

The Real Estate Innovation Lab

AN EDUCATIONAL WEBINAR FOR EY

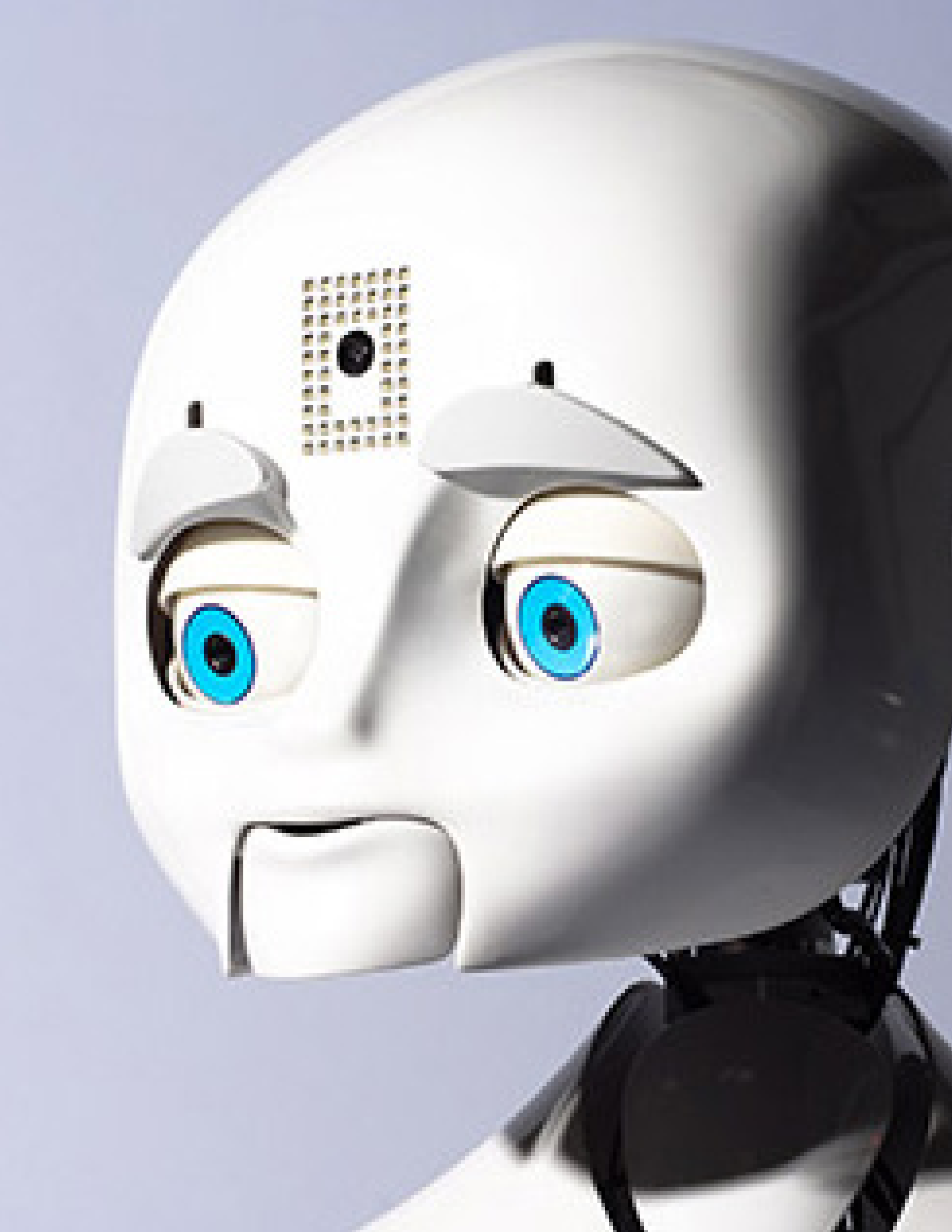


IMAGE
Nexi, MIT Media Lab Personal Robotics Laboratory

/THERE IS NO GUARANTEE THAT TODAY'S TECHNOLOGIES WILL EVOLVE IN WAYS THAT WILL SERVE EVERY ONE...WE WILL REQUIRE A DELIBERATE REINVENTING OF THE FUTURE OF WORK/

RAFAEL REIF

MIT's President Rafael Reif's "Future of Work" op-ed for The Boston Globe made it clear that the rapid advance of technologies, from AI to robotics, has had and will continue to have significant impacts on society.

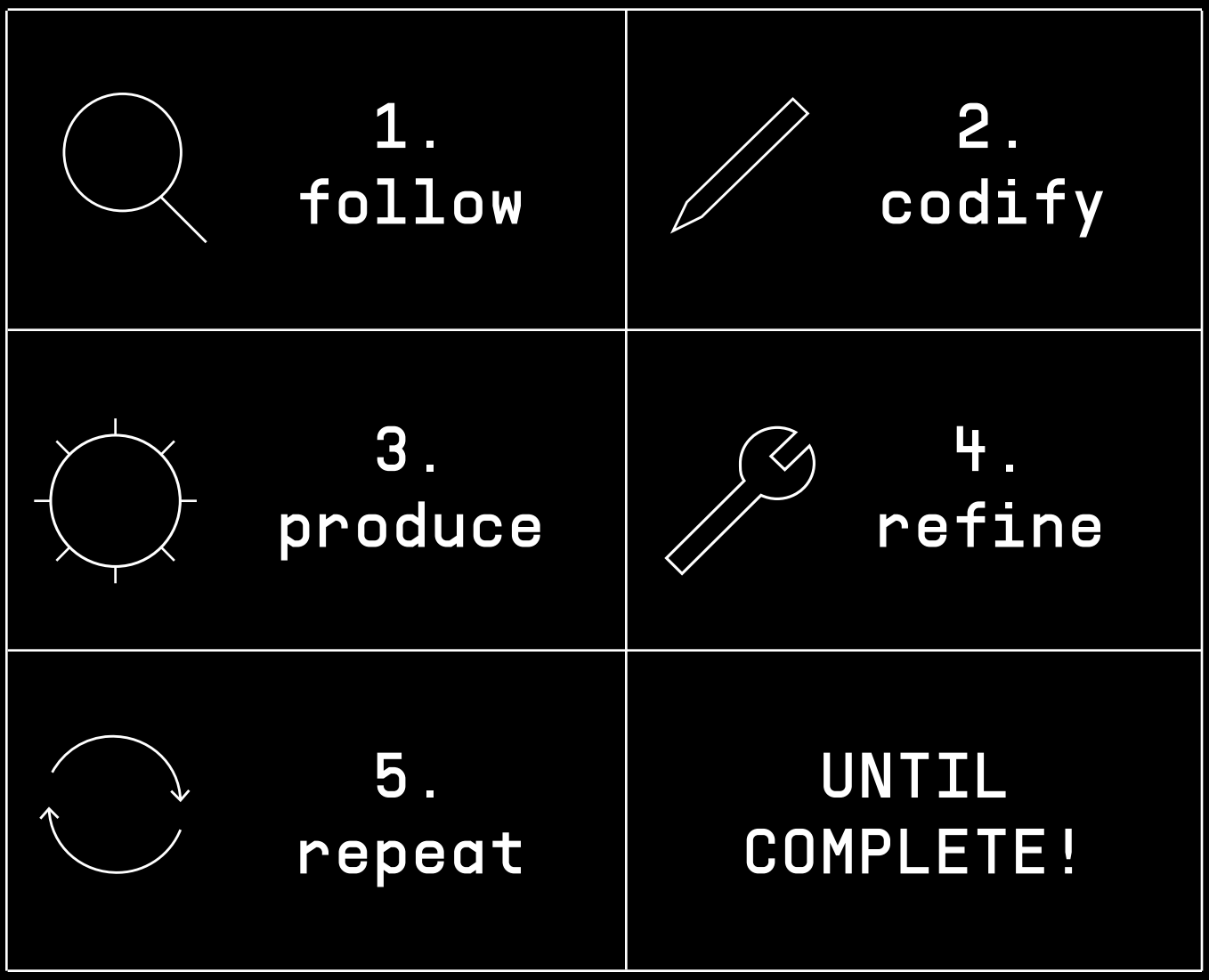
To understand the impact of automation on society, President Reif called upon MIT scholars, makers and doers not only to invent the autonomous solutions for creating a better world but also to understand where structural disruptions in the way we live, work and play may arrive.

This call to envision future disruptions caused by technological advancement and develop solutions has also come from thought leaders globally. Numerous authors have come to the table with particular attention given to the future of jobs under automation, which some argue has the potential to eradicate 50% of existing jobs by 2055 or to grow new sectors and jobs +/– 200 million jobs by 2030 (Winick, 2018).

Yet, we have limited understanding of how the primary and secondary effects of this change in work will have a fundamental impact in the real estate that we create for centuries to come.

In our assessment, we want to define what automation is, how we think it is going to impact real estate and give examples of how our industry is benefitting and facing challenges with automation today.

WHAT DOES IT MEAN TO AUTOMATE? To automate is to **FOLLOW** an action, **CODIFY**ing the action by describing in great detail what the action is. Afterwards, one can **PRODUCE** hardware or software based on computer code to mimic that action. Finally, one can **REFINE** and **REPEAT** that action until the action is completely automated.



/PROGRESS FROM TECHNOLOGY CAN BE ASSYMETRIC IN ITS FORM, UNEQUAL IN ITS DIVIDENDS AND LATENT IN ITS INTENT ON TRANSFORMATION/

Automation is the codification of tasks. Manual and cognitive actions executed by humans are now being followed to understand their routine and non-routine actions. In addition, actions or individual tasks are being dissected to understand what manual or cognitive actions are routinely done at scale. For example, tasks within manufacturing or assembly work that are repeatable have been automated and scaled in the last 75 years. However, the non-routine aspects of creative tasks within design and negotiation have thus far proved challenging for automation, but with the rise in computational power and data storage capacity the limit between computer intelligence narrows to mimic the neuro-capacity of the human mind and increasingly impacts employment.

Routine

BRICK LAYING
TILE LAYING

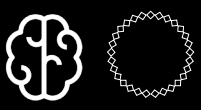
Routine

ACCOUNTING
BROKERAGE

Semi-Routine

PLUMBING
ELECTRITCITY

Non-Routine



DESIGN
ENTITLEMENT

SCALABILITY

As tasks progress from being ROUTINE, SEMI-ROUTINE and NON-ROUTINE, there is a shift in the capacity for automation to find a scalable and routine action to mimic. SEMI-ROUTINE and NON-ROUTINE tasks lack a capacity to scale across many actions for many people and therefore may not be economically feasible to justify automating the task.

THE PROGRESSIVE MARCH OF AUTOMATION INTO THE REAL ESTATE DOMAIN

Real estate and its sectors are very choppy domains. As an area of our economy, it is comprised of many currently disconnected sectors in real estate and urban development. However, automation is trying to resolve this lack of connection and streamline processes. There are ten dimensions where automation is impacting the built environment. Figure 1 depicts the MIT Real Estate Innovation Lab's ten dimensions of the built environment that could be impacted by automation.

As automation progresses, its diffusion will be very choppy across the domains of the built environment. This is important for the following reasons:

ECONOMY One third of global GDP is tied to creation, transaction, demolition and redevelopment of the built environment. The built environment makes up approximately 16% to 20% of global GDP with an annual spend of US$ 17 to 19 trillion.

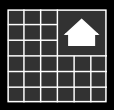
CONSTRUCTION Construction is one of the largest sectors of the world economy, with almost US$ 10 trillion spent every year globally.

JOBS The number of jobs that are tied to the built environment is estimated to be about 10 million in the US and even close to 20 mln in BRIC economies where new construction is advancing the primary building stock.

FIG.1

THE REI LIFECYCLE OF
THE BUILT ENVIRONMENT

LAND SELECTION



REDEVELOPMENT

DESIGN

DEMOLITION

ENTITLEMENT

ACQUISITION &
DISPOSITION

CAPITAL STACK

ASSET OPERATION &
MONITORING

CONSTRUCTION

LEASING &
BROKERAGE

HOW AUTOMATION IMPACTS FOR THE BUILT ENVIRONMENT WILL BE DIFFERENT FROM OTHER ECONOMIC SECTORS

The "potential" leap from analogue to digital interventions is and will be different for the built environment. Society is moving through distinct stages of automation inconsistently. Data, higher capacity computation and larger data storage capacity has enabled a computational and statistical lens to design algorithms that can support early systematic tasks of people, the functions of buildings and how they are developed and destroyed.

However, the built environment is "leapfrogging" from a domain of human-based interaction towards automation, without going through the very long capacity, data, and computational power gathering stages other sectors pioneered. In this way, the built environment is building off of other computational and algorithmic advancements made in manufacturing and IT. It's powerful, but the built environment evolves and reacts so differently than other sectors of the economy. And this can be problematic, as it can hinder economic productivity in the short- and long-run. To further dig into this challenge we ask, why is the built environment different?

There are six clear areas that can obstruct automation in the built environment and drive the sector away from potential economic growth. Our sector needs to develop a strategy to face challenges of **❶SCALABILITY**, **❷REGULATION**, **❸STAKEHOLDER COMPLEXITY**, **❹LIFECYCLE SYNERGY**, **❺LIQUIDITY RISK** and **❻LEAP-FROGGING** in human and capital equipment.

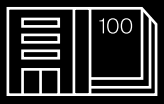
SCALABILITY
impacts the number of items that have repeatable scale across the built environment.

REGULATION
It is almost impossible to repurpose if the building does not meet the needs of the market or city.

STAKEHOLDER COMPLEXITY
Multiple decision-makers—developers, politicians, residents, construction,finance providers.

LIFECYCLE SYNERGY
The lifecycle of a building can be far longer than a person's lifetime.

LIQUIDITY RISK
Unlike the stock market, it can be far harder to sell real estate if it does not meet the market needs.



LEAP-FROGGING
From human based interaction towards automation, without a long capacity stage like others.

THE FUTURE OF AUTOMATION IMPACTING WHERE AND HOW WE LIVE, WORK AND PLAY

A United Nations report suggested that 1.3 million people move into cities every week, with 6.3 billion people expected to be living in urban environments by 2050. This huge increase is straining cities' infrastructure and the environment. New technologies such as artificial intelligence (AI), advanced robotics and the Internet of Things have the capability to create smart cities, fundamentally changing the rules of how our cities are built and operated.

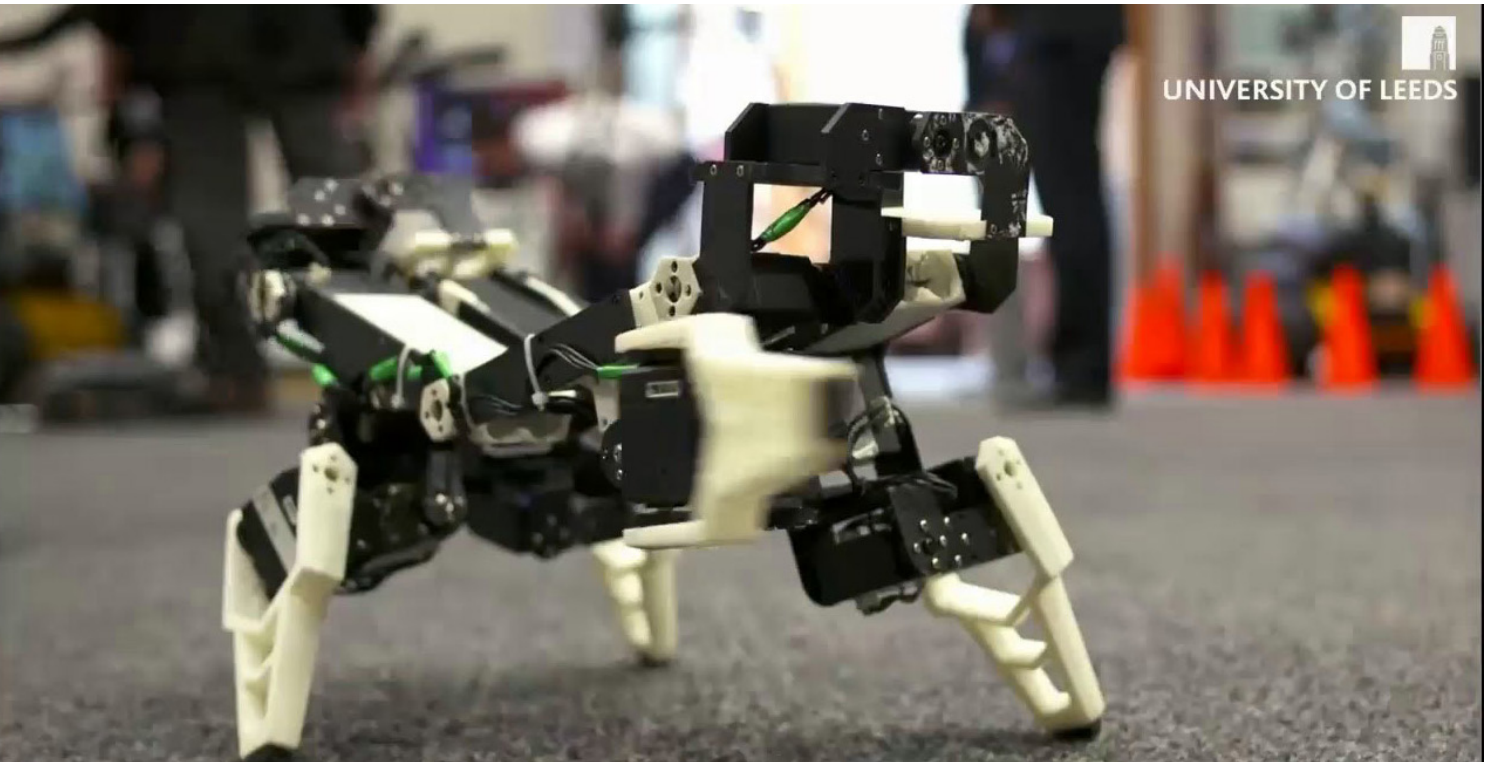
Sensors and big data will be the foundation stones of the Smart City of the future. Smart building sensors will extract data to give owners greater insight into how space is occupied and greater control over the environment, including HVAC systems, energy efficiency and air quality controls.

Shared vehicle systems and autonomous vehicles have the potential to effect on how our cities are laid out and designed. If parking spaces, which currently make up 40% of land use in most American cities, become obsolete over time, this could alleviate some of the current housing crisis with the development of this new space.

With big data, city planners will have a greater influence on our cities. Integrating robots into urban spaces is rapidly transforming some of the most technologically advanced cities—such as Dubai, Tokyo and Singapore—into real-life smart cities where robots co-live with humans. In 2020, Japan will introduce robot taxis and robot translators to help tourists traveling there for the Olympics in 2020. Dubai is using robots in security surveillance, policy and transportation systems, with a plan to have these functions 25 percent automated by 2030. Singapore plans to introduce robots as a physical extension for management and city control of existing systems, and has tested this possibility for years now with driverless Airbus helicopter bus shuttles and robots that handle postal delivery via drone.

TOP Shared vehicles and autonomous vehicles will have an enormous effect on how our cities are laid out and designed, but importantly it will come in many alternative packages. Image Source: MIT Media Lab, City Science.

BOTTOM University of Leeds Infrastructure Bot - Infrastructure is on the decline and there are not enough people to help inspect and identify problems for repair and resolution, bots will help. Image Source: University of Leeds



Building owners today not only need to understand the purpose and culture of their building, but also to make their building adapt to it. Energy use, security, safety and optimization are all areas that have seen huge advances in automation. These advances have all come about through data collection and analysis through algorithms. However, that process is increasingly becoming automated and communicating back in real time.

With the arrival of the digital twin technology, the immediate access to how a building is performing can enable owners and operators to manage assets in a free-flowing manner. New digital twin technology and the virtual representation of platforms of the physical building are embedded with rich data about spaces and assets. The immediate access to data and schematics about how a building is performing can enable owners and operators to manage assets, energy, space and comfort inside a single building or an entire portfolio of properties.

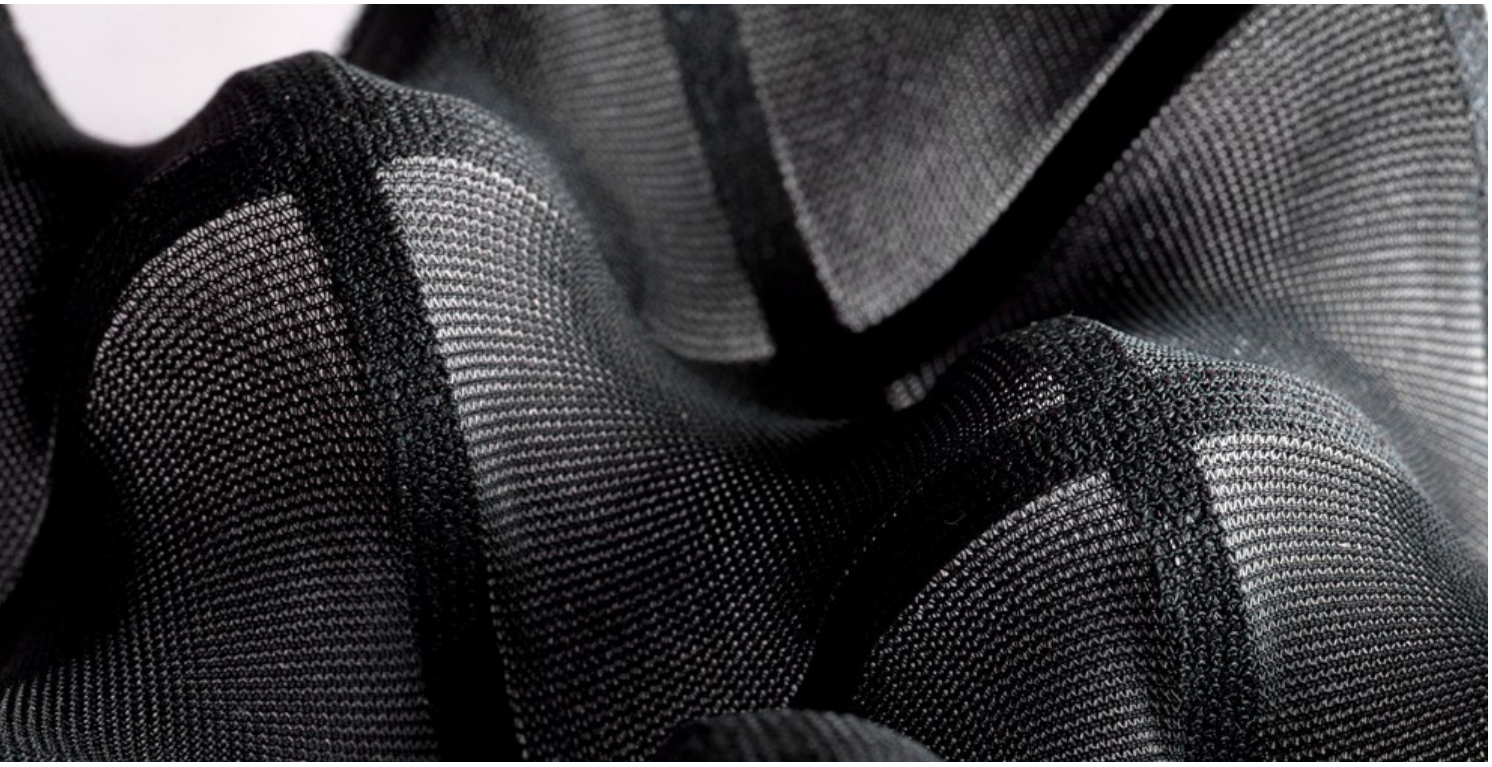
Fortunately, this technology has made its way out of the lab with several new firms offering commercial products for commercial scale buildings.

Innovations in building technology are also resulting in time and cost savings. These include automated lease generation, advanced due diligence techniques, electronic document signature software and ubiquitous sensing in the building. These are technologies that have already come to life with off the shelf commercial products.

However, there are more technologies on the horizon that are advancing to disrupt the physical structure of a building. 4D printing is the evolution of 3D printing wherein objects are printed with special material that changes shape post production. MIT's Self-Assembly Lab is at the forefront of researching this new technology, which could form the basis of amazing new inventions such as such self-assembling buildings.

TOP A digital twin refers to the digital representation of a real-world entity or system. Image Source: Willow

BOTTOM Programmable textiles would differ from other fibers in that it would offer different strength and rigidity characteristics and be able to shape and reshape based on the demand for the structure at any given time. Image Source: MIT Self Assembly Laboratory



The Internet of Things has leap-frogged ahead to create a streamlined system to manage and control large complex commercial buildings. Physical sensors of every shape, color and size can now be installed. However, this only adds to the number of interactive devices that will be connected to the 5G network.

5G rolling out in 2019 and 2020 will enable more and more devices to become wireless connection points, streamlining our digital experience inside and outside of buildings more smoothly and making the digital fabric between us and our computing objects more seamless. Windows, walls, floors, personal devices and wearables will start to become seamlessly part of the same networks.

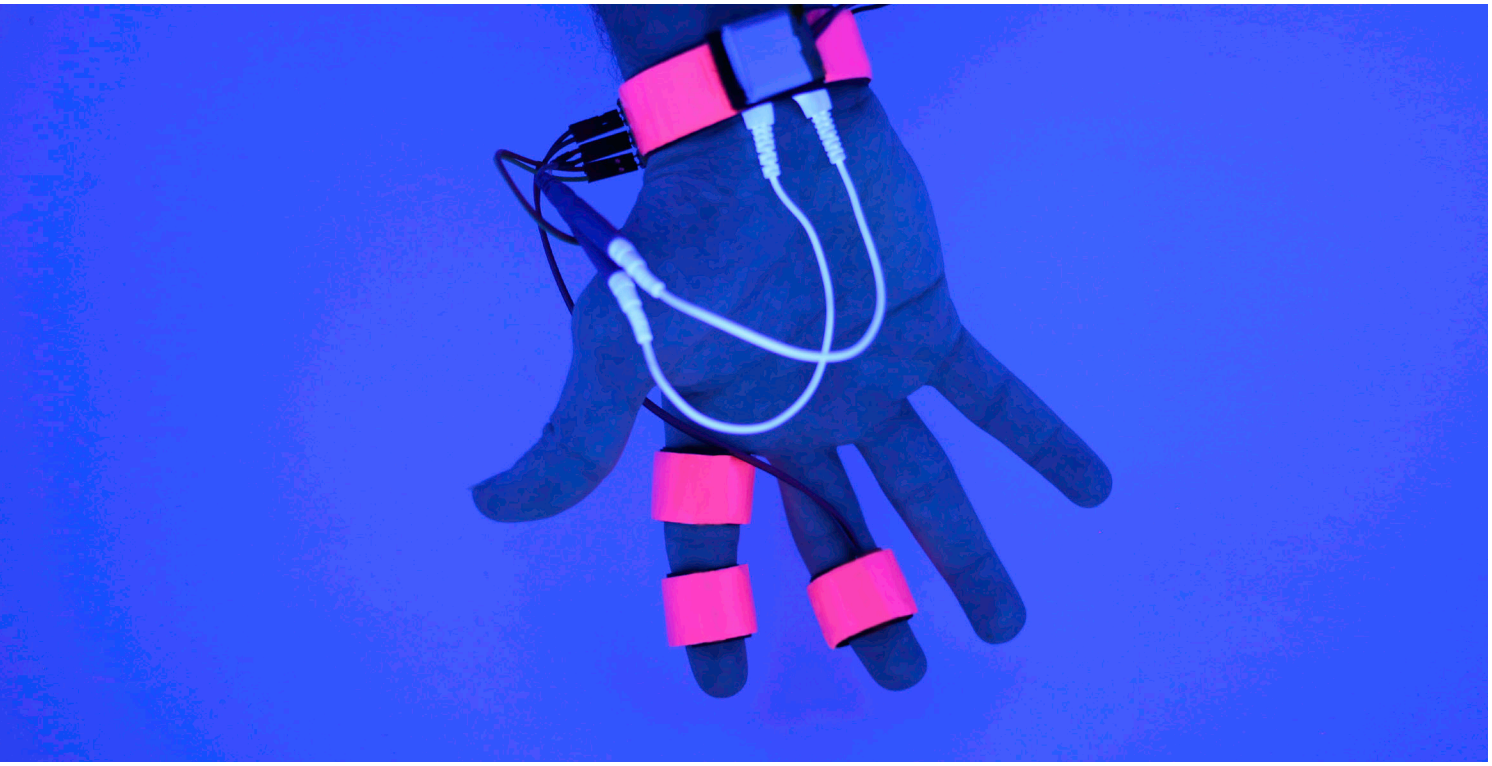
Helping everyone to achieve their most creative idea or enable a more creative and productive environment is the next generation of wellness and human augmented productivity. Capturing the best possible ideas and identifying when and where new breakthroughs are possible could be aided by the expansion of our cognitive capacities with wearable computing.

In addition, wearable technologies will allow buildings to have a greater understanding of the people inside to make it more convenient to engage and discuss in elevated and productive discussions for invention and design. Wearable technologies that connect to comfort, wellness and occupational satisfaction can be aided in the development of business models of the workplace as a service for advanced creative and cognitive work.

Finally, as robotics gain more traction in taking over tasks, then there is more need in taking technologies with their cognitive peers to elevate ideas and invent new things.

TOP Ubiquitous connection points in a 5G to 6G environment. Connectivity will become a central component of electronics that can send, receive and aid in the signaling of other devices.

BOTTOM Wearable technology that is seamlessly linking you to your thoughts and the digital, permeable layer that is constantly flowing in the background. Image Source: MIT Media Lab, DesignX, Dormio



AUTOMATION OF PROCESS
AND JOBS WITHIN
REAL ESTATE ORGANIZATIONS

/EXPLORING HOW THE SIMPLE TASK OF RECOGNITION COULD HELP AID EFFICI ENCY ACROSS THE BUILT ENVIRONMENT/

The future of automation cannot be discussed without looking at how it will affect jobs within the built environment sector. Advances in robotics, artificial intelligence and machine learning have brought us to the point where machines not only outperform humans in a variety of manual tasks but now tasks that require cognitive capabilities. One of the biggest changes taking place in real estate assets through automation is through recognition (identification). In the built environment, much information takes the form of heterogeneous and disorganized data. Building components may be described in terms of physical form or financial value; spaces may be monitored by human vision or temperature sensors, etc. Recognition tasks filter through large amounts of information for specific and meaningful features, structuring this data for further analysis and decisions.

IMAGE
AIRWORKS,
MITdesignX

The Real Estate Innovation Lab

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