Introduction to the Cross-Disciplinary STEM Core Skill Sets

DATA KNOWLEDGE & ANALYSIS

Analytics tools for business (such as Excel, R, SAS) enhance and automate data analysis. Business analytics takes trends and insights gained from data analysis to identify and anticipate outcomes for making smarter, data-driven business decisions.
Computational thinking uses problem-solving methods to turn a difficult problem into one that humans can solve using common computer science concepts. More broadly, computational thinking is something described as systematic problem-solving, with no computer necessary.
Data analysis is the process in which data is organized for use in methods that help explain the past, predict the future, and answer research questions.
Data backup and restoration refers to the process of storing copies of data in case of a loss and setting up systems that allow data to be recovered after a data loss.
A **database** is a collection of information that is organized so that it can be easily accessed, managed, and updated.
Data literacy/ fluency is the ability to derive meaningful information from data and communicate about it clearly.
The **data life cycle** describes the stages that data goes through from initial generation or capture to eventual archiving or deletion at the end of its useful life.
Data management is the practice of collecting, storing, and using data in a secure, efficient, and cost-effective way.
Data modeling is the process of creating diagrams to map data storage, flow, and relationships.
Data storage is the ability to warehouse and retrieve data generated by a variety of computers, sensors, and other connected devices.
Data visualization software (e.g. MS Excel, Tableau) represents information in the form of a chart, diagram, picture, or infographic to communicate complex and relational information to a variety of audiences.
A **query language** (e.g. SQL) is a specialized computer language for requesting information from a database.

A **spreadsheet** (e.g. MS Excel) is a tool which can be used to apply formulas to data stored in a grid of rows and columns. Spreadsheets include features to analyze data and create data visualizations.
Statistics is a branch of mathematics dealing with the collection and analysis of numerical data used to formulate conclusions about large groups by examining small samples of the group.

ADVANCED DIGITAL LITERACY

Artificial Intelligence/Machine Learning allows computers to imitate humans by using intelligent software capable of simulating reasoning, learning, and problem solving. **Machine learning** is a type of AI that uses mathematical models of data to help a computer learn without direct instruction.
Automation/robotics involves the design, construction, operation, and use of machines that can perform a variety of jobs traditionally accomplished by humans, as well as computer systems for their control, sensory feedback, and information processing. Robots learn how to automate physical processes through software programmed for a specific series of tasks.
Basic programming (e.g. Python) tells a computer what to do using a language (code) it understands. Basic programming is frequently used to operate programmable logic controllers (PLCs). One easy-to-learn programming language is Python. It uses open-source code that can run on a variety of computer systems.
Cloud literacy means understanding that the cloud consists of servers that are accessed over the internet and that store data remotely. This enables users to access and download data on any Internet-connected device.
Digital literacy/fluency is a person's ability to identify and use the appropriate digital tools and technologies to achieve a specific outcome.
Digital twins are virtual replicas of physical machines or of non-physical processes. They use a combination of technologies — industrial internet of things (IIoT) technologies, machine learning, sensors attached to machines, and artificial intelligence to create a software model that mimics the operation of a machine. This means that a digital twin can run a simulation to answer questions about what might happen under specific conditions.

Edge computing is the practice of processing data near the edge of a network, where the data is being generated, instead of sending it to the cloud. Edge computing allows data to be retrieved more quickly.

Function block diagram programming is a computer language in which elements appear as blocks showing inputs and outputs. It is often used to run programmable logic controllers (PLCs) in an automated manufacturing environment.

Human-Machine Interface (HMI) is a panel that allows a human to control a machine. The HMI software controls hardware that allows an operator to control machines in industrial environments. The interface is often a touch screen similar to an iPad. Legacy machines may have physical buttons or knobs.

The **Internet of Things** (IoT) consists of physical devices that are connected to the Internet. Industrial IoT (IIOT) devices are a combination of sensors, software, and electronics that connect to a central location usually in the cloud and can be controlled or monitored by an app on a mobile device or other HMI.

Network architecture is the physical organization and logical design of software, hardware, protocols, and transmission media (wired or wireless) for communicating information within the network. The two most common types of network architectures are Peer-To-Peer and Client/Server network.

Network/device communication is a set of rules or protocols that allow two or more devices to communicate, either wired or wirelessly. TCP/IP is the most widely used communications protocol and is used to access the Internet.

Security controls include defenses or countermeasures to avoid, identify, prevent, or minimize security risks to hardware, data, or computer systems. Basic security controls include actively managing hardware devices and software on a network to prevent unauthorized access.

BUSINESS KNOWLEDGE & PROCESSES

Business cycles are the "ups and downs" in economic activity (i.e. all activities that produce, trade, and consume goods and services) over a period of time.

Blockchain is a digital, public database that records online transactions or movements of an item and stores this information in encrypted blocks. The records are kept in a distributed network to prevent falsification. Benefits of blockchain technology include accurate tracking, increased transparency, creation of a permanent ledger, and possible cost reduction.
Communication is how we give and receive information and convey our ideas and opinions to inform and persuade others through verbal, non-verbal and written means.
Continuous process improvement consists of methods for regularly reviewing products, services and processes to identify opportunities for productive change and to then adopt new measures, gather data, analyze the outcomes and make adjustments.
Customer/Stakeholder analysis is a process for understanding the broad community of people that are affected by a company's decisions. Internal customers include employees who need time and materials to perform their jobs. External customers include outsiders who purchase the company's product or service.
Entrepreneurship is the concept of developing and overseeing a new business or improving an existing product, service, or method of production for profit. **Entrepreneurial thinking** involves thinking creatively and recognizing opportunities as well as being flexible and comfortable with uncertainty or risk. It requires extra effort to yield potential process improvement.
Ethics are the moral standards of right and wrong governing human behavior. In technology, ethics issues arise regarding copyrights, privacy, freedom, data protection, online behavior and more.
Lean processes focus on strategies for maximizing customer value while using fewer resources and minimizing waste. Lean thinking means always thinking about how processes and products can be improved.
Supply chains (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.
Market trends are patterns related to consumer purchasing. Market trends are used to forecast whether demand for a company's products or services is going to increase or decrease.
Overall Equipment Efficiency (OEE) identifies the percentage of manufacturing time that is truly productive. An OEE score of 100% means that a company is manufacturing only good parts (a measure of quality), as quickly as possible (a measure of performance), and with no stop time (a measure of availability).

Risk management involves understanding the full consequences of events and decisions on the company and stakeholders and making decisions that factor in those possible consequences and outcomes.

ROI, or return on investment is the amount of money or benefit expected in response to spending on goods or a process. ROI is expressed as a percentage calculated by dividing the amount of profit from an investment by the amount invested.

Supply/demand is the relationship between the amount of goods and services, or labor available and the amount customers want. Supply and demand play a role in business decisions about what products and services to offer, pricing, marketing, and potential expansion plans.

Vertical and horizontal integration In the vertical integration business model, a company expands by gaining control of more of its supply chain. In a horizontal integration business model, a company acquires or merges with other companies that create the same type of product or offer the same services.