Core Concepts of Technology

ITEA 2

Objectives

In this presentation, you will learn about the core concepts of technology:

- **Systems**, which are the building blocks of technology, are embedded within larger technological, social, and environmental systems (ITEA 2-X. See System Lesson for more information)
- Selecting **resources** involves **trade-offs** between competing values, such as availability, cost, desirability, and waste. (ITEA 2-Z)
- **Requirements** involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development. (ITEA 2-AA)
- **Optimization** is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints. (ITEA 2-BB)
- New technologies create new **processes.** (ITEA 2-CC)
- Quality control is a planned process to ensure that a product, service, or system meets established criteria. (ITEA 2-DD)
- Management is the process of planning, organizing, and controlling work. (ITEA 2-EE)

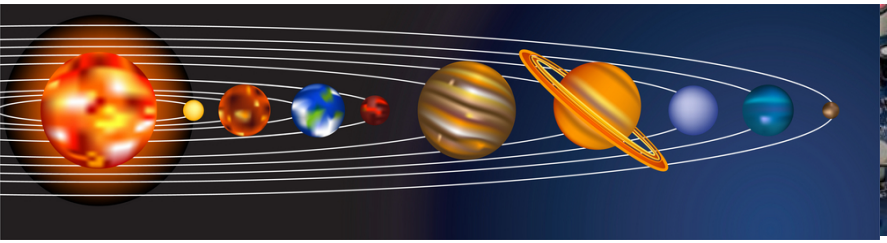
Core Concepts

These core concepts make up the foundations of the field of study that is technology. Everything you study about technology will involve these core concepts:

- Systems
- Resources
- Requirements
- Optimization and trade-offs
- Processes
- Controls

Systems

A **system** is a group of interrelated components designed collectively to achieve a desired goal. There are many kinds of systems including technological systems, social systems, and environmental systems. Systems is a big enough topic for its own lesson and so will be explored in more detail in the next lesson of this course. In this lesson, it is important for you to know what a system is, and how it relates to the other core concepts in technology.



A **technology system** is a combination of materials, devices, structures, information and energy working together to solve problems and extend human capabilities.

Systems and Feedback

A system often includes a **component** that permits revising or refining the system when the **feedback** information suggests such action. For example, the fuel level indicator of a car is a feedback system, part of the larger system that is a car, that lets the user know when the system needs additional fuel.

Integrated Systems

Systems are the building blocks of technology. Smaller systems are combined and embedded into larger systems. This is true of technology, as well as social and environmental systems.

A farm is an example of an integrated system of both living (the farmer, crops, animals, weeds, insects) and non-living (the tractor, barn, house, machinery, fertilizer) subsystems.

For example, a tractor is a vehicular system comprised of many mechanical, electrical, electronic (non-living) sub-systems for propulsion, steering, lighting, seating, etc. The boundaries of each sub-system "interface" (connect) with one or more of the others. Successful interfacing of sub-systems is called "systems integration".

Systems also appear in many aspects of daily life, such as solar systems, political systems, civil systems, and technological systems.






Resources for Technology

All technological activities require resources, which are the things needed to get a job done. The basic technological resources are:

1. **Tools and Machines**
2. **Processes**
3. **Materials**
4. **People**
5. **Capital**
6. **Energy**
7. **Time**
8. **Information.**

Every technological (human-made) system and design makes use of the seven types of resources. These resources must be present for any technological “event” to take place. We live in a very complex age where these resources are very valuable. If we use them wisely, we will be better able to serve creators and customers of technology.

Resource: Tools and Machines

Tools and machines are those devices designed to extend and enhance human capabilities.

Tools

1. Any implement, instrument, or utensil held in the hand and used for cutting, hitting, digging, rubbing, etc.
2. Any instrument that is the working part of a power-driven machine.

Machines

1. A structure of a framework and various fixed and moving parts, for doing some kind of work.
2. A device that transmits or changes the application of energy (lever, inclined plane, wheel and axle, screw, pulley, and wedge).

Other Resources for Technology

Processes are human activities used to create, invent, design, transform, produce, control, maintain, and use products and systems. It is a systemic sequence of actions that combines resources to produce and output.

Materials have many different qualities and can be classified as natural (e.g., wood, stone, metal, clay), synthetic (e.g., glass, concrete, and plastics), and mixed — natural materials modified to improve properties (e.g., leather, plywood, and paper).

People are the most important resource for all technological activity. Do you think people are as important a resource as they have been in the past?

Capital is the money and other finances available for the creation and use of technological products and systems.

Energy involves the ability to do work, and all technological systems require energy to be converted and applied.

Time, which is allocated to all technological activities, is limited, and therefore, its effective use is critical in technological endeavors.

Information is one of the basic resources used by technological systems. Information is data and facts that have been organized and communicated in a coherent and meaningful manner. Information is gathering, reading, observing, hearsay, or any way and by any source. It does not always mean facts. Knowledge is more factual and valid than information.

Selecting Resources: Trade-offs

Creative thinking and economic and cultural influences shape technological developments. For example, the interests, desires, and economy of a group of people will cause a transportation system to develop in one way and not another.

A transportation system for a large city may rely on mass transit, while one in a town might require reliance on personal vehicles, such as bicycles or cars.

Selecting resource use involves **trade-offs** between competing values such as availability, cost, desirability, and waste.

Los Angeles, California

Beijing, China

Requirements: Criteria and Constraints

Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development.

A designer or engineer is always working within requirements, such as criteria and constraints.

The **criteria** set the parameters for a design by identifying the key elements and features of what the product or system is and what it is supposed to do. Efficiency, for example, is an important criterion in most designs.

Constraints are limits on a design. Some constraints are absolute — no one can build a perpetual-motion machine, for instance.

Identifying criteria and specifying constraints will provide the basis for what the design should be and what its limits are.

Requirements in the design and development process

Carefully consider concept generation, development, production, marketing, fiscal matters, use, and disposability of a product or system.

Next, plan and select the best possible solution that takes into account the constraints and criteria obtained from research and personal preference. This involves synthesizing various factors, including the constraints, criteria, and information gathered by research.

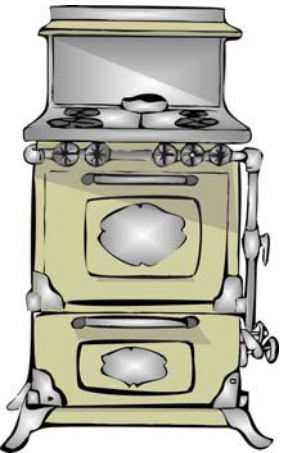
Most of the constraints that a designer works with are relative — funding, space, materials, human capabilities, time, or the environment — that must be balanced against each other and against how well the design satisfies the requirements.

Optimization

Optimization is a process or methodology of designing or making a product, process, or system to the point at which it is the most fully functional, effective, or as near perfection as possible.

Optimization is used for a specific design purpose to enhance or to make small gains in desirable characteristics. An optimum design is most possible when a mathematical model can be developed so that variations may be tested.

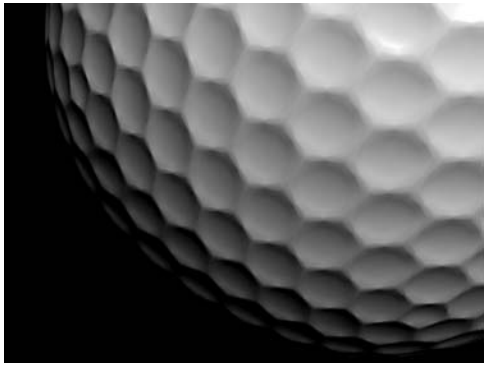
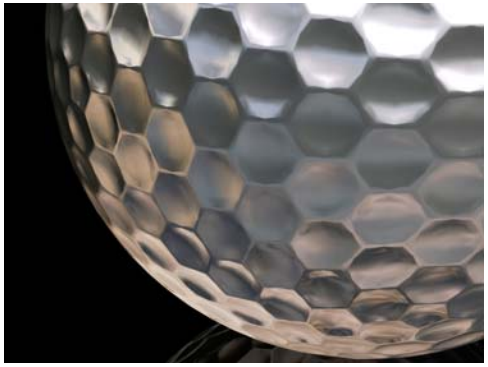
For example, from the time of the first gas cook stove in 1936 to the time of the microwave oven in 1967, the focus was on simplifying the process of cooking and reducing the time of food preparation.



Trade-offs

Trade-offs involves a choice or exchange for one quality over another. For example, the decision to favor the best material regardless of weight in order to achieve maximum strength may require a designer to make a trade-off of costs.

In order to maintain established requirements, trade-offs are made to meet the characteristics of an optimum design.


New technologies create new processes

New products and systems can be developed to solve problems or to help do things that could not be done without the help of technology.

For example, engines increase the speed at which people can travel, and pumps move water to locations where it is needed.

The development of technology is a human activity and is the result of individual or collective needs and the ability to be creative. Making life easier involves generating new products and systems through creativity and innovation.

Quality Control

After using market research to gather and analyze customers' positive and negative reactions, manufactures evaluate and present future designs. Using a process called quality control, manufactures compare parts, assemblies, and finished products with engineering standards.

Quality control ensures that the product performs within an acceptable range. Quality control involves measuring and analyzing materials entering the system, work in progress, and the outputs of the system. It is an ongoing process designed to ensure that resources are effectively used and that consumers receive functional products.

Quality control is a planned process to ensure that a product, service, or system meets established criteria.

Quality control is concerned with how well a product, service, or system conforms to specifications and tolerances required by the design.

Making quality donuts

Quality Control Standards

For example, a set of rigorous international standards (ISO 9000) has been established to help companies systematically increase the quality of their products and operations. ISO 9000 standards are a collection of international standards for application in all types of organizations. It is one of the most widely used quality standards in the world.

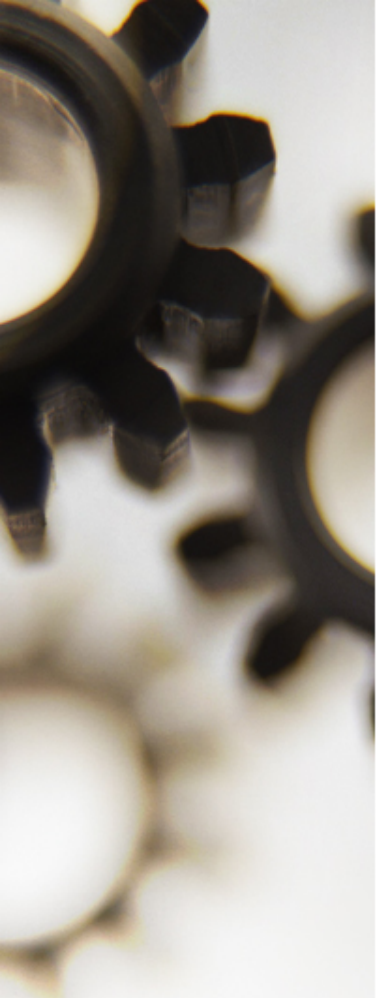
ISO 9000 is a family of standards for quality management systems. ISO 9000 is maintained by ISO, the International Organization for Standardization and is administered by accreditation and certification bodies. For a manufacturer, some of the requirements in ISO 9001 (which is one of the standards in the ISO 9000 family) would include:

- a set of procedures that cover all key processes in the business;
- monitoring manufacturing processes to ensure they are producing quality product;
- keeping proper records;
- checking outgoing product for defects, with appropriate corrective action where necessary; and
- regularly reviewing individual processes and the quality system itself for effectiveness.
- facilitate continual improvement

A company or organization that has been independently audited and certified to be in conformance with ISO 9001 may publicly state that it is "ISO 9001 certified" or "ISO 9001 registered." Certification to an ISO 9000 standard does not guarantee the compliance (and therefore the quality) of end products and services; rather, it certifies that consistent business processes are being applied.

Core Concepts of Technology: Summary

- These core concepts make up the foundations of the field of study that is technology. Everything you study about technology will involve these core concepts:
- A **system** is a group of interrelated components designed collectively to achieve a desired goal.
- A technology system is a combination of materials, devices, structures, information and energy working together to solve problems and extend human capabilities
- All technological activities require **resources**. There are various definitions of the resources depending on how the resources are used.
- There are seven types of technology resources: (1) tools, machines and processes, (2) materials, (3) people, (4) capital, (5) energy, (6) time, and (7) information
- A designer or engineer is always working within **requirements**, such as **criteria** and **constraints**
- **Criterion** is a desired specification (element or feature) of a product or system. Criterion can be the size, color, shape, etc
- **Constraint** is a limit to the design process. Constraints may be such things as appearance, funding, space, materials, and human capabilities
- **Optimization** is designing for perfection. The entire process of creating should include optimization — from the initial idea to the final product or system
- **Trade-off** involves a choice or exchange for one quality over another. In order to maintain established requirements, trade-offs are made in order to meet the characteristics of an optimum design.
- **Quality control** is a planned process to ensure that a product, service, or system meets established criteria.
- Quality control is concerned with how well a product, service, or system conforms to specifications and tolerances required by the design
- ISO 9000 is a family of standards for quality management systems used world-wide



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