South Dakota Architecture and Construction

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Mitchell

Participants:

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Participants introduced themselves stating name, location, and curricular area of expertise.

An introductory video, *Success in the New Economy* written and narrated by Kevin Fleming and produced by Bryan Y. Marsh, was shared. This video (available on the Internet at https://vimeo.com/67277269), describes a fallacy in the traditional "college for all" model of education and encourages individuals to select career paths based on interests and skills.

It was noted that the purpose of the work was to review South Dakota's state standards for architecture and construction to ensure that they:

- Are aligned with industry needs
- Prepare students to be successful in employment and in postsecondary training
- Establish a sequence of courses leading to completion of a program of study.

It was clarified that standards describe "what" is to be learned, not "how" it is to be learned.

Program of study was defined as:

- A nonduplicative sequence of both academic and technical courses
- Beginning no later than grade 11 and continuing for at least two years beyond high school
- Culminating in a degree, diploma or certification recognized as valuable by business/industry partners.

A program of study was viewed as the bridge connecting preparatory and advanced work in high school with further study at the postsecondary level through a collegiate program or advanced training through work.

A summary of a recent labor market analysis for South Dakota was presented, with separate slides shown identifying the 20 largest industry clusters, the fastest growing industry clusters by percentage growth and increase in employment demand, and the occupations with a projected demand of 50 or more.

Participants were asked to identify industry trends by describing what was new in the industry, what is emerging in the industry but not yet routinely practiced, and what is no longer done in the industry. It

was intended that this information would guide discussion about where new standards were needed and where existing standards could be deleted. For architecture and construction the discussion suggested:

New

- Use of Computer Aided Drafting (CAD)
  - Sketch Up
  - Auto CAD/Inventor
  - Solid Works
  - Revit
  - Archi-CAD
- Specialization in construction
  - Drywall, but not taping or texture
  - Masonry – poured walls, flat work
- Prefabrication of components
  - Trusses
  - Joists
  - Walls
- Engineered materials
  - Structural insulated panels
  - Plywood treated to eliminates need for house wrap
  - I-joists
  - Insulated concrete
- Computer Numerical Control (CNC) cabinetmaking
  - Custom cabinetry
  - Hand tool assembly

Emerging

- [No specific notes other than those shown as "new" above]

No longer done

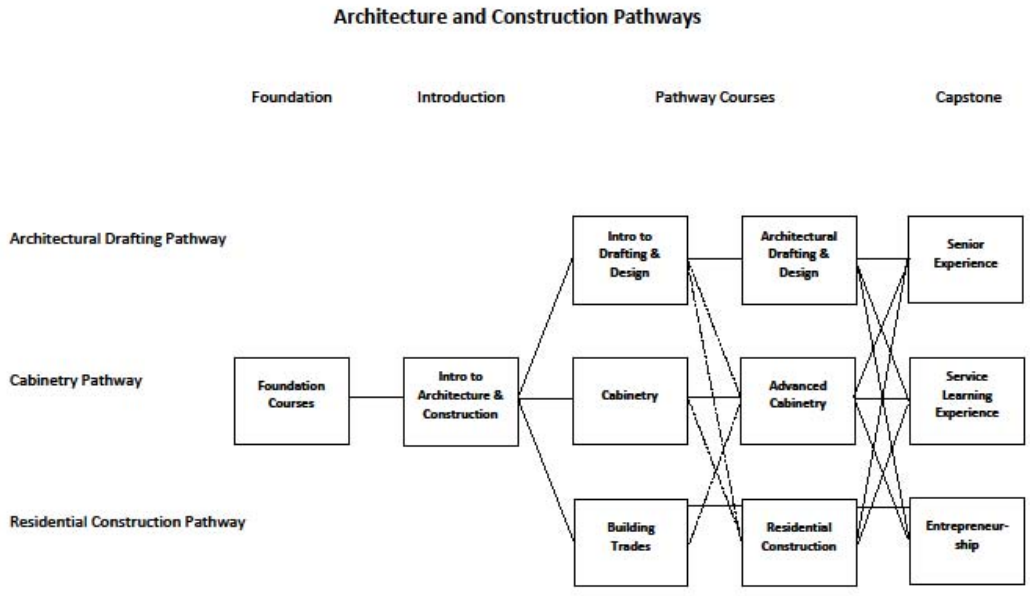
- Line weight [in drafting]

Results of a recent survey of employers were shared. The survey was designed to ascertain if employers were having hiring difficulties, if applicants were deficient in either soft or technical skills, and options for a state response. 140 survey responses were included in the results with largest participation from hospitality and tourism (30), architecture and construction (19), manufacturing (15), agriculture, food and natural resources (14), and transportation, distribution and logistics (10). In general:

- Four out of five employers noted having hiring difficulties in the previous 12 months.
- Primary reasons for this hiring difficulty were:
  - Low number of applicants (97)
  - Lack of work experience (67)
  - Lack of technical or occupational skills (34)
  - Inability to pass drug tests or having a criminal record (30)
  - Unwillingness to accept offered wages (29)
- Occupational areas noting the greatest hiring difficulties were hospitality (20), architecture & construction (16) and manufacturing (14) though these results are skewed by the response rate from the individual sector
- The most highly noted soft skills lacking were:
  - Initiative (85)

    - Attendance/dependability (84)
    - Communications (74)
    - Customer service (64)
    - Problem solving (55)
- Similarly, employers noted the highest needs for additional training in:
    - Attendance/timeliness/work ethic (75%)
    - Customer service (58%)
    - Problem-solving (53%)
    - Teamwork (41%)
- Two out of five employers noted that applicants lacked technical skills.
- Employers asked that the state response focus on:
    - Promotion of opportunities (11)
    - Teaching of ethics (11)
    - Teaching soft skills (6)

The current state program of study in architecture and construction was reviewed and participants were asked to chart out a new program of study incorporating course titles for which standards would be developed. The process involved placing course titles on post-it notes on the wall with an open process to place courses where deemed appropriate, remove courses not considered appropriate, and add courses deemed necessary. The resulting structure is shown in the chart below and includes foundation courses, a single introductory course to the cluster, two levels of pathway courses in three separate pathways (architectural drafting and design, cabinetry, and residential construction), followed by a capstone experience. The structure gives students latitude to move from beginning pathway courses in one pathway to advanced pathway courses in another pathway except for architectural drafting and design where the introductory course is considered prerequisite for the advanced course.



As a final review of the course structure outlined in the program of study, the postsecondary partners in the group were asked to brainstorm what skills they were seeking from high school students who had completed the program of study, and high school participants were asked to brainstorm what skills they were seeking from students entering the cluster from the foundation course experience. This process ensured that the end points of standards development met the target to continue in the program of study at the next level. Participants were also asked to brainstorm community-based experiences that might strengthen the learning to give guidance to work-based opportunities in the standards development. The results of that brainstorming showed:

Postsecondary partners want:

- Knowledge and experience with drawing tools, both hardware and software
- Retaining experience with board drawing skills
    - Geometric construction
    - Orthographic projection
    - Isometric drawings
    - Perspective
- Understanding electronic drawing concepts
    - Ability to visualize – thinking in multiple ways
    - Background information/management planning
- Basic business concepts
    - Construction business
    - Business relations within the community
    - Employment benefits
    - Sub-contracting
- Knowledge of energy ratings
    - Green construction – materials, worksite, alternative energy
- Safety certification
    - OSHA-10
    - Career Safe
- Career development – awareness of commercial construction

High school partners want:

- Basic CAD concepts
    - Understanding of X-Y-Z coordinates
    - G-code [the most commonly used numerical control programming language]
    - Some programming

Information was provided about what makes good standards. These criteria included:

- Essential – does it define knowledge and skills that an individual must have to participate fully and effectively in programs that prepare them to enter careers with livable salaries, and to engage in career advancement in growing, sustainable industries?
- Rigorous – does it ask a student to demonstrate deep conceptual understanding through the application of knowledge and skills to new situations?
- Clear and specific – does it convey a level of performance without being overly prescriptive? Is it written in a way that the general public would understand?
- Teachable and Learnable – does it provide guidance to the development of curricula and instructional materials? Is it reasonable in scope?

- Measurable – Can it be determined by observation or other means that the student has gained the knowledge and skills to be demonstrated to show attainment of the standard?
- Coherent – Does it fit within the progression of learning that is expected for the program of study?
- Sequential – Does it reinforce prior learning without being unnecessarily repetitive? Does it provide knowledge and skills that will be useful as the student continues through the program of study?
- Benchmarked – Can the standard be benchmarked against industry or international standards? Does it prepare the student to be successful in the regional, state and global economies?

State agency staff met in May to review the processes to be used for standards review. During that session the staff identified other criteria to be considered when writing standards:

- Connections to postsecondary programs
- Relevant across the content area
- Compatible with virtual learning
- Reflects business/industry input
- Adaptable to change over time
- Allows for instructional creativity
- Appropriate for the target audience
- Aligned with relevant academic content
- Applicable to student organizations
- Recognizes unique features of CTE

These additional criteria were shared with participants for their consideration during standards development.

Participants were encouraged to identify a "big picture" concept statement describing what was to be accomplished within the course before developing standards. This "big picture" statement would eventually be revised to be an executive summary statement at the time that the standards were drafted.

A Standards Template was shared with the participants. A template was completed for each course. The elements of the template were reviewed with the group:

- The course title was inserted at the top.
- A grid of administrative information was completed to the extent the information was known. This grid included:
    - The Career Cluster [Architecture and Construction]
    - The Course Code
    - Any prerequisites or recommended prior coursework
    - Credits [generally established by the individual school district]
    - Graduation requirement [generally established by the individual school district]
    - Program of study and sequence [a listing of the components of the program of study]
    - Student organization
    - Coordinating work-based learning [refer to spectrum of work-based learning activities]
    - Industry certifications [if appropriate for the course]
    - Dual credit or dual enrollment
    - Teacher certification requirements
    - Resources

- Course description. Eventually this will be an executive summary describing the course, but in the process participants were encouraged to develop a "big picture" statement about the course to serve as a reminder when developing standards.
- Program of study application: a more detailed description of the elements within the program of study and where the particular course fits within a sequence.
- Course Standards and prods
    - "Prods" is a list of topics to keep in mind when developing standards to see that related topics are included. The prods identified by state staff include:
        - Safety
        - Soft skills
        - Reinforcing academic concepts in math, language arts, science and social studies
        - Addressing all aspects of the industry
        - Trends [so that students are thinking of the direction that an industry is moving]
    - Indicators – the main topics written in terms of a demonstration of knowledge and skills
    - Sub-indicators – statements identifying in more detail how the indicator will be demonstrated
    - Integrated content – A space that allows for examples, explanation, reference to credentials, alignment with other academic standards or other useful information to bring clarity to the understanding about the intent of the sub-indicator
    - Notes – a place for additional information to clarify the intent and expectations of the indicator.

An example was shared to ensure understanding.

Working teams of 3 to 4 individuals were then established to write the standards. Each team selected a course to begin the work, and added additional courses as work progressed. Early drafts were reviewed by the consultants and participants were led with guiding questions so that they could refine their own work. Eventually, when all standards had been developed for all courses, the participants did a final group review of all standards to give their approval. Final documents were then reviewed by the consultants for format and structure, and saved to the shared Dropbox. Participants were given two weeks to make any final comments or suggestions, at which time the Dropbox was put into a "read-only" status.

For Architecture and Construction, the following course standards were developed:

Introduction to Architecture and Construction

IAC 1 Explore the different career opportunities involved in the architecture and construction industries.

IAC 1.1 Compare career possibilities in the drafting industry.

IAC 1.2 Investigate and examine career opportunities in cabinetry industry

IAC 1.3 Research career opportunities in the architecture and construction fields.

IAC 2 Introduce safety concepts in the architecture and construction industries.

IAC 2.1 Apply general shop safety principles

IAC 2.2 Identify job site and career safety concepts

IAC 2.3 Define OSHA (Occupational Safety Health Administration) and its role in the construction industries

IAC 2.4 Apply general hand and power tool safety procedures

IAC 3 Apply basic math principles used in the architecture and construction industries.

IAC 3.1 Demonstrate proper use of appropriate math skills

IAC 3.2 Demonstrate proper measuring and layout skills

IAC 4 Recognize the materials used in the architecture and construction industries.
- IAC 4.1 Identify wood species and engineered building materials.
- IAC 4.2 Recognize proper application of fasteners, adhesives, and hardware.
- IAC 4.3 Explore new upcoming materials used in building industry.

IAC 5 Examine Basic drafting skills used in architecture and construction.
- IAC 5.1 Recognize basic drafting terms and abbreviations
- IAC 5.2 Differentiate between different drafting styles
- IAC 5.3 Identify different aspects of blueprints/project plans to show a working knowledge of specifications.
- IAC 5.4 Classify the different styles of residential architectural structures

IAC 6 Display skills needed in architecture and construction industries.
- IAC6.1 Apply proper measuring and cutting techniques to perform job related tasks
- IAC 6.2 Display a working knowledge of tools and equipment used in the industry
- IAC 6.3 Construct a project using the assigned design process
- IAC 6.4 Demonstrate necessary job skills needed in architecture and construction industries

Introduction to Drafting and Design

IDD 1 Examine basic drafting terminology and equipment.
- IDD 1.1 Recognize basic drafting terms and abbreviations.
- IDD 1.2 Differentiate basic drafting tools and their uses.

IDD 2 Apply basic math skills to design work.
- IDD 2.1 Apply algebraic and trigonometric formulas used in drafting and design.
- IDD 2.2 Understand the various drawing scales used in drafting.

IDD 3 Examine basic drafting fundamental and technical skills
- IDD 3.1 Integrate symbols, lettering and Geometric shapes used on technical drawings.
- IDD 3.2 Illustrate line types recommended by American National Standards Institute (ANSI).
- IDD 3.3 Define dimensioning styles and techniques on metric and imperial drawings.

IDD 4 Apply drawing techniques to produce various technical plans.
- IDD 4.1 Create orthographic projections
- IDD 4.2 Create isometric and pictorial drawings.

IDD 5 Implement computer aided software into design work.
- IDD 5.1 Identify CAD skills and applications of technical design.
- IDD 5.2 Apply CAD defaults and preferences to set up a drawing.
- IDD 5.3 Generate drawings and projections using CAD software.

IDD 6 Explore career-ready practices.
- IDD 6.1 Understand professional drafting practices in the workplace and communication skills.
- IDD 6.2 Compare career possibilities in the drafting industry.

Architectural Drafting and Design

ADD 1 Understand architectural design fundamentals and history.
- ADD 1.1 Identify architectural products and styles.
- ADD 1.2 Interpret the fundamentals of framing plans.
- ADD 1.3 Identify building codes and governing bodies.
- ADD 1.4 Identify residential building materials

ADD 2 Understand drawing management, dimensioning, and notations.
- ADD 2.1 Examine drawing identification and management techniques used in architectural drafting.
- ADD 2.2 Illustrate proper dimensioning and notation practices used in architectural drafting.

ADD 3 Develop a residential plot and foundation system plan.

ADD 3.1 Create a plot/site plan for a residence.

ADD 3.2 Design footings and foundation for a residence.

ADD 4 Generate the necessary construction plans to build a residence.

ADD 4.1 Develop a floor plan using accepted symbols and techniques.

ADD 4.2 Prepare a working drawing of the residence HVAC, lights and electrical needs.

ADD 4.3 Design a residential roof plan.

ADD 4.4 Understand the use of elevations in the design of a residence.

ADD 4.5 Draw interior and exterior stair details appropriate to those found in a residence.

ADD 4.6 Develop door, window, and finishing schedules.

ADD 4.7 Understand basic estimating practices used in the construction industry.

ADD 4.8 Generate final presentation drawings and three dimensional computer model.

Cabinetry

C 1: Observe and apply rules and regulations to comply with personal and shop safety.

C1.1 Apply hand/power tool and lab safety standards.

C1.2 Describe and wear appropriate personal protective equipment (PPE) when needed.

C1.3 Indicate a knowledge of government regulations regarding health and safety in the shop.

C 2: Explore the different career opportunities in the industry.

2.1 Investigate and examine career opportunities in cabinetry industry

2.2 Demonstrate an understanding of necessary job skills needed in cabinetry careers

C 3: Apply basic math principles used in the industry.

3.1 Demonstrate proper use of appropriate math skills

3.2 Demonstrate an understanding of the difference between board feet and linear feet

3.3 Demonstrate proper measuring and layout skills

C 4: Identify various materials and apply project planning.

4.1 Identify wood species and engineered materials.

4.2 Analyze design elements of a project plan

4.3 Create and implement a bill of materials and cut list from a project drawing

4.4 Identify various types of hardware, fasteners, and adhesives used in the cabinetry industry

C 5: Recognize various cabinetry joinery and assembly techniques.

5.1 Demonstrate common joinery techniques

5.2 Demonstrate knowledge of industry concepts to assemble projects

C 6: Recognize and apply surface preparation and finishing techniques.

6.1 Apply surface preparation techniques

6.2 Apply finishing products

Advanced Cabinetry

AC 1 Demonstrate proper rules and regulations to comply with personal and shop safety.

AC 1.1 Apply hand/power/industrial tool and lab safety practices.

AC 1.2 Determine and wear appropriate personal protective equipment (PPE)

AC 1.3 Comply with government regulations regarding health and safety in the shop.

AC 2 Evaluate the career market that surrounds the cabinetry industry.

2.1 Acquire career information and demonstrate knowledge of the career-planning process

2.2 Identify individual career goals in the cabinetry industry.

2.3 Enhance the development of employment readiness skills

AC 3 Utilize advanced math skills, formulas, and principles used in cabinetry.

AC 3.1 Apply geometric formulas to determine areas of various structures

AC 3.2 Apply appropriate formulas to determine percentages/decimals
AC 3.3 Apply appropriate formulas to determine ratios, fractions, and proportion measures
AC 3.4 Apply appropriate formulas to determine measurement of dimensions, spaces, and structures
AC 3.5 Develop a model that shows the conceptual understanding of a three-dimensional form from a two-dimensional drawing
AC 3.6 Define the X,Y,Z coordinates involved in common Computer numeric control (CNC) applications

AC 4 Identify various materials and evaluate the proper application in project planning.
AC 4.1 Differentiate various cabinetry materials and their appropriate applications
AC 4.2 Identify the common grades of lumber and sheet goods
AC 4.3 Describe and identify natural defects in woods
AC 4.4 Utilize proper storage and handling techniques

AC 5 Demonstrate advanced skills and techniques used in industry.
AC 5.1 Determine plumb, level, and square
AC 5.2 Demonstrate proper techniques used in various sawing, shaping, carving, molding, and routing applications.
AC 5.3 Apply fabricating techniques of various cabinet parts
AC 5.4 Differentiate between different styles in cabinets, doors, and drawers
AC 5.5 Identify and create the basic wood and mechanical joints used in cabinetry.

AC 6 Demonstrate the use of cabinet fasteners and hardware
AC 6.1 Determine proper application and use of mechanical fasteners and adhesives
AC 6.2 Analyze different hinge systems and their applications
AC 6.3 Analyze various drawer glides and their appropriate applications

AC 7 Demonstrate proper assembly and finish preparation techniques
AC 7.1 Develop logical assembly process/procedure
AC 7.2 Demonstrate various ways to remove excess adhesive
AC 7.3 Apply surface preparation skills before finishing

AC 8 Demonstrate the use of finishing materials and processes.
AC 8.1 Explain the purpose and applications of various types of finishes and finishing processes
AC 8.2 Develop and follow a finishing schedule
AC 8.3 Utilize safe and approved methods for cleanup and disposal
- Occupational Safety and Health Administration (OSHA)
- Environmental Protection Agency (EPA)
- Department of Environment and Natural Resources (DENR)

Building Trades

BT 1: Understand and Apply Industry Safety Procedures
BT1.1 Identify and demonstrate the proper industry safety standards.

BT 2: Utilize appropriate industry math skills and formulas
BT2.1 Understand and demonstrate basic math skills and formulas.

BT 3: Identify and correctly use appropriate hand, power, and pneumatic tools
BT3.1 Demonstrate safe and proper use of hand tools.
BT3.2 Demonstrate safe and proper use of power tools.
BT3.3 Demonstrate safe and proper use of pneumatic tools.

BT 4: Understand blueprint reading and perform basic survey techniques
BT4.1 Demonstrate how to read blueprints.
BT4.2 Demonstrate basic survey techniques.

BT 5: Apply basic organizational, spatial, structural and construction principles of carpentry
- BT 5.1 Demonstrate the understanding of the building process by the building of a construction project.

BT 6: Study principles, standards and applications of plumbing
- BT6.1 Define safety procedures for plumbing
- BT6.2 Distinguish pipe sizes, fittings, adapters, and coupling.
- BT6.3 Demonstrate the use of plumbing materials.

BT 7: Employ basic knowledge and methods of electrical wiring
- BT7.1 Select electrical materials considering safety.
- BT7.2 Identify electrical materials.
- BT7.3 Illustrate uses of electrical materials.

BT 8 Employ basic knowledge and methods of concrete technology
- BT8.1 Identify safe practice associated with concrete materials
- BT8.2 Calculate the various required ingredients used in concrete.
- BT8.3 Employ application of concrete in different situations.

BT 9: Student will participate in career exploration activities
- BT9.1 Research career opportunities in the architecture and construction fields.

Residential Construction

RC 1: Understand and apply industry safety procedures
- RC1.1 Demonstrate proper industry safety standards.

RC 2: Utilize appropriate industry math skills and formulas
- RC2.1 Understand and demonstrate basic math skills.

RC 3: Understand concepts of blueprint reading and perform basic survey techniques
- RC3.1 Demonstrate how to read blueprints.
- RC3.2 Demonstrate survey techniques and site layout.

RC 4: Identify and understand wood building materials, fasteners, and adhesives
- RC4.1 Understand and demonstrate the use of wood building materials.
- RC4.2 Understand and demonstrate the use of fasteners and adhesives.

RC 5: Identify and correctly use appropriate hand, power and pneumatic tools
- RC5.1 Demonstrate safe and proper use of hand tools.
- RC5.2 Demonstrate safe and proper use of power tools.
- RC5.3 Demonstrate safe and proper use of pneumatic tools.

RC 6: Integrate concrete technology to achieve thorough construction background
- RC6.1 Understand and demonstrate the uses of concrete and reinforcing materials.

RC 7: Understand and perform framing of flooring, wall, ceiling and roofing systems
- RC7.1 Understand and demonstrate framing of flooring systems.
- RC7.2 Understand and demonstrate framing of wall and ceiling systems.
- RC7.3 Understand and demonstrate framing of a roofing systems.

RC 8: Understand and demonstrate installation of windows and exterior doors
- RC8.1 Understand and demonstrate installation of windows.
- RC8.2 Understand and demonstrate installation of exterior doors.

RC 9: Identify and perform different exterior finishing methods
- RC9.1 Understand and demonstrate installation of exterior finish.

RC 10: Identify and understand different roofing applications
- RC10.1 Understand and demonstrate installation of roofing materials.

RC 11: Understand the importance of, and properly install, thermal and moisture protection
- RC11.1 Understand and demonstrate installation of thermal and moisture protection.

RC 12: Perform drywall installation and finishing techniques
RC12.1 Understand and demonstrate drywall installation.
RC12.2 Understand and demonstrate drywall finishing.
RC 13: Understand methods and complete interior finish work
RC13.1 Understand and demonstrate interior finishing.
RC 14: Understand the cabinet manufacturing process and install cabinets
RC14.1 Understand basic cabinet design and installation.
RC 15: Understand and demonstrate installation of stairs.
RC15.1 Identify the various types and parts of stairs.
RC15.2 Using appropriate math formula calculate the number and sizes of risers and treads for a stairway.
RC15.3 Layout and cut stringers.
RC 16: Study the principles and standards of Basic Residential Electric and Plumbing applications
RC16.1 Understand and demonstrate basic residential electric and plumbing applications.
RC 17: Student will participate in career exploration activities
RC17.1 Research career opportunities in the Architecture and Construction fields.

A cover letter has been drafted to guide business/industry feedback to the standards developed through this process. The seven standards documents will be reformatted with three columns for business/industry feedback at the sub-indicator level utilizing a 1 (low) to 5 (high) scale:

- Is the sub-indicator essential?
- Is the sub-indicator clear and specific?
- Is the sub-indicator measurable?

Business/industry partners are also asked if the standards reflect the preparation necessary for a student to enter her/his particular occupational field. A sample of the reformatted document follows.

Course Standards

Indicator# IAC 1 Explore the different career opportunities involved in the architecture and construction industries.

			Essential 1 (low) – 5 (high)	Clear and Specific 1 (low) – 5 (high)	Measurable 1 (low) – 5 (high)
Webb Level	*Sub-indicator*	*Integrated Content*			
Two Apply	IAC 1.1 Compare career possibilities in the drafting industry. Examples: • Using SDMyLife career discovery to explore all drafting careers • Visiting the Occupational Outlook Handbook to explore drafting careers				
Two Apply	IAC 1.2 Investigate and examine career opportunities in cabinetry industry Examples: • Using SDMyLife career discovery to explore all cabinetry careers • Visiting the Occupational Outlook Handbook to explore cabinetry careers				
Two Apply	IAC 1.3 Research career opportunities in the architecture and construction fields.				

Following business/industry review, state staff will revise the standards documents as necessary to incorporate business/industry suggestions. The revised documents will be shared with participants in the standards development process and, eventually, with teachers of architecture and construction courses throughout the state for their feedback. Final documents will be taken through public hearings and delivered to the State Board of Education for adoption.