Introduction to the New Fundamental Knowledge and Skills for STEM Technicians in the Future

DATA KNOWLEDGE & ANALYSIS

WORKING DEFINITION

1. Computational thinking is the reformulation of a difficult problem into one that humans can solve using common computer science concepts.

2. Data analysis is the process in which data is ordered and organized for use in methods that help explain the past and predict the future.

2a. Statistics is a branch of mathematics dealing with the collection and analysis of numerical data.

2b. Analytics tools (such as Excel, R, SAS) enhance and automate data analysis.

2c. Data modeling is the process of creating diagrams to represent data stored in a database.

2c. Data visualization software (e.g. MS Excel, Tableau) represents information in the form of a chart, diagram, picture.

3. The **data management life cycle** describes the stages that data goes through from initial generation or capture to eventual archival or deletion at the end of its useful life.

4. Data literacy is the ability to derive meaningful information from data.

5. Data management is the practice of collecting, keeping, and using data securely, efficiently, and cost-effectively.

5a. Data storage is the ability to warehouse and retrieve data generated by a variety of computers, sensors, and other connected devices. Storage needs take capacity, performance, and backup into consideration

5b. A **spreadsheet** (e.g. MS Excel) is a tool which stores data in a grid of rows and columns.

5c. A **database** is a collection of information that is organized so that it can be easily accessed, managed, and updated.

5d. A **query language** (e.g. SQL) is a specialized language for requesting information from a database.

5e. Data backup and recovery refer to the process of backing up data in case of a loss and setting up systems that allow data to be recovered due to data loss.

ADVANCED DIGITAL LITERACY

WORKING DEFINITION

1. <u>Artificial Intelligence</u> is a science of computers emulating humans with intelligent software capable of simulating reasoning, learning, and problem solving.

> **1a. <u>Machine learning</u>** is the ability of a computer to identify patterns to make predictions and decisions without human assistance.

2. <u>Automation/robots</u> are machines that can perform a variety of jobs by automating tasks traditionally accomplished by humans. The robot learns how to automate physical processes through software programmed for a specific series of tasks.

> **2a. <u>Human-Machine Interface</u>** (HMI) is a panel that allows a human to control a machine. On modern machines, the interface is often a touch screen similar to an iPad. Legacy machines may have physical buttons or knobs. The HMI is normally software that control hardware and be found in industrial environments that allows an operator to control machines.

3. <u>Basic programming</u> (e.g. Python) is used in programs for programmable logic controllers (PLCs). The idea is based on technicians having a common language between programmers and industrial maintenance personnel. It typically uses sequential programming language that is designed to represent a program through ladder diagrams.

4. <u>Function block diagram programming</u> is a language in which elements appear as blocks showing inputs and outputs. Function block programming is a graphical language often used for programmable logic controller (PLCs) in an automated manufacturing environment to monitor or control temperature, flow, and pressure levels.

5. <u>Digital literacy/fluency</u> is a person's ability to identify and use the appropriate digital tools and technologies to achieve a specific outcome.

> **5a. <u>Cloud literacy</u>** means understanding that the cloud stores data remotely and enables users to access and download data on any Internet-connected device, such as a laptop, tablet or smartphone. The cloud is being used by every team within a business: design and engineering, production, quality control, research and testing, manufacturing, inventory management, HR, accounting, vendor relations, e-commerce, and sales and marketing.

6. <u>Digital twins</u> use sensors attached to machines to create a software model that mimics the operation of the machine. The sensors provide the software model a live status of important components of the machine. This pairing of the virtual and physical worlds allows analysis of data and monitoring of systems to head off problems before they can occur.

7. <u>Edge computing</u> is the practice of processing data near the edge of your network, where the data is being generated, instead of in a centralized data-processing warehouse (usually the cloud). It can improve response time and save bandwidth.

8. <u>Network architecture</u> is the physical and logical design of software, hardware, protocols, and transmission media (wired or wireless). The two most common types of network architectures are Peer-To-Peer and Client/Server network.

9. <u>Network/device communication</u> is a set of rules or protocols that allow two or more devices to communicate over a wire or air. TCP/IP is the most widely used communications protocol and is used to access the Internet.

    9a. The **<u>Internet of Things</u>** (IoT) consists of physical devices that are connected to the Internet. IoT devices are a combination of sensors, software, and electronics that connect to a central location usually in the cloud. IoT devices are normally controlled or monitored by an app on a mobile device. A Ring doorbell is a common example of an IoT device.

    9b. <u>Security controls</u> include defenses or countermeasures to avoid, identify, prevent, or minimize security risks to property, data, or computer systems. Two of the most basic security controls include actively managing hardware devices and software on the network to prevent unauthorized access.

BUSINESS KNOWLEDGE & PROCESSES
WORKING DEFINITION

1. <u>Blockchain</u> is a digital, public ledger that records online transactions. It consists of an algorithm that allows for the tracking of the movement of an item. The records are kept in a distributed network to prevent falsification and are kept secure by encrypting, validating, and permanently recording transactions.

2. <u>Overall Equipment Efficiency</u> (OEE) identifies the percentage of manufacturing time that is truly productive. An OEE score of 100% means you are manufacturing only Good Parts, as fast as possible, with no Stop Time.

3. <u>Business cycles</u> are the "ups and downs" in economic activity.

4. <u>Communication</u> skills are essential to professionals who need to inform and persuade through written, social, and verbal communication. Social communication skills are the non-verbal components to communicating (e.g. eye contact).

5. <u>Continuous process improvement</u> is the ongoing improvement of products, services, or processes through incremental and breakthrough improvements.

6. <u>Entrepreneurship</u> consists of seeing a commercial opportunity and responding by bringing a new product or process to the market, or by improving an existing product, service, or method of production.

7. <u>Ethics</u> are the moral standards to which we and our society holds us; these can be more stringent than what we are legally required to do.

8. <u>Stakeholder analysis</u> (including internal and external customers) is understanding the broad community of people that are affected by a decision. Internal customers are needs generated by employees to perform their jobs. External customers are outsiders who pay for your product or service. Decisions may impact both.

9. <u>Lean processes</u> involve strategies for maximizing customer value while using fewer resources and minimizing waste.

10. <u>Market trends</u> consist of what people want and how they buy. Forecasting, or guessing how a product or service will sell involves market research. A hype cycle is the pattern that a technology follows from its invention through its mainstream commercialization.

11. <u>**ROI, or return on investment**</u>, is the amount of money or benefit expected in response to performing a process that costs money or effort. Businesses look to maximize what their return is when allocating resources – committing labor or money.

12. <u>Risk management</u> involves understanding the full consequences of a decision on your stakeholders and making decisions that take into account the relative values of risk and reward.

13. <u>Supply/demand</u> is the relationship between the amount provided and the amount customers want.

14. <u>Logistical chains</u> (e.g. production chains, distribution chains, value-added chains) are the flow of a product through production from the raw materials up through finished product in the customers hands. The value-added chain describes how each member of the chain performs a function that moves the product along the supply chain to the customer and what costs their actions add.

15. <u>Vertical and horizontal integration</u> In the vertical integration business model, a company expands by gaining control of more of its supply chain. Horizontal integration means acquiring or merging with other companies that do the same thing.