

## Unit 7 Business Skills

### Introduction

This unit covers business principles and skills used throughout the design process and integral to the successful completion of a design project. The content in this unit is derived from the course Introduction to Engineering Design developed by Project Lead the Way, Inc.

The steps for achieving success as a design professional are covered in four orders of business:

- Portfolio Development
- Presentation
- Production
- Marketing

### About this Unit

You will four key business skills that enhance the design./P>

### Lesson

- Portfolio Development
- Presentation
- Production
- Marketing

## Lesson 1 - Portfolio Development

Essentially, a portfolio is a record. It is a record of your original thoughts and accomplishments in a specific area. It is a record of important events. It is a record of your best work, and it demonstrates the progress you have made creating it contents. It is a record of original work with sketches, diagrams, and other evidence to back up the originality. It is a record of your thought process as you moved through a unit. And, most importantly, it is a record of your progress through a specific area.

Portfolios are used in many areas. Artists use them to illustrate their work. When a student is applying to an art school, he/she needs to submit a portfolio of his/her sketches and work in various mediums. Architects use portfolios to show the buildings they have designed and the awards they might have earned for their work. Engineers utilize portfolios to illustrate specific design projects and their progress through a project. In fact, an engineer's portfolio, in the format of an engineer's notebook, is a legal document that can be used as evidence in a court of law.

You are going to be expected to keep a portfolio for each of the engineering courses that you take. In each course, you will keep documentation of your original ideas, sketches, projects, accomplishments, best works, and materials to support your work. You will need to be careful about what kinds of documentation you keep in the portfolio. Just as copyright and plagiarism issues are important in research papers that you write for English and history classes, they are just as important here. A portfolio is about you: you ideas, your work, your thoughts, and your successes!

The unit you are about to begin is relatively short, but it is a work-in-progress. You will be expected, with guidance from your instructor, to keep working on your portfolio, removing, adding, and refining information and documentation as the year progresses.

### Exercise

- Create a Portfolio

### Standards

This lesson meets standards for Science Content, Math, Language Arts, and Technology.

### Key Terms

Artifact	Portfolio
Plagiarize	

### Evaluation

Student portfolios will be assessed and evaluated periodically as the year progresses.

## Resources

Harms, Henry R., and Swernofsky, Neal R., *Technology Interactions*, Glencoe McGraw- Hill, 1999 ISBN 0-02-677701-0 (Teacher's Resource Guide) and ISBN 0-02-838779-1 (Student Text).

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Knowlton, Kenneth W., Beauchemin, Robert A., and Quinn, Patrick J., *Technical and Freehand Drawing and Sketching*, McGraw-Hill, Inc., 1977 ISBN 0-07-035207-0.

## Procedure

1. Discuss portfolios. (Instructor-led discussion)
2. Review a PowerPoint. (Student)
3. Complete Exercise - Create a Portfolio. (Student)

## Exercise 1 - Create a Portfolio

To create a portfolio, you will complete the following steps.

### **To create a portfolio**

- 1.** You will participate in an instructor-lead discussion on portfolios, why to keep portfolios, and elements of a good portfolio.
- 2.** You will review *Student Portfolio Development.ppt* located in the Business Skills data set folder. During the review, you will take notes for future use with your portfolios.
- 3.** You create the title page, the table of contents page, and section pages for your portfolio. Once completed, you will submit a paper copy to the teacher for evaluation. You will keep an electronic copy of your portfolio for future use.
- 4.** You will submit your portfolio periodically for assessment.

## Lesson 2 - Presentation

Have you ever asked a 20-year-old what they thought of the Beta video format? If so, you probably received a very quizzical look. Very few people in and around that age have ever heard of it. This is not to say that the Beta format was not good. In fact, it is far superior to VHS. Beta, however, was not marketed well and was never accepted by the public. For this reason, we as consumers have been living with an inferior product for years, awaiting better technologies, such as the Compact Disk and the Digital Video Disk. Perhaps this is reason to pause and consider why Beta never really survived in the market place.

The Beta video format was not marketed well from the start. The people developing the VHS format sold their product much more effectively despite the fact that it was an inferior product. Once a certain majority of people purchased the VHS players, Beta no longer had a chance. Movie producers were releasing their titles on VHS instead of Beta, so people continued to purchase VHS players. Beta quickly died out. What is the moral of this story?

### Exercises

- Review Communication Techniques
- Develop Presentation Skills

### Standards

This lesson meets standards for Science Content, Math, Language Arts, and Technology.

### Key Terms

35mm slides	Graphs	Prototype
Assembly Model	HTML	Slide Show
AVI	Intonation	Specification Sheets
Charts	Mock-up	Technical Drawing
Engineering Notebook	Poster Board	Three-Dimensional Solid Modeling
Graphic Organizer	Posture	

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## Resources

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Beakley, George C., Evans, Donovan L., Keats, John Bertrand, Engineering: An Introduction to a Creative Profession, Fifth Edition, Macmillan Publishing Company, 1986 ISBN 0-02-307090-0.

Lockhart, Shawna D., and Johnson, Cindy M., Engineering Design Communication: Conveying Design Through Graphics, Preliminary Edition, Addison Wesley Longman, Inc., 1999 ISBN 0-201-38042-0.

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Webster's New World Dictionary with Student Handbook, Concise Edition, Southwestern Company, 1978.

## Procedure

1. Discuss portfolios. (Instructor-led discussion)
2. Review a PowerPoint. (Student)
3. Complete Exercise - Create a Portfolio. (Student)

## Exercise 1 - Review Communication Techniques

Have you ever really considered what makes a good TV reporter? What is it about them that keeps your attention, or helps you follow their story? Is it that they are well prepared? Is their story well written? Is it that they are just plain captivating? Chances are they possess all of these things. It is safe to say, however, that not all TV reporters were born with these skills. Many reporters require years of training and practice to develop these qualities.

Even the shyest person who fears presentations can develop these skills. Practicing a few simple presentation techniques can make even the most reticent more confident and the presentation more effective. For example, simple behaviors such as maintaining eye contact, using good posture, and self-control can improve a presentation greatly. Confidence is probably the most difficult element of a good presentation to develop. With practice and preparation, one can build confidence as well.

### **To review communication techniques**

1. You will prepare and present, using positive communication techniques, a 2-3 minute overview of a current events article.

## Exercise 2 - Practice Presentation Skills

Imagine that you and a group of your friends have recently been invited to attend a full day presentation by a famous video game creator. They want you to be part of a group of kids who will evaluate their concepts. The night before, you can hardly sleep as you imagine the awesome graphics and sounds that the new games will provide. In the morning you dress in all your best gaming clad clothing and set out to meet your friends. You want everyone to know that you are the world's greatest video game fan. As you meet up with all your friends, everyone is hyped and describing what they will see today. "Wild, crystal clear graphics and radical sounds with tons of bass," someone says. You all board a bus that picks the group up at the school and off you go.

You arrive at the civic center where the company is hosting the event. Your heart is pumping in anticipation of what lies ahead. You can almost hear the sounds from the bus. As you get off the bus and enter the building, you figure that you must be early because there is nothing going on, no sound and no video screens. Then a man enters the room and asks everyone to sit down so they can begin. When everyone is seated a man in a business suit wheels in a cart and an easel. As he pulls a laser pen from his pocket he flips the first page on the easel to display a color sketch of a character for one of the new games. Instantly you are brought down. You realize that there will be no awesome graphics and no thundering sounds. You instantly think, "What am I doing here?" You have just been totally let down by your favorite gaming company.

### To practice presentation skills

1. Given an instructor-prepared list of presentation scenarios, you will select, from the following list, the most appropriate types of visual aids and written documents: charts, graphs, mock-ups, prototypes, video tapes, 35mm slides, poster board, computer graphics, animation, and HTML documents.
2. You will list the types and identify the elements of various forms of written documents as they relate to presentations.

## Lesson 3 - Production

In today's marketplace, you can purchase manufactured items from around the world, and, amazingly enough, all under one roof. The quality of these products is superb and you can purchase the products in any quantity you wish. The competition to produce a product that will outsell other similar products is fierce.

Manufacturing products today requires a vast knowledge of design parameters, manufacturing processes, automation, environmental impact, and material science. This unit of study will look at the challenges of manufacturing and production.

The total concept of producing a product is based on a few major concepts. The first, and probably the most important, is how profitable the venture will be. Without a reasonable return on investment, there is no purpose to continue.

Can the product be manufactured? The design of the product could be such that there are no common machines to produce it. This is not to say that product designs that need innovative machines or machining is wrong. You must keep in mind the expense-to-profit margin, which drives the market at all times. A product that is pre-designed with manufacturing in mind will yield more profit.

Do we make parts or buy them? Designing with manufactured parts like screws, o-rings, snap rings, etc., are cost saving measures. Do we use robots to facilitate assembly and perform hazardous jobs? The financial impact to a product's cost can be increased due to injuries incurred by the workforce. Is the design suitable for automated manufacturing? Automated manufacturing uses machines instead of humans to complete most processes.

All aspects of the production process need to be addressed. Design analysis is used to determine the types of machines that will be required to implement production. Process planning determines the requirements and order of production. Plant layout is necessary to determine the best flow of parts through the plant. Jig and fixture designs, equipment specifications, material specifications, material handling, tool design, and manpower are all items that need to be addressed before production begins. Environmental concerns, such as resource recovery and re-manufacturing, must also be considered during the entire process plan.

Finally, when production is initiated, the problem of keeping the product within specifications becomes a paramount issue. To ensure a quality product, data has to be collected, analyzed, and shared with the entire production team. Another issue to keep in mind in order to ensure quality, is packaging. The aesthetic requirement of packaging to enhance sales, as well as the protection of the product through the shipping cycle, completes the production process.

The need for qualified manufacturing engineers has never been greater.

### Exercises

- Analyze Manufacturing Design

- Review Process Planning
- Review Design for Automated Manufacturing
- Review Materials, Procurement, Handling, and Cost Analysis
- Review Quality Control
- Determine Manpower and Facility Requirements
- Design Packaging

## Standards

This lesson meets standards for Science Content, Math, Language Arts, and Technology.

## Key Terms

Aesthetic	Inventory	Total Quality Control
CIM	JIT	Total Quality Management
CNC	Manufacturing	Utilities
Component	Marketability	Ventilation
Concurrent Engineering	Marketing	Warehousing
Control (SPC)	Physical Plant	Waste
Cost Analysis	Process	
Defects	Real Time Inspection	
Design for Manufacture	Receiving	
Durability	Reliability	
Engineering	Research	
Finance	Responsible	
FMS	Route	
Graphics	Package	
Integrity	Self-Motivation	

## Evaluation

Student portfolios will be assessed and evaluated periodically as the year progresses.

## Resources

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Webster's New World Dictionary with Student Handbook, Concise Edition, Southwestern Company, 1978.

## Procedure

1. Discuss the seven topics listed in the exercises. (Instructor-led discussion)
2. Complete Exercise - Analyze Manufacturing Design. (Student)
3. Complete Exercise - Review Process Planning. (Student)
4. Complete Exercise - Review Design for Automated Manufacturing. (Student)
5. Complete Exercise - Review Materials, Procurement, Handling, and Cost Analysis. (Student)
6. Complete Exercise - Review Quality Control. (Student)
7. Complete Exercise - Determine Manpower and Facility Requirements. (Student)
8. Complete Exercise - Design Packaging. (Student)

## Exercise 1 - Analyze Manufacturing Design

As a product begins its journey from concept to reality, many factors have to be considered in order to produce that product at a reasonable price. Design for Manufacturing (DFM) is a method of producing products with manufacturing in mind. It considers all scenarios that can be encountered in a manufacturing environment to produce a product in the least amount of time, while maintaining a high level of quality and reliability. This process, also known as concurrent engineering, includes personnel from design, manufacturing, quality control, purchasing, service, marketing, and sales departments. They work together to make decisions, keeping in mind the needs and the limitations of each of their departments.

When a product is made using this process, the design time will be shorter, since there will be little need to go back and redesign the product due to manufacturing limitations. The transition into production will be quicker due to the fact that the design of jigs, fixtures, molds, and processes have already been considered and included. The assembly of components will be faster because layout has already been designed.

Producing a quality product in a timely manner, and having a satisfied customer, is of the utmost importance in manufacturing. Many markets are so competitive that if a product has not gone through the DFM process, a similar product may appear for less money. The only difference is that the second company considered manufacturing during the product and development stage, leading to considerable savings.

### To analyze manufacturing design

1. After classroom discussion on designing a product for manufacturing, you will write a paragraph describing the role of each department in the decision making process.
2. You will search the web for an example of manufacturing specifications or constraints in the production of a product (e.g. surface finish, material) and turn in one or more examples.
3. You will be given a list of materials and will select a manufacturing process appropriate to the material.

## Exercise 2 - Review Process Planning

The design is complete and all concurrent team members are satisfied that the design can be manufactured. It is now the job of the manufacturing engineer to determine the processes that each part must go through to complete that part. Each process must occur in the correct order to minimize handling and routing. Machines must be ordered and placed on the factory floor in a timely manner so as not to interfere with the intended deadline. Electricity has to be run to supply power to operate machinery. Conveyor lines to transfer parts need to be purchased. Environmental concerns have to be addressed.

The process engineer must consider the capability of the machines, the machine tools, forming operations, material removal, cutting speeds and feeds, and characteristics, such as material properties, part geometry, tolerances, surface qualities and others. Setup requirements, programming, and fixturing are all important items that have to be considered.

Anything that pertains to the making of a part, the finishing of a part, the assembly or sub-assembly of a product, and the packaging of the product must be addressed during this stage.

### To review process planning

1. You form a team with other students and produce a list of the components that make up a manufactured item (e.g., toy). Each part and process needed to make the part will be identified. The parts will be identified as either purchased or in-house produced.
2. Students will take one part of a product that was produced in-house and develop a process route. Students will sketch and label the machines and the route the part takes from raw material to finished product.

## Exercise 3 - Review Design for Automated Manufacturing

The manufacturing engineer determines the level of technology that is appropriate in order to manufacture a specific product or part. The product design is the deciding factor in the complexity of the technology used.

There are three basic levels of technology in use today. The first, low technology, is used throughout most industries in some form. This form of technology requires a low level of investment and the risk factor is minimal. The operator skill can range from low to high and is usually a one machine, one-man situation. An example of this is a gang drill where an operator is responsible to place parts in a fixture and activate a drill to remove material. In this mundane job an operator loads a part into the first drilling station and continues loading until all stations are full. The stations are refilled as the drilling operation is completed in sequence.

The second level, present technology, is widely used in today's factories. Machine shops and factories, which operated with low technology for years, first integrated numerical control (NC) machines to improve quality and rate of production. Now, computer numerical control (CNC) is replacing most manual machines for production. The skill to support and operate this machinery is moderate to high. The investment for a CNC machining center carries a medium risk factor. An example of present technology is mold making which was done by a skilled tool and die maker, and is commonly done today by CNC. The design is generated in a three-dimensional modeling system, converted into machine language, and cut by CNC.

The third level, high technology, is beginning to be integrated into some industries and seems to be the wave of the future. The investment risk is medium to high, and the operator level is also high. The operator must have a thorough knowledge of computers and programming because of the need to integrate and link computers with machines. Modification to facilities is usually necessary to support the necessary environment for this type of technology. There have been trends toward automated manufacturing, and some industries have made great strides toward this end. The system associated with this level is flexible manufacturing systems (FMS).

Computer integrated manufacturing (CIM) is a concept which uses computers to integrate a manufacturing endeavor. All functions from concept to advanced integration of machine operations and extending to customer support should included computer systems. A computer makes information available to all parties involved, and can be sent through the manufacturing facility to allow people to analyze it.

### **To review process planning**

1. After a presentation on CNC, FMS, and CIM, you will write a hierarchy of the terms discussed.

## Exercise 4 - Review Materials, Procurement, Handling, and Cost Analysis

As the need for companies to reduce expenditures and maintain a profit margin increases, measures need to be taken to reduce material acquisitions. This process was started in Japan, and has been labeled just in time (JIT). It is a computer-based monitoring system, which stresses the effective use of resources. Throughout the entire manufacturing process, materials are tracked by bar codes and delivered to their proper location just as they are needed. This process focuses on the elimination of tasks, such as storage, transportation, and others that increase costs. Raw materials delivered to the site are immediately transported to the machines to be turned into parts. Materials will only be acquired for those machines when all of the materials for the first shipment are depleted. Parts are delivered for assembly just before they are needed, and products are produced just in time to meet customer needs. At all levels, inventory is reduced to the bare minimum.

One of the drawbacks to this system is that if an unexpected increase occurs in one of these cycles, suppliers may not be able to meet demand, "just in time." An inability to meet customer's needs at a critical time could mean a loss of revenue.

The JIT process as a whole has been very successful in minimizing cost and increasing the profitability of a product. The process must be regulated and scrutinized closely to achieve success.

As a product is being designed in a DFM environment and materials are being considered, it is important to perform a cost analysis of the product. According to customer specifications, there may be target costs that might have to be met that will drive some of the design materials. Cost-related material allocations may have to be given to sub-systems to provide a guide for teams to follow. While in the design phase, a product may prove to be too costly to prove profitable and might be dropped before it affects the company negatively.

### **To review materials, procurement, handling, and cost analysis**

1. You will write a paragraph on the reasons why companies save money by utilizing the JIT process.

## Exercise 5 - Review Quality Control

Quality control is a term used in industry to define a process that is concerned with the prevention of producing bad parts during the manufacturing cycle. This is accomplished by the use of precision measuring devices and statistical techniques. As parts are being produced, precision measurements of critical dimensions of that part are collected. Inspection requirements are set to achieve the product's specifications there were agreed upon by the design team.

The collected data is used to determine if a process is under control. This is accomplished by mathematical computations of large samples of data to statistically determine the processes' capability. If the statistics show a skew to the right or left of the intended dimension, known causes can predict what is happening, and preventive measures can be applied before parts are out of dimensional tolerances. This process is also applicable in any production process where data can be collected and analyzed.

The U.S. government used statistics to control quality at the beginning of World War II, when massive quantities of interchangeable parts were needed. The quality control process was needed to ensure that suppliers from various manufacturing companies conformed to specifications set by the government for those interchangeable parts. If the manufacturer was found to be non-conforming to those standards, the manufacturer was disqualified as a supplier.

This process was improved upon in the early 1970's by the ideas and philosophy of W. Edward Deming. Deming brought his ideas to U.S. industrialists and was utterly rejected. He then took his ideas to the Japanese industrialists, and was accepted with open arms. His ideas of quality control and total quality management (TQM) skyrocketed the Japanese ability to produce superior products at lower costs than the Americans.

Deming's approach to product quality relies on all the individuals involved in the design and production processes contributing continuous feedback so that the process is constantly improved. It is the responsibility of all involved, from management to custodian, to work for the improvement and success of the company.

### **To review Review Quality Control**

1. You will research the Thomas Register for a piece of quality control machinery and printout a description of that item.

## Exercise 6 - Determine Manpower and Facility Requirements

There are a multitude of factors to be considered during the development of a product. Facility design affects the profitability, and moreover, the productivity of a product or a company. What are the types of things that need to be considered when planning a facility? First is the plant location. The plant must be located so that raw materials can easily be acquired and the finished products can be transported to market without elevating costs. Utilities have to be sufficient to operate all aspects of the plant. The layout of the physical plant is probably the most difficult. The location of production machines to efficiently move raw materials, parts, sub-assemblies, and finished products through the plant will reduce production costs. In addition to plant layout, the layout of each workstation needs to be considered. The efficiency of design will increase production. The acquisition of manpower to operate the plant is another issue that needs to be addressed. The need for low technology jobs is declining, and the need for existing technology or high technology is increasing. Most jobs are going to require a high school education and many require knowledge of computers and computer language. Automation of equipment is creating the need to upgrade education and skills. The jobs in the future will need employees who are highly skilled. Those who are creative and have the ability to make decisions for the good of the company will be highly paid.

ISO 9000 standards have become a major contributing factor influencing facility design. To be a certified ISO 9000 company, the facility must conform to many standards. Some of the facility requirements include:

- Resources that include but are not limited to, proper equipment, qualified personnel, and sufficient levels of inventory.
- Product identification and tractability: the company must be able to have written documentation to trace a product and its components through all stages of production from receiving raw materials through delivery of the final product.
- Process control is required to ensure that the product is produced under controlled conditions.
- Inspection and testing of a product must occur to verify that parts are meeting standards set for that product.
- A system must be in place to identify non-conforming parts and products and eventually segregate those items until proper disposition has been determined.
- Proper handling, storage, packaging and delivery systems must be in place.

### To determine manpower and facility requirements

1. You will record the jobs necessary to run a facility and the physical facility requirements. For example, a fast food store, video rental, or music store.

## Exercise 7 - Design Packaging

The way in which a product is presented to a consumer is an important marketing tool. A good package must include three major criteria. First, it must be appealing and attractive to the consumer in order for them to purchase the product. Secondly, it must protect the product from the factory to the consumer's front door. And thirdly, it must protect against moisture, odor, insects, sunlight, and rough handling. The package must include directions for use and related information for assembly if necessary.

There are many branches of packaging, and in some cases the packaging materials exceed the cost of the product. The first branch is consumer packaging. Packagings of this type are designed with the individual purchaser in mind, and tend to be small in size with features that make it easy to use. The types of products using this packaging include food, drug, hardware, beverage, baker, toiletry, cosmetic, and personal products.

Industrial packaging is another branch. This packaging is sold to another company instead of an individual. Raw material and goods that are semi-finished or finished that are being transported to another company fall into this category. They are usually large items that require large packaging, or large quantities of small items, which are handled in bulk.

The last branch is institutional packaging. This type of packaging is for products usually sold in bulk, for example, food. Some of the items like a box of soap detergent typify this type of packaging. Institutional packaging can also include small servings of catsup, relish, crackers, salt, or pepper. Products used in hospitals that use a variety of surgical and health care kits use special packaging that the average person seldom sees.

Think of all of the different types of packaging you come in contact with in your everyday lives-it's mind-boggling! Examples of different types of packaging include packaging peanuts, Styrofoam inserts, cardboard boxes, blister packs, bubble wrap, tubes, bottles, shrink-wrap, aluminum cans, etc. The list could go on and on.

When you go home, take a look at some packages, examine them, try to figure out how they were produced or what techniques were used to assemble them. Packaging is really a fascinating area of engineering.

### To design packaging

1. You will take notes during instructor's lesson on packaging requirements.
2. You will design a package for a given product.
3. You will complete an instructor-generated worksheet based on the instructor's lesson for homework.
4. You will complete the egg drop box packaging activity.

## Lesson 4 - Marketing

All of the middle-sized and large manufacturing businesses around the world have a marketing department. What is a marketing department? What does it do? What kinds of people work there?

Companies are in business to make money. The responsibility of determining product cost is one key element to the financial success of the company. A slight error here, an oversight there, and profitability of the company is compromised. Engineers, accountants, estimators, and statisticians are just a few of the people involved with this process.

Packaging is a key element in the financial stability/profitability of a company. The protection of the product during shipping, warehousing, and shelf-life storage in a store is extremely important. Also, the appearance of the package has a lot to do with the marketability of a product. In some cases, the cost of packaging may exceed the cost of the product itself. The designer and the sales and marketing person would be working in conjunction with the packaging company during this process.

### Exercise

- Analyze Product Cost

### Standards

This lesson meets standards for Science Content, Math, Language Arts, and Technology.

### Key Terms

Cost Analysis Design for Manufacture Inventory Just in Time Overhead Real Time Inspection Total Quality Management Warehousing

Artifact	Portfolio
Plagiarize	

### Evaluation

Student portfolios will be assessed and evaluated periodically as the year progresses.

## Resources

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## Procedure

1. Discuss portfolios. (Instructor-led discussion)
2. Review a PowerPoint. (Student)
3. Complete Exercise - Create a Portfolio. (Student)

## Exercise 1 - Analyze Product Cost

Whenever a product is produced, many factors are taken into consideration to arrive at a cost for the product. Cost of design, cost of engineering, material costs, manufacturing costs, cost of inventory, sales projections, costs related to sales, overhead costs, and shipping costs, including packaging, are all used in product cost estimation. This cost estimation phase is extremely important because businesses want to make money. Every factor is estimated and re-estimated to project a cost of the product that is going to be competitive in the marketplace, yet profitable for the company.

### **To analyze product cost**

1. During instruction, you will define vocabulary terms for the section and take notes.
2. You will break out into groups of three and formulate a cost analysis for a given product.