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The New Revolution: Industry 4.0

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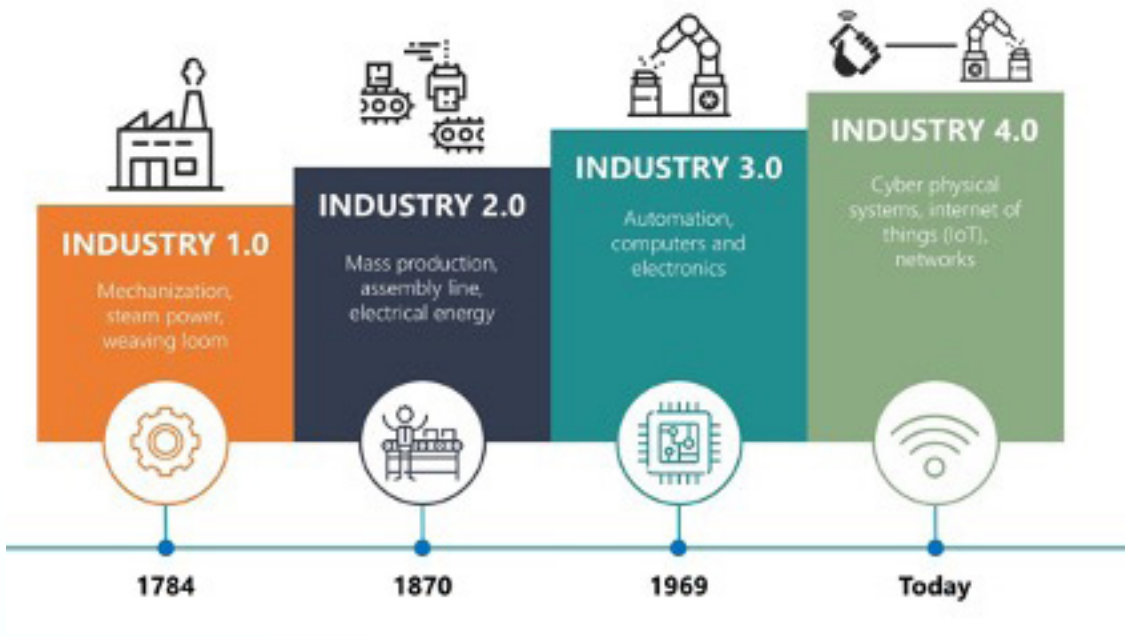

The Connecticut Center for Advanced Technology, Inc. (CCAT) has engaged the manufacturing sector for over 17 years as a non-profit technology demonstration and training center. Our three Advanced Technologies Centers are state-of-the-art facilities equipped with leading-edge industrial equipment and tools, described below. CCAT is a manufacturing technology provider advancing the adoption of such technologies for companies within the regional and global manufacturing supply chain.

As Chief Technology Officer and Principal Investigator, my focus is leading federal programs, investigating new technology opportunities and interfacing with technology companies and providers in the State, within our region and beyond. Drawing upon my experience as a materials scientist with a deep understanding of advanced technologies, together with the CCAT team, we provide value to the manufacturing ecosystem by bringing solutions to complex problems.

Advanced Design, Automation and Metrology (ADAM) Lab
A suite of Industry 4.0 technologies supporting digital transformation for manufacturing include: **generative design**, automation, optimization, metrology (study of measurement), destructive and non-destructive inspection, and model-based definition (three-dimensional computer-aided design [3D CAD] model that fully defines the part or product with a complete dataset).

Additive Technology Optimization and Machinery (ATOM) Lab
Various platforms to additively print (layer-by-layer) different materials: metal powders, polymers (plastics) and continuous fiber composites; also binder jetting of metal/ceramic/sand which uses an industrial printhead to selectively deposit a liquid binding agent onto a thin layer of powder particles. Additionally, a variety of high-precision (subtractive) machining technologies coupled with advanced design, modeling & simulation software.

Advanced Composite Technology Center (ACTC)
This lab focuses on the fabrication of parts with complex geometries from carbon fiber, fiberglass and other materials with the use of robotic equipment (Automated Fiber Placement) to build composite structures one ply (layer) at a time.

So, what is Industry 4.0?

Industry 4.0 – also known as a Smart Factory or the **Industrial Internet of Things** – refers to the trend of automation and data exchange in manufacturing. Its interconnection of industrial technologies produces big data analytics, which in turn, allows **cyber-physical systems** to communicate and cooperate with each other, as well as with humans, in real-time. Ultimately, these systems lead to improvements such as increases in efficiency (reducing costs) and throughput (products out to market faster). This digital transformation also allows companies to innovate faster. What's more, manufacturers are looking for talented problem solvers who have a multidisciplinary understanding of hardware and software and possess the ability to continually learn, adapt to new technologies and solve new problems.

Additive manufacturing can be applied to almost every industry including aerospace, construction, energy, and medical supply manufacturing. It is an important component of Industry 4.0 and the future of manufacturing. With additive manufacturing, parts can be built with complex geometries not feasible with other technologies. This technology is often referred to as rapid prototyping which means a sample can be built from a concept very fast compared to conventional manufacturing techniques.

For many manufacturing processes, additive technologies can be applied to reduce the manufacturing cost, improve product performance, reduce design and manufacturing lead times, and enhance maintenance, repair & overhaul (MRO) and spare parts availability.

The Connecticut Center for Advanced Technology, Inc (CCAT), headquartered in East Hartford, is an applied technology development, demonstration and training center that innovates, validates, demonstrates, and assists with the adoption of leading-edge technologies into the manufacturing supply chain, while providing vital workforce training and upskilling necessary for companies to fully-utilize the technology advancement.

Meet the Scientist

I consider myself a late bloomer, realizing my passion for science in high school (after taking physics and astronomy). I had the ambition to work for NASA and wanted to become an astronaut. I had a small telescope growing up and would spend nights looking into the cosmos (really big things!). Little did I know that once I went to college – the first in my family – I would soon trade my telescope for an electron microscope as I was exposed to a whole new world of materials science to study really small things on the micro- and nano-scale: Refer to scale of things: https://www.nisenet.org/sites/default/files/ScaleLadder_Poster_3of5_May10.pdf

Skills & Kowledge

- Scientific fundamentals – fundamental understanding of relevant scientific disciplines such as physics and chemistry
- Mathematical and computational fundamentals – ability to utilize quantitative tools for data analysis and design; e.g. CAD software
- Analytical thinking – evaluate information to identify root (source) of problem based on data and analysis
- Problem solving – develops alternate solution paths to problems and provides supporting information to pick the best option

Words To Know

Supply Chain: the sequence of processes involved in the production and distribution of a commodity.

Generative design: mimics nature's evolutionary approach to design – driven by **artificial intelligence** – to optimize a design to best fulfill functional requirements.

Artificial Intelligence: wide-ranging branch of computer science concerned with building smart machines capable of performing tasks that typically require human intelligence; promotes machine learning.

Industry 4.0: the current trend of automation of and data exchange in traditional manufacturing and industrial practices; includes cyber-physical systems, the industrial internet of things and cloud computing. The term has been used interchangeably with "fourth industrial revolution".

Industrial Internet of Things: interconnected sensors, instruments, and other devices networked together with computers for industrial applications, including manufacturing and energy management.

Cyber-physical systems: the integration of computation, networking and physical processes

hyperlinks

ManufaCTure 4.0 https://ctcreates.org/ - lots of resources for students, educators & families and manufacturers
Virtual CT Manufacturing Fair https://ctcreates.org/virtual-fair/tours/ - explore CT manufacturing companies through virtual tours and video profiles CCAT, Inc https://www.ccat.us/

For Students and Teachers Making Curriculum Connections, see the following:

Connecticut State Department of Education (CSDE) - Common Core State Standards (CCSS): Mathematics

- CCSS.Math.Practice.MP1 Make sense of problems and persevere in solving them
- CCSS.Math.Practice.MP3 Construct viable arguments and critique the reasoning of others
- CCSS.Math.Practice.MP5 Use appropriate tools strategically

CSDE - Next Generation Science Standards: Scientific and Engineering Practices

- Asking questions and defining problems; developing and using models; planning and carrying out investigations; analyzing and interpreting data; using Mathematics and computational thinking; constructing explanations and designing solutions; engaging in argument from evidence; and obtaining, evaluating, and communicating information.

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