

**Metropolitan Workforce Innovation Division**

# WIDX 1000 Introduction to Prototype Design

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## Course Design

### Course Information

Description: Explore the fundamentals of Prototype Design. Study the three integrated concepts of: design thinking, business acumen, and low-volume production to ideate, prototype and manufacture a human-centered product. Compare careers and occupations that require prototyping skills.

 **Career Cluster** Science, Technology, Engineering and Mathematics

 **Instructional Level** Associate Degree

 **Total Credits** 4.5

**Total Hours** 49.5

### Types of Instruction

Team-Based Learning

Project-Based Learning

### Credits/Hours

### Purpose/Goals

The proliferation of easy to use manufacturing equipment has created a dramatic shift in the manufacturing, engineering, and IT industries. Businesses are clamoring to leverage to availability to its fullest extent.

The iterative design process of prototyping allows businesses to fail early and inexpensively, resolve design challenges more quickly, and produce a working form of a new design with minimal effort and resources.

### Target Population

MCC students considering careers in prototype design

### Pre/Corequisites

#### Prerequisite: None

#### Corequisite

* Use a web browser and internet search engines; perform research on the internet.
* Download, install and use software without assistance.
* Compress multiple files into one file for Emailing as required.
* Send and receive Email and upload/download files with the email system.

### Textbooks

None

### Learner Supplies

Basic Art Supplies

### General Education Outcomes

#### Communication

#### Communication

##### Criteria

learner engages in the four stages of the communication process: collecting, shaping, drafting, and revising

learner selects, organizes, and presents details to support a main idea

learner participates in groups using a variety of collaborative techniques

learner uses knowledge of target audience expectations and values to shape a text

learner uses various techniques in writing and speaking, including authority, point-of-view, style, and voice

learner employs good mechanics and craftsmanship

#### Critical Thinking

##### Criteria

learner interprets and evaluates statements, theories, problems, and observations from different points of view or perspectives

learner questions the validity of assumptions, evidence, and data

learner assesses the value or importance of positions, policies, and formulated solutions

learner uses imagination, intuition and divergent thinking

#### Information Literacy

##### Criteria

learner determines the extent of information needed

learner critically evaluates information and its sources

learner incorporates selected information into a personal knowledge base

learner uses information ethically and legally

learner manages, presents, and stores information digitally or otherwise

#### Numeracy

##### Criteria

learner interprets, analyzes, and solves basic numerical problems

learner estimates the reasonableness of an answer

learner interprets, evaluates, and presents graphic/tabular data

learner utilizes basic statistical knowledge

#### Scientific Inquiry

##### Criteria

learner formulates hypotheses based on observations

learner applies the scientific method to evaluate claims

learner evaluates societal issues from a scientific perspective

learner makes informed judgments about science-related topics and/or policies

#### Social and Cultural Awareness

##### Criteria

learner explains the influence of history, geography, the arts, humanities, and the environment on individual cultural development

learner distinguishes subjective opinions and ideology from objective findings and data

learner recognizes social and individual biases

learner develops personal and social responsibility and participates as an engaged citizen in order to promote a civil society

learner recognizes the importance of individual differences and similarities in a global context

### Program Outcomes

#### Manage administrative tasks.

##### Summative Assessment Strategies

Portfolio/Artifacts

##### Criteria

Students manage communications.

Students prepare reports.

Students prepare prototype documents.

Students present prototype project reports.

#### Develop a philosophy for life-long learning and community involvement.

##### Summative Assessment Strategies

Self-Assessment

Portfolio/Artifacts

##### Criteria

Students participate in prototyping community learning.

Students share learned knowledge.

Students participate in continuing education

Participate in industry events (e.g. conferences, trade shows, maker/hackerspace events)

### External Standards

Title: DACUM: Prototype Production Technician

#### Copyright Information

##### Produced by:

The Ohio State University College of Education and Human Ecology, Columbus, OH

##### DACUM Panel:

Nathan Davis, 3D Engineer, Kul 3D/Sympateco, Omaha, NE; Dane Foster, Business Development Manager, Kul 3D/Sympateco, Omaha, NE; Matt Gabowski, Business Development Manager, Distefono Technology & Manufacturing, Omaha, NE; Scott Morgan, COO/CFO K2CO, Inc., Ashland, NE; Jason Webb, Creative Technologist, Omaha, NE;

##### DACUM Facilitators:

##### Jamie Bridgham, Art Brown, Tammy Green, Jerome Patten Tina Wagner, Team Leader

##### Notes

See the [Prototype Production Technician DACUM Research Chart](https://mccneb.wids.org/PublicDocuments.axd?DocumentID=9e1a0452-31b1-4deb-b8a8-3fda363a7995) for more information.

### Target Standards

A. Compile Prototype Specifications

A.1 Identify prototype internal/external client needs

A.2 Define prototype end use purpose

A.3 Document prototype specifications

A.4 Conduct prototype background research (e.g., patents and existing products)

A.5 Review prototype models and samples

A.6 Determine prototype project feasibility

A.7 Determine best prototype method

A.8 Obtain prototype specification approval

B. Develop Prototype Project Plan

B.1 Determine prototype project steps

B.2 Determine prototype project deliverables

B.3 Estimate prototype project task timing

B.4 Review prototype equipment personnel capacities

B.5 Prepare prototype timeline chart

B.6 Schedule internal/external prototype project resources

B.7 Identify prototype project milestones

B.8 Obtain prototype project design plan approval

C. Develop Prototype Budget

C.1 Create prototype budget template

C.2 Estimate prototype costs per task

C.3 Determine cost of prototype material

C.4 Assess make/buy prototype parts costs

C.5 Obtain prototype budget approval

D. Create Prototype Design

D.1 Collaborate on prototype design ideas

D.2 Determine prototype design review points

D.3 Create first prototype design version (e.g., sketch, CAD model)

D.4 Create prototype naming conventions

D.5 Assess prototype design machinability

D.6 Modify existing prototype design

D.7 Select prototype design materials

D.8 Validate prototype design components

D.9 Create final prototype design

D.10 Obtain prototype design approval

D.11 Generate prototype bill of materials

E. Construct Functional Prototype

E.1 Review approved prototype design

E.2 Accumulate prototype materials

E.3 Create prototype CNC machining programs

E.4 Manufacture prototype part(s)

E.5 Assemble prototype part(s)

E.6 Perform prototype finishing work (e.g., plate, paint, sand)

E.7 Prepare prototype firmware/software code

E.8 Test prototype functionality

E.9 Present first prototype version

E.10 Revise functional prototype

F.5 Prepare prototype project record(s)

F.7 Present prototype project reports

F.8 Participate in prototype meetings

F.9 Document inventory consumed

G.6 Share learned knowledge

### Course Competencies

#### Solve prototype design challenges using design thinking.

##### Assessment Strategies

* Product: Paper Prototype

##### Criteria: You will know you are successful when:

* paper prototype meets client specifications
* paper prototype shows improvement
* paper prototype includes your individual contribution to the processes

##### Learning Objectives

* Explain design thinking.
* Conduct an end-user interview.
* Sketch a prototype based on an end user interview.
* Build a prototype based on an end user interview and feedback.

#### Apply concepts of iterative design to the prototyping process.

##### Assessment Strategies

* Product: Prototype(s) in multiple stages
* Product: Portfolio

##### Criteria: You will know you are successful when:

* prototype addresses an existing problem
* prototype meets standards set by client-peer
* you present a drawing of your prototype
* prototype is clearly labeled
* prototype is described in detail
* prototype is revised using client-peer feedback
* portfolio contains prototype designs that solve problems
* portfolio contains prototype designs that use unique approaches/solutions
* portfolio contains prototype designs that uses two - three types of media
* portfolio contains prototype designs that include explanations of design choices and thought processes
* portfolio clearly shows improvement in prototype designs
* prototype includes correct grammar and punctuation
* portfolio follows instructor's standards for professional quality

##### Learning Objectives

* Summarize the history of design.
* Define prototype design.
* Describe the types of prototyping.
* Identify tools and equipment used in prototype design.
* Define the scope of a work portfolio
* Explain the process used to construct a prototype portfolio.
* Discuss concepts of iterative design.
* Define improvement and relate the definition to prototype design.
* Explain ways to notate a prototype portfolio.

#### Use sketching techniques to create prototypes.

##### Assessment Strategies

* Drawing/Illustration: Sketch of Prototype

##### Criteria: You will know you are successful when:

* sketch combines ideas or information in new ways
* sketch facilitates the contributions of team members
* sketch communicates the purpose/idea of the project
* sketch evidences knowledge of the intended audience
* sketch was created using a logical structure
* sketch shows evidence of refinement from past iterations
* sketch makes use of text, symbols, and visual orientation
* sketch includes design team name, date, and assignment #

##### Learning Objectives

* Define prototype sketching.
* Explain the purpose of sketching in prototyping.
* Describe the most appropriate materials and tools for sketching.
* Describe the importance of input from client/end user.
* Explain sketches and the methods used to create them.
* Select symbols, color, views, dimensions, and scale to enhance sketches
* Question the necessity of perfection
* Explain a 3D sketch in 2D by using coordinates and axes

#### Use graphic design software to create prototypes.

##### Assessment Strategies

* Drawing/Illustration: Electronic Drawing of Prototype

##### Criteria: You will know you are successful when:

* the student enters, modifies, retrieves, stores, and verifies data and other information in a computer
* prototype conveys information into the chosen format
* prototype demonstrates the concept it is intended to show
* prototype includes color and labels for clarification
* prototype is neat and attractive

##### Learning Objectives

* Explain the purpose of software in prototyping
* List various software programs used in prototyping
* Identify the most appropriate software for particular prototypes
* Explain how skills from sketch prototyping relate to software prototyping
* Discuss common challenges regarding prototype images
* Explain the process of creating, saving, attaching documents and submitting electronic files
* Incorporate keyboard shortcuts into software use
* Use CorelDraw

#### Use equipment, tools, and materials to produce prototypes.

##### Assessment Strategies

* Product: Physical Prototype

##### Criteria: You will know you are successful when:

* physical prototype evidences skills applied from the Software Learning Plan
* physical prototype was built using appropriate method
* physical prototype (and/or documentation) shows evidence of group input
* physical prototype was built according to the specifications design plan
* physical prototype was built following safety processes and procedures
* A. Compile Prototype Specifications
* A.2 Define prototype end use purpose
* A.3 Document prototype specifications
* A.4 Conduct prototype background research (e.g., patents and existing products)
* A.5 Review prototype models and samples
* B. Develop Prototype Project Plan
* D.1 Collaborate on prototype design ideas
* D.7 Select prototype design materials

##### Learning Objectives

* Explain the concepts of physical prototyping.
* List various equipment, tools and materials used in physical prototyping.
* Identify the most appropriate equipment, tools and materials for particular prototypes.
* Explain skills from sketch and software prototyping relate to physical prototyping.
* List common challenges with producing physical prototypes.
* Determine solutions to problems with physical prototypes.
* Explain the process of finishing physical prototypes.
* Describe the safe use of FabLab equipment, tools, and materials.

#### Use the process of low-volume manufacturing to produce products.

##### Assessment Strategies

* Product: Five or More Matching Products

##### Criteria: You will know you are successful when:

* products are the result of teamwork
* products were created based on the safe use of equipment, tools, and materials
* products were produced based on specifications and criteria in the design plan
* products were created with an element of complexity (according to instructor's direction)
* products match and meet the criteria for low-volume manufacturing

##### Learning Objectives

* Explain the concepts of low-volume manufacturing.
* List various equipment, tools and materials used in low-volume manufacturing.
* Identify the most appropriate equipment, tools and materials for particular production.
* Explain how skills from sketch and software prototyping relate to LVM.
* List common challenges with low-volume manufacturing.
* Explain the process of building matching products.

#### Identify ways prototyping contributes to an organization's business initiatives.

##### Assessment Strategies

* Written Product: Innovation Plan

##### Criteria: You will know you are successful when:

* innovation plan follows the model provided by instructor
* innovation plan evidences creative thinking
* innovation plan combines ideas or information in new ways
* you organize ideas and communicate oral messages appropriate to listeners and situations
* you use verbal language and other cues such as body language appropriate in style, tone, and level of complexity to the audience and the occasion
* you speak clearly and communicates a message
* your delivery holds audience attention; you are energetic and enthusiastic
* innovation plan communicates business initiatives and solutions

##### Learning Objectives

* Explain the basic principles of private enterprise.
* Summarize the purposes of strategic plans, corporate initiatives, and business goals.
* Describe the role of prototyping in achieving business objectives.
* Create a business profile.
* Organize a team meeting.
* Explore strategies teams use to meet business goals.
* Apply A3 Model to solve business problems and organizational challenges.

#### Evaluate prototyping careers in business and industry.

##### Assessment Strategies

* Sketchbook Presentation: Prototyping Careers

##### Criteria: You will know you are successful when:

* you present information in a style and tone consistent with the audience's level of interest and level of knowledge or understanding
* your delivery holds audience attention; you are energetic and enthusiastic
* portfolio includes at least 10 items
* portfolio is appropriate for information presented
* sketches are titled
* sketches are labeled
* sketches include colors and/or textures to increase readability
* sketches give a reasonable interpretation of the prototype/solution
* you speak clearly and communicates a message
* you combine ideas or information in new ways
* sketches/explanation consider the human, interpersonal, and factual dimensions of a problem
* D. Create Prototype Design
* D.6 Modify existing prototype design
* D.9 Create final prototype design

##### Learning Objectives

* Research prototype design careers.
* Summarize the job duties of a prototype design technician.
* Identify aspects of the prototype design career for further study.
* Review the MCC Career Services Portal.
* Explore job search strategies.
* Explore job interviewing strategies.
* Select sketches to include in course portfolio.

### Course Learning Plans and Performance Assessment Tasks

| **Type** | **Title** | **Source** |
| --- | --- | --- |
| PAT | Sketching Techniques - Paper Prototype 1: Sketch | Course |
| PAT | Design Challenges - Paper Prototype 2: Physical  | Course |
| PAT | Graphic Design - Electronic Prototype: Drawing/Illustration | Course |
| PAT | Prototyping in Business - Oral Presentation using A3 Model | Course |
| PAT | Prototyping Careers - Job Search Strategies | Course |
| PAT | Concepts of Iterative Design - Portfolio | Course |
| PAT | Equipment, Tools, and Materials - Physical Prototype | Course |
| PAT | Low-Volume Manufacturing - Matching Products | Course |
| LP | Design Challenges and Design Thinking | Course |
| LP | Sketching Techniques | Course |
| LP | Using Software to Create Prototypes | Course |
| LP | Contributing to Business Initiatives | Course |
| LP | Careers in Prototyping  | Course |
| LP | Concepts of Iterative Design | Course |
| LP | Equipment, Tools, and Materials | Course |
| LP | Low-Volume Manufacturing | Course |

## Performance Assessment Task: Sketching Techniques - Paper Prototype 1: Sketch

### Directions

Prototyping starts with an idea. Often, the idea is generated from a need to solve a problem. In this assignment, you will interview a client and design something you could make that meets your client's criteria and solves his/her problem.

Use active listening skills -- ask questions.

* Take notes.
* Check for understanding.
* Remain client-focused by identifying the unique needs of your client.

Use the materials provided by your instructor to render a drawing of a product that would meet your client's needs and solve his/her problem. You do not need to be an artist, and the drawing doesn't have to be perfect, just representative.

Show your drawing to your client for feedback.

Take detailed notes (and/or alter you sketch) regarding the feedback he/she provides.

*\* Criteria listed with a letter or letter/number combination (such as A, A.2, D.1, etc.) are those specifically requested by business partners who hire and employ individuals with prototype design skills.*

### Environment: Classroom

### Evaluator(s)

* Instructor
* Peer

###  Target Course Competencies

* Use sketching techniques to create prototypes.

### Scoring Guide

| **Criteria** | **Ratings** |
| --- | --- |
| paper prototype communicates real-world application | Yes No |
| sketch combines ideas or information in new ways | Yes No |
| Use sketching techniques to create prototypes. | Yes No |
| sketch facilitates the contributions of team members | Yes No |
| sketch communicates the purpose/idea of the project | Yes No |
| sketch evidences knowledge of the intended audience | Yes No |
| sketch was created using a logical structure | Yes No |
| sketch shows evidence of refinement from past iterations | Yes No |
| sketch makes use of text, symbols, and visual orientation | Yes No |
| sketch includes design team name, date, and assignment # | Yes No |

## Performance Assessment Task: Design Challenges - Paper Prototype 2: Physical

### Directions

The process of prototyping involves iterative design. Often, the first idea to solve a problem is refined several times before you arrive at a prototype you and your client are comfortable with. In this assignment, you will use your initial sketch, all of your notes, and feedback from the client to improve the design of your prototype so that it meets your client's criteria and solves his/her problem.

Carefully review your client's feedback.

 Use the materials provided by your instructor to create a 3D model of a product that would meet your client's needs and solve his/her problem. You do not need to be an artist, and the model doesn't have to be perfect, just representative.

Show your model to your client for feedback.

Take detailed notes regarding the feedback he/she provides.

*\* Criteria listed with a letter or letter/number combination (such as A, A.2, D.1, etc.) are those specifically requested by business partners who hire and employ individuals with prototype design skills.*

### Environment: Classroom

### Evaluator(s)

* Instructor
* Peer

### Target Course Competencies

* Solve prototype design challenges using design thinking.

### Scoring Guide

| **Criteria** | **Ratings** |
| --- | --- |
| **Solve prototype design challenges using design thinking.**  |  |
| paper prototype meets client specifications | Present Not Present |
| paper prototype shows improvement | Present Not Present |
| paper prototype includes your individual contribution to the processes | Present Not Present |
| physical prototype communicates real-world application | Present Not Present |

## Performance Assessment Task: Graphic Design - Electronic Prototype: Drawing/Illustration

### Directions

Use the *Sketching Prototypes Roadmap* provided by your instructor to sketch prototypes using the software: CorelDraw.

*\* Criteria listed with a letter or letter/number combination (such as A, A.2, D.1, etc.) are those specifically requested by business partners who hire and employ individuals with prototype design skills.*

### Environment: Classroom

### Evaluator(s)

* Instructor

### Target Course Competencies

* Use graphic design software to create prototypes.

### Scoring Guide

| **Criteria** | **Ratings** |
| --- | --- |
| Use graphic design software to create prototypes.  | Present Not Present |
| the student enters, modifies, retrieves, stores, and verifies data and other information in a computer | Present Not Present |
| prototype conveys information into the chosen format | Present Not Present |
| prototype demonstrates the concept it is intended to show | Present Not Present |
| prototype includes color and labels for clarification | Present Not Present |
| prototype is neat and attractive | Present Not Present |

## Performance Assessment Task: Prototyping in Business - Oral Presentation using A3 Model

### Directions

An important way that businesses stay competitive in the marketplace is by process improvement, reinvention, and innovation. To that end, prototyping enables businesses to quickly, safely, and at a relative low cost try out new ideas without the need for heavy investment in time, labor, and resources.

For this assessment, you and your design team will:

* Apply effective meeting techniques to brainstorm an idea/concept for a prototype based on a business need.
* Create a team charter (or list of team norms) to agree upon how the team will function during this project.
* Discuss the results of the Gallup StrengthsFinder, and create a plan to use the strength of each team member.
* Apply the A3 Model to create a form that will capture ideas and strategies for the project.
* Create a presentation of your prototype recommendation.
* Include the ways in which the prototype addresses the business need in the presentation.

*\* Criteria listed with a letter or letter/number combination (such as A, A.2, D.1, etc.) are those specifically requested by business partners who hire and employ individuals with prototype design skills.*

### Environment: Classroom

### Evaluator(s)

* Instructor
* Peer

### Target Course Competencies

* Identify ways prototyping contributes to an organization's business initiatives.

### Scoring Guide

| **Criteria** | **Ratings** |
| --- | --- |
| **Identify ways prototyping contributes to an organization's business initiatives.**  |  |
| innovation plan follows the model provided by instructor | Present Not Present |
| innovation plan evidences creative thinking | Present Not Present |
| innovation plan combines ideas or information in new ways | Present Not Present |
| you organize ideas and communicate oral messages appropriate to listeners and situations | Present Not Present |
| you use verbal language and other cues such as body language appropriate in style, tone, and level of complexity to the audience and the occasion | Present Not Present |
| you speak clearly and communicates a message | Present Not Present |
| your delivery holds audience attention; you are energetic and enthusiastic | Present Not Present |
| innovation plan communicates business initiatives and solutions | Present Not Present |

## Performance Assessment Task: Prototyping Careers - Job Search Strategies

### Directions

Presenting your strengths as a prototype designer is an essential employability skill. Being able to speak confidently about your work, your approach to design, and your successes is one of the best ways for you to "sell" your self to an employer.

For this assessment, you will be selecting the best sketches from your sketch book and presenting them to the entire class. Your presentation should be no more than 7 minutes and should include:

* Clear images of your sketches (on PowerPoint, Keynote, Sway or another presentation software that you can access from the internet)
* Clearly labeled images
* Color, indications of scale, legends where appropriate
* Purpose of prototype
* Story of your thought process (your design thinking) regarding each sketch
* Features of each sketch
* The iterations of your sketches (re-imaginings, changes)
* Any feedback from your design team
* Final decisions/thoughts about each sketch

*\* Criteria listed with a letter or letter/number combination (such as A, A.2, D.1, etc.) are those specifically requested by business partners who hire and employ individuals with prototype design skills.*

### Environment: Classroom

### Evaluator(s)

* Instructor
* Other

### Target Course Competencies

* Evaluate prototyping careers in business and industry.

### Scoring Guide

| **Criteria** | **Ratings** |
| --- | --- |
| **Evaluate prototyping careers in business and industry.**  |  |
| you present information in a style and tone consistent with the audience's level of interest and level of knowledge or understanding | Present Not Present |
| your delivery holds audience attention; you are energetic and enthusiastic | Present Not Present |
| portfolio includes at least 10 items | Present Not Present |
| portfolio is appropriate for information presented | Present Not Present |
| sketches are titled | Present Not Present |
| sketches are labeled | Present Not Present |
| sketches include colors and/or textures to increase readability | Present Not Present |
| sketches give a reasonable interpretation of the prototype/solution | Present Not Present |
| you speak clearly and communicates a message | Present Not Present |
| you combine ideas or information in new ways | Present Not Present |
| sketches/explanation consider the human, interpersonal, and factual dimensions of a problem | Present Not Present |
| D. Create Prototype Design | Present Not Present |
| D.6 Modify existing prototype design | Present Not Present |
| D.9 Create final prototype design | Present Not Present |

## Performance Assessment Task: Concepts of Iterative Design - Portfolio

### Directions

When seeking employment in technical fields, it is common to encounter employers who expect job seekers to have a portfolio of their work experience. Whether animated and online or an in-person collection of tangible artifacts, having a portfolio of your work allows you to demonstrate your skill and competence to an employer. It's proof of what you've learned, showcases ways that you have used what you've learned. Creating a professional portfolio is also a way for you to keep track of what you've learned, what you've created, as well as skills and techniques you've gained along the way.

For this assessment, you'll use the example work portfolio that your instructor provides as a model to follow for creating your own. Be sure to include clearly notated sketches from your weekly assignments.

*\* Criteria listed with a letter or letter/number combination (such as A, A.2, D.1, etc.) are those specifically requested by business partners who hire and employ individuals with prototype design skills.*

### Environment: Classroom

### Evaluator(s)

* Employer
* Instructor
* Peer
* Self

### Target Course Competencies

* Apply concepts of iterative design to the prototyping process.

### Target General Education Outcomes

* Communication
* Critical thinking

### Scoring Guide

| **Criteria** | **Ratings** |
| --- | --- |
| **Apply concepts of iterative design to the prototyping process.** |  |
| prototype addresses an existing problem | Present Not Present |
| prototype meets standards set by client-peer | Present Not Present |
| you present a drawing of your prototype  | Present Not Present |
| prototype is clearly labeled | Present Not Present |
| prototype is described in detail | Present Not Present |
| prototype is revised using client-peer feedback | Present Not Present |
| portfolio contains prototype designs that solve problems | Present Not Present |
| portfolio contains prototype designs that use unique approaches/solutions | Present Not Present |
| portfolio contains prototype designs that uses two - three types of media | Present Not Present |
| portfolio contains prototype designs that include explanations of design choices and thought processes | Present Not Present |
| portfolio clearly shows improvement in prototype designs | Present Not Present |
| learner assesses the value or importance of positions, policies, and formulated solutions | Present Not Present |
| prototype includes correct grammar and punctuation | Present Not Present |
| learner employs good mechanics and craftsmanship | Present Not Present |
| portfolio follows instructor's standards for professional quality | Present Not Present |

## Performance Assessment Task: Equipment, Tools, and Materials - Physical Prototype

### Directions

After ideation and iterative sketching, it's time to give your concepts some form. The purpose of this assessment is to determine how well you can use equipment, tools, and materials to create physical prototypes. The goal is for you to create three dimensional representations of your ideas to continue refining your solutions adjusting how the solutions works and can work based on experiments in laser cutting, 3D scanning, 3D printing, sanding and other equipment processes.

* In your design team, create a design plan for your physical prototype.
* Consult with your instructor regarding your plan.
* Adjust your plan as necessary based on your instructor's recommendations.
* Follow the safe use of equipment, tools, and materials to build a physical prototype.
* Use feedback from peers and your instructor to make improvements to your physical prototype.
* Apply the iterative design process until you have a reasonable representation of your concept.

*\* Criteria listed with a letter or letter/number combination (such as A, A.2, D.1, etc.) are those specifically requested by business partners who hire and employ individuals with prototype design skills.*

### Environment: Lab

### Evaluator(s)

* Instructor

### Target Course Competencies

Use equipment, tools, and materials to produce prototypes.

### Target General Education Outcomes

* Communication
* Critical thinking

### Scoring Guide

| **Criteria** | **Ratings** |
| --- | --- |
| **Use equipment, tools, and materials to produce prototypes.**  |  |
| learner participates in groups using a variety of collaborative techniques | Present Not Present |
| learner interprets and evaluates statements, theories, problems, and observations from different points of view or perspectives | Present Not Present |
| physical prototype evidences skills applied from the Software Learning Plan | Present Not Present |
| physical prototype was built using appropriate method | Present Not Present |
| physical prototype (and/or documentation) shows evidence of group input | Present Not Present |
| physical prototype was built according to the specifications design plan | Present Not Present |
| physical prototype was built following safety processes and procedures | Present Not Present |
| A. Compile Prototype Specifications | Present Not Present |
| A.2 Define prototype end use purpose | Present Not Present |
| A.3 Document prototype specifications | Present Not Present |
| A.4 Conduct prototype background research (e.g., patents and existing products) | Present Not Present |
| A.5 Review prototype models and samples | Present Not Present |
| B. Develop Prototype Project Plan | Present Not Present |
| D.1 Collaborate on prototype design ideas | Present Not Present |
| D.7 Select prototype design materials | Present Not Present |

## Performance Assessment Task: Low-Volume Manufacturing - Matching Products

### Directions

Designing low-volume products often requires give and take regarding process limitations, quality, and speed of development. For this assessment, your design team will select a product and then replicate the process several times to create five or more matching products.

In your design team, apply successful meeting and teamwork strategies to:

* Select a product to reproduce.
* Create a design plan.
* Consult with your instructor regarding the design plan.
* Incorporate any necessary changes/suggestions from your instructor.
* Use paper prototyping and software as necessary to create a prototype.
* Select the appropriate equipment, tools, and materials for your product.
* Apply safety processes and procedures.
* Use the process of iterative design to move from prototype to product.
* Create 5 or more matching products.

*\* Criteria listed with a letter or letter/number combination (such as A, A.2, D.1, etc.) are those specifically requested by business partners who hire and employ individuals with prototype design skills.*

### Environment: Lab

### Evaluator(s)

* Instructor
* Peer

### Target Course Competencies

Use the process of low-volume manufacturing to produce products.

### Target General Education Outcomes

* Communication
* Critical thinking

### Scoring Guide

| **Criteria** | **Ratings** |
| --- | --- |
| **Use the process of low-volume manufacturing to produce products.**  |  |
| learner participates in groups using a variety of collaborative techniques | Present Not Present |
| learner uses imagination, intuition and divergent thinking | Present Not Present |
| products are the result of teamwork | Present Not Present |
| products were created based on the safe use of equipment, tools, and materials | Present Not Present |
| products were produced based on specifications and criteria in the design plan | Present Not Present |
| products were created with an element of complexity (according to instructor's direction) | Present Not Present |
| products match and meet the criteria for low-volume manufacturing | Present Not Present |

## Learning Plan: Design Challenges and Design Thinking

### Overview/Purpose

The purpose of this Learning Plan is to provide you with immediate, hands-on experience regarding the process of prototyping, designing for clients/customers, and the iterative design process.

### Target Competencies

#### Solve prototype design challenges using design thinking.

##### Assessment Strategies

* Product: Paper Prototype

##### Criteria: You will know you are successful when:

* paper prototype meets client specifications
* paper prototype shows improvement
* paper prototype includes your individual contribution to the processes

##### Learning Objectives

* Explain design thinking.
* Conduct an end-user interview.
* Sketch a prototype based on an end user interview.
* Build a prototype based on an end user interview and feedback.

### Learning Activities

DISCUSS concepts of prototyping

 **Learning Materials**

 [What is Design Thinking](https://www.youtube.com/watch?v=a7sEoEvT8l8&feature=youtu.be) (https://www.youtube.com/watch?v=a7sEoEvT8l8&feature=youtu.be)

DISCUSS concepts of iterative design

CREATE a prototype sketch. COMPLETE phase one of the *dSchool* prototyping session.

CREATE a prototype model. COMPLETE phase two of the *dSchool* prototyping session.

PRESENT prototype designs to client.

RE-DESIGN prototype based on client specifications.

REVIEW the prototype of a peer in the course.

COMPLETE User Experience Evaluation.

### Assessment Activities

OBSERVATION by instructor.

REVIEW by Peer.

 **Learning Materials**

 [INFO 1951 Peer Review Form](https://mccneb.wids.org/PublicDocuments.axd?DocumentID=fc70c305-0426-4b3d-9db0-279182a459e6) (INFO 1951 Peer Review Form.docx)

COMPLETE the *Design challenges and Design Thinking Assessment Task*. SUBMIT the sketches and resulting paper prototype to your instructor.

## Learning Plan: Sketching Techniques

### Overview/Purpose

Drawing is an important part of the prototype design process. The road to executing a good idea often starts with putting pencil to paper to capture initial thoughts and ideas. It's not necessary to be an artist or to have high skills in sketching to create drawing that will help you move forward with your ideas. The effort of thinking visually and recording your visual thoughts, however they come to you, is enough to get started.

### Target Competencies

#### Use sketching techniques to create prototypes.

##### Assessment Strategies

##### Criteria: You will know you are successful when:

* sketch combines ideas or information in new ways
* sketch facilitates the contributions of team members
* sketch communicates the purpose/idea of the project
* sketch evidences knowledge of the intended audience
* sketch was created using a logical structure
* sketch shows evidence of refinement from past iterations
* sketch makes use of text, symbols, and visual orientation
* sketch includes design team name, date, and assignment #

##### Learning Objectives

* Define prototype sketching.
* Explain the purpose of sketching in prototyping.
* Describe the most appropriate materials and tools for sketching.
* Describe the importance of input from client/end user.
* Explain sketches and the methods used to create them.
* Select symbols, color, views, dimensions, and scale to enhance sketches
* Question the necessity of perfection
* Explain a 3D sketch in 2D by using coordinates and axes

### Learning Activities

1. REVIEW online sketching videos.
2. PRACTICE sketching.
3. MODIFY sketches based on peer feedback.
4. USE tools and materials to create sketches.

### Assessment Activities

* COMPLETE Sketches Handout Form and turn it in to your instructor.
* DISCUSS concepts of sketching to create prototypes.

## Learning Plan: Using Software to Create Prototypes

### Overview/Purpose

Computer-aided design is an integral part of prototyping. The advantages of creating drawings an illustrations on the computer are the ability to make quick updates, the generous amount of features available in software to make 3D renderings, alter the size of drawings, work on large files, import/export files, and fine-turn your designs with precise tools. Drawing electronically allows you to experiment with portotypes in a way that drawing freehand on paper does not. From image duplication to painting, using online software can be faster, more efficient, and provide you with greater flexibility when exploring your ideas. Also, you never know when a client/customer will request a change in requirements, specifications, cost, purpose, or function of a product. Using a software platform can make responding to those changes a lot less time-consuming.

### Target Competencies

#### Use graphic design software to create prototypes.

##### Assessment Strategies

* Drawing/Illustration: Electronic Drawing of Prototype

##### Criteria: You will know you are successful when:

* the student enters, modifies, retrieves, stores, and verifies data and other information in a computer
* prototype conveys information into the chosen format
* prototype demonstrates the concept it is intended to show
* prototype includes color and labels for clarification
* prototype is neat and attractive

##### Learning Objectives

* Explain the purpose of software in prototyping
* List various software programs used in prototyping
* Identify the most appropriate software for particular prototypes
* Explain how skills from sketch prototyping relate to software prototyping
* Discuss common challenges regarding prototype images
* Explain the process of creating, saving, attaching documents and submitting electronic files
* Incorporate keyboard shortcuts into software use
* Use CorelDraw

### Learning Activities

1. ERASE prototype and RECREATE from scratch.
2. COPY someone else's design and IMPROVE it.
3. WRITE a 1-page paper explaining why the improved design is better.

### Assessment Activities

CREATE prototype sketches with *CorelDraw* and SUBMIT them to your instructor following the Submission Guidelines.

## Learning Plan: Contributing to Business Initiatives

### Learning Activities

1. WATCH a video on effective meeting processes.
2. REVIEW the Effective Meetings handout.
3. CONDUCT a mock meeting with your design team.
4. DEVELOP a team charter with and for your design team.
5. SUMMARIZE the ways in which your *Gallup StrengthsFinder* results will impact your Design Team.
6. DESIGN an A3 form that will meet the needs of your Design Team.
7. USE the A3 form created by your Design Team to address a business problem or challenge.

### Assessment Activities

* CONDUCT a presentation with your Design Team regarding recommendations for solving a business problem using a prototype design process.
* COMPLETE the *Contribution to Business Initiatives Assessment Task*. SUBMIT the innovation plan to your instructor.

## Learning Plan: Careers in Prototyping

### Overview/Purpose

The sooner your start thinking about your career and planning for it, the more meaningful your classes will be. You'll also have an easier transition into your career when you start planning for it early.

The purpose of this Learning Plan is to provide you with an opportunity to explore potential career in the prototype design industry. Use this time to scan job databases, visit the websites of potential employers, and enhance your job seeking skills.

A Career Skills Coach will be available to help you with research as will as resume, cover letter, and mock interviewing techniques. The goal of this learning session is to help you build the skills and confidence necessary to speak to employers about your work in prototype design.

### Target Competencies

#### Evaluate prototyping careers in business and industry.

##### Assessment Strategies

* Sketchbook Presentation: Prototyping Careers

##### Criteria: You will know you are successful when:

* you present information in a style and tone consistent with the audience's level of interest and level of knowledge or understanding
* your delivery holds audience attention; you are energetic and enthusiastic
* portfolio includes at least 10 items
* portfolio is appropriate for information presented
* sketches are titled
* sketches are labeled
* sketches include colors and/or textures to increase readability
* sketches give a reasonable interpretation of the prototype/solution
* you speak clearly and communicates a message
* you combine ideas or information in new ways
* sketches/explanation consider the human, interpersonal, and factual dimensions of a problem
* D. Create Prototype Design
* D.6 Modify existing prototype design
* D.9 Create final prototype design

##### Learning Objectives

* Research prototype design careers.
* Summarize the job duties of a prototype design technician.
* Identify aspects of the prototype design career for further study.
* Review the MCC Career Services Portal.
* Explore job search strategies.
* Explore job interviewing strategies.
* Select sketches to include in course portfolio.

### Learning Activities

1. ATTEND in-class business partner speaker presentation
2. TAKE A TOUR of a manufacturing facility. Tour will be arranged by the instructor.
3. ATTEND the in-class career presentation made by MCC Career Skills Coach.

**Learning Materials**

Job Interview Questions and Answers

Interview Dos and Don'ts

1. MEET with a Career Skills Coach to discuss careers in prototype design.

**Learning Materials**

[What's Your Type? Careers in IT](https://mccneb.wids.org/PublicDocuments.axd?DocumentID=78bae020-960b-4fa1-95fa-9eb7183c0303): What's Your Type Career In IT.pdf

### Assessment Activities

* EXPLAIN the design choices you've made regarding the prototype sketches in your *sketchbook* to the class and any guest/visitors. USE the *sketchbook portfolio specifications document* provided by your instructor to create your portfolio.

## Learning Plan: Concepts of Iterative Design

### Overview/Purpose

The purpose of this Lesson Plan is to provide you with an opportunity to create a professional portfolio of your work in this class that can be used during a job interview for a prototype design technician position or can be kept as a record of your learning and skills application in designing prototypes.

### Target Competencies

#### Apply concepts of iterative design to the prototyping process.

##### Assessment Strategies

* Product: Prototype(s) in multiple stages

##### Criteria: You will know you are successful when:

* prototype addresses an existing problem
* prototype meets standards set by client-peer
* you present a drawing of your prototype
* prototype is clearly labeled
* prototype is described in detail
* prototype is revised using client-peer feedback
* portfolio contains prototype designs that solve problems
* portfolio contains prototype designs that use unique approaches/solutions
* portfolio contains prototype designs that uses two - three types of media
* portfolio contains prototype designs that include explanations of design choices and thought processes
* portfolio clearly shows improvement in prototype designs
* prototype includes correct grammar and punctuation
* portfolio follows instructor's standards for professional quality

##### Learning Objectives

* Summarize the history of design.
* Define prototype design.
* Describe the types of prototyping.
* Identify tools and equipment used in prototype design.
* Define the scope of a work portfolio
* Explain the process used to construct a prototype portfolio.
* Discuss concepts of iterative design.
* Define improvement and relate the definition to prototype design.
* Explain ways to notate a prototype portfolio.

### Learning Activities

CREATE a prototype of a prototype portfolio.

**Learning Materials**

*Instructor's Portfolio/Sketchbook Examples*

### Assessment Activities

SUBMIT weekly portfolio additions to your instructor for review.

## Learning Plan: Equipment, Tools, and Materials

### Overview/Purpose

The purpose of the Learning Plan is to help you develop the skills to take concepts and designs and transform them into physical prototypes. In order to accomplish this, you must first be aware of the various pieces of equipment, tools, and materials available to you. In addition, you'll have an opportunity to experience how the equipment, tools, and materials function as well as the guidelines that are necessary to keep yourself and others safe while you're using tools and equipment in the lab.

### Target Competencies

#### Use equipment, tools, and materials to produce prototypes.

##### Assessment Strategies

* Product: Physical Prototype

##### Criteria: You will know you are successful when:

* physical prototype evidences skills applied from the Software Learning Plan
* physical prototype was built using appropriate method
* physical prototype (and/or documentation) shows evidence of group input
* physical prototype was built according to the specifications design plan
* physical prototype was built following safety processes and procedures
* A. Compile Prototype Specifications
* A.2 Define prototype end use purpose
* A.3 Document prototype specifications
* A.4 Conduct prototype background research (e.g., patents and existing products)
* A.5 Review prototype models and samples
* B. Develop Prototype Project Plan
* D.1 Collaborate on prototype design ideas
* D.7 Select prototype design materials

##### Learning Objectives

* Explain the concepts of physical prototyping.
* List various equipment, tools and materials used in physical prototyping.
* Identify the most appropriate equipment, tools and materials for particular prototypes.
* Explain skills from sketch and software prototyping relate to physical prototyping.
* List common challenges with producing physical prototypes.
* Determine solutions to problems with physical prototypes.
* Explain the process of finishing physical prototypes.
* Describe the safe use of FabLab equipment, tools, and materials.

### Learning Activities

1. REVERSE-ENGINEER a prototype selected by your instructor. LIST the process, materials, tools, and equipment that were used to create the prototype.
2. TAKE the lab safety training.
3. VIEW the equipment, tools, and materials how-to and informational videos.
4. OBSERVE a demonstration on the proper use of equipment, tools, and materials in the lab.
5. PRACTICE using the equipment, tools, and materials as directed by your instructor.
6. REVIEW a sample *Specifications Plan*. DISCUSS the contents of the plan within your design team and CREATE a similar plan for a physical prototype.

### Assessment Activities

* COMPLETE the *Equipment, Tools, and Materials Performance Assessment Task.* SUBMIT the resulting physical prototype to your instructor.

## Learning Plan: Low-Volume Manufacturing

### Overview/Purpose

When the process of manufacture first began, trades people and their apprentices created products by hand, one-by-one. As manufacturing processes and equipment improved and the demand for goods and services grew, the concept of mass production emerged as a solution to those challenges. However, there are still times when businesses have a need to produce a small number of products. Prototype Design Specialists and those who work in this field can help businesses meet that need by using a method called low-volume manufacturing.

### Target Competencies

#### Use the process of low-volume manufacturing to produce products.

##### Assessment Strategies

* Product: Five or More Matching Products

##### Criteria

* products are the result of teamwork
* products were created based on the safe use of equipment, tools, and materials
* products were produced based on specifications and criteria in the design plan
* products were created with an element of complexity (according to instructor's direction)
* products match and meet the criteria for low-volume manufacturing

##### Learning Objectives

* Explain the concepts of low-volume manufacturing.
* List various equipment, tools and materials used in low-volume manufacturing.
* Identify the most appropriate equipment, tools and materials for particular production.
* Explain how skills from sketch and software prototyping relate to LVM.
* List common challenges with low-volume manufacturing.
* Explain the process of building matching products.

### Learning Activities

1. DISCUSS the concepts of low-volume manufacturing.
2. EXPLAIN quality concerns and Statistical Process Control concepts.
3. BRAINSTORM ways to reduce waste and rework.
4. DESCRIBE several manufacturing processes such as casting, forming, cutting, and joining.
5. CREATE a list of *low-volume manufacturing criteria* based on in-class discussions and reference materials.
6. EVALUATE examples of low-volume manufacturing and DETERMINE if the examples meet the criteria of low-volume manufacturing.

### Assessment Activities

SUBMIT your *low-volume manufacturing criteria list* to your instructor for review.

COMPLETE the *Low-Volume Manufacturing Assessment*. SELF-ASSESS your team's ability to meet the criteria specified on your *Low-Volume Manufacturing Criteria List*.

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