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The Lab in Lion City

HP's new corporate lab at a top-tier university in Singapore is already making the workforce of the future a possibility.

BY SANJAY SURANA



Photo by Scott Woodward

The replica of the 1955 Nanyang Arch in NTU's historic Yunnan Garden. The arches symbolize three elements of traditional Chinese philosophy—*tian* (heavens), *di* (earth), and *ren* (humanity).

of more than 30,000. HP has had a Singapore office since 1970, allowing the lab to leverage the HP site infrastructure, talent pipeline, and business teams, and views Singapore as a key location in the Asia-Pacific region. “We have 50 years’ experience working with the Singapore government,” Regan notes. “The growth of digital manufacturing is in Asia, it’s the hub of the world.”

INSIDE THE LAB

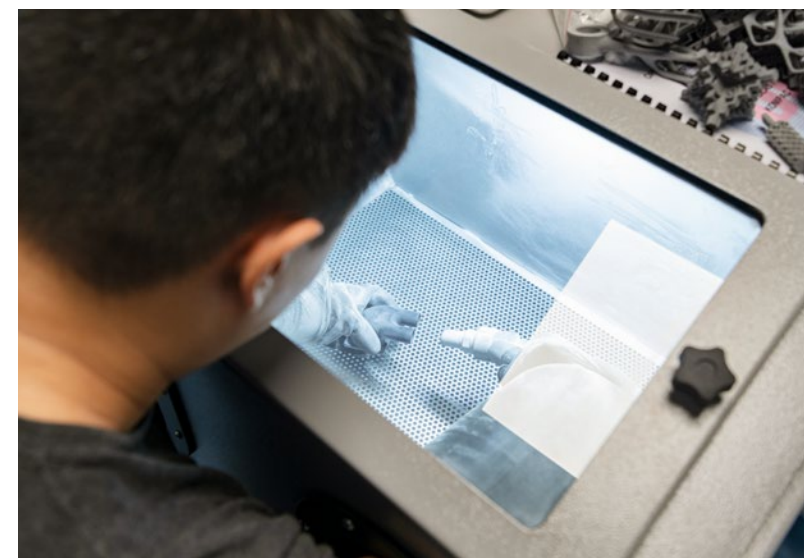
The lab will focus on 15 projects, exploring sectors such as advanced polymers for manufacturing, predictive diagnostics for manufacturing test and quality assessment, and optimization of end-to-end supply chain operations. Just inside large plate-glass doors, cabinets contain cases for tools and phones, shaver housings, and prosthetic appendages, all made with HP 3D printing technology. Just beyond, a spacious room lined with desks is where researchers—master’s and doctorate students from NTU, lab staff, and HP employees—work on projects, discuss ideas, and tap out code.

In the heart of the lab is the printing room, a broad space with the same sky-blue floor as the rest of the office. A pair of HP Multi Jet Fusion 5200 monochrome printer clusters and one HP Multi Jet Fusion 580 color printer stand under silvery ducts that snake up to the ceiling. Regan demonstrates the process, from the powder that’s loaded into trolleys that are pushed into the printer housing, to the processing station, to a sealed bead-blaster cleaning unit whose interior is only accessible via built-in rubber gloves. Nylon powder is laid down in thin layers just 100 microns thick to create a product. Down a narrow corridor, a malware lab is also under construction—a satellite facility to HP’s main cybersecurity site in Bristol, England—where research will be conducted into how malware can disrupt the security of digital manufacturing environments.

About 85 people, including HP staffers, researchers, professors, and students, work at the lab. Most projects start with a scope that comes from HP, and then an NTU professor works with an HP employee to develop a research plan, staffing, and project tactics. “The projects must make sense to both HP and NTU,” adds Regan,



A 3D-printed hand splint, above. Digital manufacturing engineer Vishnu Rajeev Nair readies newly printed HP Multi Jet Fusion parts for cooling and retrieval, top right. Removing excess powder from 3D-printed parts using the bead blaster, middle. Adrian Ong, a digital manufacturing engineer, and PhD student Joyce Lim Xin Yan in the researchers’ office, bottom right.



Photos by Scott Woodward

noting that the manufacturing solutions HP is working on are aimed at affordable, scalable, and customizable means of production in areas like dental, footwear, eyewear, and automotive and industrial parts.

Jianmin Zheng, associate professor at the School of Computer Engineering and co-director of the Institute for Media Innovation at NTU, is working on a few different proposals for HP based on geometric processing for 3D-part design, elastic-material design, and geometry control of lattice structures for 3D printing. “The lab provides an excellent base for NTU professors, researchers, and students to conduct cutting-edge technologies in close collaboration with HP researchers,” he says. “This also provides a great opportunity to train manpower in this field in Singapore and beyond.”

In the western part of Singapore, near army training camps and dense jungle, sits Nanyang Technological University (NTU). One of the top colleges in the world, the 500-acre campus is populated with pastel-colored residence halls, glass-walled classrooms, and a historic Chinese garden. And as of January, it’s also home to the HP-NTU Digital Manufacturing Corporate Lab, a tie-up between the Silicon Valley giant, the university, and the Singapore government. HP’s first corporate laboratory in Asia, it will play a key role in retraining and upskilling the Singapore workforce, with an integrated focus on 3D printing, artificial intelligence (AI), machine learning, and cybersecurity, all part of a larger push by the Singapore government to prepare the workforce for the advent of digital manufacturing and the Fourth Industrial Revolution, known as Industry 4.0.

“This is HP’s largest university collaboration worldwide,” notes Dr. Mike Regan, the director of the lab, who moved to Singapore from Oregon to run the facility. “It’s our first holistic lab at a university where we can set up projects and recruit talent. Having a presence in a university allows us to work across different departments.”

NTU was a natural choice given its preeminent research labs, strong engineering departments, well-respected faculty, many multidisciplinary fields, and student pool

SKILLS FOR THE FUTURE

The need to upskill workforces is imperative. According to 2018 research by consulting firm Korn Ferry, there will be a global shortfall of 85 million high-skilled workers by 2030, so as technology moves forward, retraining is critical to ensure the workforce remains current. The 2018 World Economic Forum Future of Jobs Report states that “workers will see an average shift of 42% in required workplace skills in the period leading up to 2022,” and on average will need 101 days of retraining and upskilling. For Singapore, projections suggest a staggering labor shortage of 1.1 million out of a workforce of four million. Manufacturing has played a key role in the Lion City’s success as it transitioned from a labor-intensive economy to one fueled by innovation, so much so that in 2015 manufacturing accounted for almost one-fifth of GDP. The new HP lab’s focus on additive, digital, and advanced materials manufacturing, as well as robotics and automation, is a core component of Singapore’s Research, Innovation, and Enterprise 2020 Plan.

“The onset of Industry 4.0 is unleashing disruptive technologies not only in manufacturing but also in services sectors,” explains Shanti Jagannathan, principal education specialist, Sustainable Development and Climate Change at the Asian Development Bank.

“Millions of jobs are likely to be displaced by automation, but the good news is that adoption of Industry 4.0 will also lead to additional labor demand arising from productivity increases.” Skills development, she adds, is critical to mitigate the negative effects of job displacement. As factories adopt technologies like robotics, artificial intelligence, and additive manufacturing, there is a great need for reskilling existing employees for new jobs and upskilling those whose tasks may dramatically transform with these technologies.

In the first half of this year, the lab will start courses taught by HP staff and NTU professors, aimed at retraining the Singaporean workforce. Offered through the government’s SkillsFuture program, the courses range from two to five days and will be focused on 3D printing of advanced polymer products, as well as medical devices and tissues, and for building and construction. Up to 200 continuing education students in the fields of engineering and design are expected to sign up this year. “We are seeing there is a clear need for more people to be trained for the future of manufacturing,” states Regan, adding that giving people exposure to these subjects is critical. The course modules will eventually become units of specialization for undergraduate and postgraduate students at NTU.



Photo by Scott Woodward

Jagannathan believes that the HP-NTU partnership is a model that developing countries should closely follow. “A tripartite collaboration between industry, a leading academic institution, and the government redefines the triple-helix model for the world of Industry 4.0,” she says.

Vishnu Rajeev, a fresh-faced recent postgraduate from NTU, has benefited from this combined approach. Rajeev was an intern with HP at its first ever Smart Manufacturing Applied Research Center that opened in Singapore three years ago. He then joined the new corporate lab as a full-time employee, helping researchers in 3D printing and digital manufacturing. He says the AI and data analytics he is learning with HP are vital new skill sets that will benefit anyone with an interest, even in passing, in the field. “You have to be multidisciplinary now. The days of going into one stream are long gone.”

The casing for a sensor-based desk lamp, printed with a HP Multi Jet Fusion 580 printer.

BUILDING THE FUTURE OF DIGITAL MANUFACTURING

Photo by Scott Woodward



MIKE REGAN
Director and CTO, HP-NTU Digital
Manufacturing Corporate Lab

Digital manufacturing is a new mode of production that is transforming the industry. Some may think of digital manufacturing as just 3D printing, but it encompasses much more than that.

Enabled by a computer system, digital manufacturing is an adaptable process that allows for constant improvement while also satisfying customer demand for customization. It is often referred to as the Four A's: artificial intelligence, automation, additive manufacturing, and analytics. As HP has looked holistically across this space, we identified three primary research vectors.

The first is in 3D additive technology, where we’re looking at plastics, metals, and our voxel capabilities.

This includes powder and fusing fundamentals, system-level modeling, doping for composition and phase control, and materials science to influence part properties and strength.

The second key vector we’re investigating is AI, which includes machine learning, robotics in factories, advanced test and diagnostics, and computational voxel design tools. As an example, robotics can be used to pick up and hold 3D-printed parts, and facilitate cleaning.

The third vector is security, from secure learning to a secure manufacturing environment. HP is world-class in terms of protecting

printers and PCs from malware and other threats, so we’re extending our core strengths and building new muscle to protect our customers and their factories in the digital manufacturing space.

By combining the three pillars together, we create HP’s drive into digital manufacturing research. As HP looks to the future, it is clear that we have a great opportunity in front of us with digital manufacturing and, in particular, in research and development in a number of critical areas.

At the HP-NTU Lab we aim to introduce top students and researchers to the HP Way and drive research initiatives that impact our strategic directions

and business. We see great opportunities for these researchers to pursue lifelong careers at HP, whether in HP Labs, a business unit, application or field service, or as a technical marketing leader. When you combine a large university setting and the support of the Singapore government, it’s clear that we have an exciting prospect here to impact our research, businesses, talent, and recruitment.

Mike Regan leads the research team in driving innovation and technology in 3D additive manufacturing, AI and machine learning, and cybersecurity.