METROPOLITAN COMMUNITY COLLEGE
NEW INSTRUCTIONAL PROGRAM PROPOSAL
NOVEMBER 2016

I. DESCRIPTION INFORMATION

- **Institution Name:** Metropolitan Community College (MCC)
- **Proposed Program Name:** Prototype Design
- **Degrees/credentials to be awarded graduates of the program:** Associate in Applied Science Degree
- **Other programs offered in this field by this institution:** None
- **CIP Code:** 11.0101
- **Administrative units for the program:** 108.0 credit hours
- **Proposed delivery sites/types of delivery:** Fort Omaha Campus, online, on-campus, and hybrid.
- **Date approved by governing board:** The Metropolitan Community College board of Governors approved this program proposal on November 15, 2016.
- **Proposed date (term/year) the program will be initiated:** 2017-2018 academic year
- **Description and purpose of the proposed program:** This program provides students with a mix of business, design, and prototyping concepts in order to gain experience in the prototyping process. Students gain specialized, high-skilled experience to prepare them to work in a technology-savvy workforce that spans across business and industry.
- **Program Requirements:**

Prototype Design (PDTAS)

Award: Associate in Applied Science Degree

Program location: Fort Omaha Campus, Online

This program provides students with a mix of business, design, and prototyping education necessary for prototype development. Students gain specialized, high-skilled experience to prepare them for tech-savvy prototyping work across industries and occupations.

Graduation Requirements	**Credit Hours**
General education	27.0
Major requirements	72.0
Option requirements	9.0
Total credit hours required	**108.0**

General Education Requirements (27.0 credit hrs.)

Course #	Course Name	Credit Hours
Communications		
	English level I	4.5
	English level II	4.5
Humanities/social sciences		
	Humanities/Social Science	4.5
Quantitative/Numeracy Skills		
MATH 1220	Business Mathematics (or higher)	4.5
Other		
HMRL 1010	Human Relations Skills	4.5
INFO 1001	Information Systems and Literacy	4.5

Prototype Design Requirements (72.0 credit hrs.)

Course #	Course Name	Credit Hours
BSAD 1000	Introduction to Business	4.5
BSAD 2420	Production and Operations Management	4.5
DIMA 1305	Concept Development	4.5
DRAF 2100	SolidWorks Fundamentals	9.0
INFO 1011	Project Management	4.5
INFO 1515	Robotics Concepts	4.5
INFO 1951	Introduction to Prototype Design	4.5
INFO 1955	How to Build Almost Anything	4.5
INFO 1965	Rapid Prototyping in the Fab Lab	4.5

INFO 1968	Basic Model Making	4.5
INFO 1950	The Business of Innovation	4.5
INFO 2105	Intermediate SolidWorks	4.5
INFO 2949	Prototype Design Capstone	4.5
PROT 1020	Introduction to Process Operations in Manufacturing Technology	4.5
PROT 2020	Manufacturing Prototyping	4.5

Other requirements for Prototype Design (9.0 credit hrs.)

Choose 9.0 credits

Course #	Course Name	Credit Hours
BSAD 1010	Principles of Marketing	4.5
INFO 1615	Digital Electronic Concepts	4.5
INFO 1962	How to Build an Electric Guitar	4.5
INFO 2265	The Internet of Things	4.5
PROT 1030	Introduction to Quality and Continuous Improvement	4.5

Prototype Design – Recommended Course Sequence

Below is a suggested guide for students planning careers in prototype design after two years of full-time study.

FIRST YEAR

First Quarter

	English Level I	4.5
INFO 1001	Information Systems and Literacy	4.5
INFO 1951	Introduction to Prototype Design	4.5

Second Quarter

	English Level II	4.5
DIMA 1305	Concept Development	4.5
INFO 1955	How to Build Almost Anything	4.5

Third Quarter

BSAD 1000	Introduction to Business	4.5
MATH 1220	Business Math	4.5
PROT 1020	Introduction to Process Operations in Manufacturing Technology	4.5

Fourth Quarter

HMRL 1010	Human Relations Skills	4.5
INFO 1011	Project Management	4.5
INFO 1965	Rapid Prototyping in the FabLab	4.5

Fifth Quarter

DRAF 2100	SolidWorks Fundamentals	9.0
INFO 1515	Introduction to Robotics	4.5

Sixth Quarter

BSAD 2420	Production and Operations Management	4.5
INFO 1950	The Business of Innovation	4.5
INFO 2105	Intermediate SolidWorks	4.5

Seventh Quarter

	Choice	4.5
INFO 1968	Basic Model Making	4.5
PROT 2020	Manufacturing Prototyping	4.5

Eighth Quarter

	Choice	4.5
	Humanities/Social Sciences	4.5
INFO 2949	Prototype Design Capstone	4.5

Course Descriptions

Course	Description
Core Courses - Required	
BSAD 1000--Introduction to Business	This course provides a survey of the structure and functions of the American business system together with and overview of business organization, finance, managerial control, production, distribution, personnel the interdependence of business and government, and consumer business solutions.
BSAD 2420--Production and Operations Management	This course is an overview of the fundamentals of production and operations management used in service and manufacturing organizations. Students study the application of the measurement of productivity and customer service; the planning and management of materials, manpower, and capacity; and the concepts of quality and project management.
DIMA 1305--Concept Development	This course provides a basic introduction to graphic design. It emphasizes creative problem solving through the use of thumbnail and rough sketches.
DRAF 2100—SolidWorks Fundamentals	Students use SolidWorks, a parametric solid modeling and rendering software, to model parts, drawing, and assemblies. Topics include sweep, loft, extrude, and revolve. The course also features top-down assembly modeling. This is a hands-on, project-based course.
INFO 1011--Project Management	Project management is the discipline of defining and managing the vision, tasks, and resources required to complete a project. This course provides a deep dive into the project management process, resource management (time, money, and people,) quality control, communications, and risk. Students complete projects utilizing project management software.
INFO 1515 – Robotics Concepts	This course enables students to construct and program robots or other mechatronic systems that interact directly with prototype design. Students explore the mechanical, electronic, and software aspects of these systems.
INFO 1951--Introduction to Prototype Design	Students review the history of design and design thinking, safety, terminology, tools, materials, software, the iterative prototype development process, and careers/occupations that require prototyping skills. This course introduces concepts related to lean manufacturing such as working in teams, managing effective meetings, and using decision/analysis tools.

INFO 1955--How to Build Almost Anything	This course covers the safe use of hand and power tools to include the proper setup and use of tools. Students learn basic concepts of prototype construction using tools and materials found in the Fabrication Lab. Students complete a project involving all stationary and power tools. Material costs for projects are additional.
INFO 1965--Rapid Prototyping in the Fab Lab	Students use digital tools and techniques relevant to the task of visualizing and prototyping 3-D designs in the Fab Lab. Students review the fundamentals and theory behind rapid prototyping methods; different types of application methods, tools, techniques, and materials; physical limitations of rapid prototyping; and its impact on the design process. Topics include safe use of machines in the Fabrication Lab and microcontroller programming. Students work in small groups to complete a project.
INFO 1968--Basic Model Making	This course explores the processes involving materials, tools, reverse-design workflow, assembling parts, applying adhesives and fillers. Hands-on projects include shaping metals and plastics into complex and intricate parts.
INFO 1950--The Business of Innovation	This course introduces students to the skills needed to innovate what they do as contributors in businesses striving to meet organizational goals. Concepts include ideation, prototyping, and production in support of business goals and organizational objectives. Course reinforces concepts related to lean manufacturing such as working in teams, managing effective meetings, and using decision/analysis tools.
INFO 2105--Intermediate SolidWorks	Projects involving intermediate skills in technical drawing, drafting, tools, best approaches, logical design process and problem solving.
INFO 2949—Prototype Design Capstone	The course integrates key skills obtained throughout the program and students complete projects from ideation to functional prototype. Students incorporate lean manufac-turing concepts such as working in teams, managing effective meetings, and using decision/analysis tools.
PROT 1020--Intro to Process Operations in Manufacturing Technology	This course is designed to introduce students to the process, operations, and theory found in various manufacturing industries. Students become familiar with manufacturing design, production process and flow, production machine operations, and product logistics.
PROT 2020--Manufacturing Prototyping	This class introduces the basic concepts of additive manufacturing (AM), in the past, present, and future. Emphasis is centered on human-centered design, low-volume production, intersection of quality, cost, speed, materials, environmental impacts, and the scale of production.
Option Courses (students choose two)	
BSAD 1010--Principles of	This course features a survey of the distributive fields, their

Marketing	functions, and interrelationships. The course covers the concept and strategies of the marketing mix; the application of marketing concepts in both consumer and business to business environments; and controversial marketing topics, including ethical challenges of advertising.
INFO 1615--Digital Electronics	Students are introduced to semiconductor devices, basic electronic circuits, digital devices, and digital circuits. This course emphasizes to concepts and principles through hands-on activities.
INFO 1962--How to Build an Electric Guitar	In this class, students learn the concepts and topics of mechanical engineering, electronics, CAD design, manufacturing, chemistry, metrology, math, and physics by examining what is required to produce music from an electronic string-instruments while building, testing, and playing their own electric guitar. Students choose their guitar body, construct the neck and assemble their own guitars, solder all electronics, tune them using a chromatic tuner, and use them to play a simple song. Material costs for project are additional.
INFO 2265--The Internet of Things	This course introduces students to the network of physical objects which are embedded with electronics, software, sensors, and network connectivity, that enables these objects to collect and exchange data. Concepts include networking everyday objects, embedding electronics, data collection, economic implications, data analysis, and user analysis.
PROT 1030--Introduction to Quality and Continuous Improvement	This course introduces students to quality and continuous improvement as it relates to process, power, and manufacturing. Topics include drawings and symbols, properties and behavior of materials, quality management principles, techniques, and tools. Student gain skills in measurement and analysis along with components and systems calibration.

II. REVIEW CRITERIA

A. Centrality to Role and Mission

According to the Nebraska statutes (Chapter 85, Article 9 and Article 15) and the Comprehensive Statewide Plan for Postsecondary Education, the primary role of Nebraska community colleges is applied technology and occupational education intended to prepare individuals for immediate entry into specific occupations or careers. The mission of Metropolitan Community College (MCC) is to deliver relevant, student-centered education for a diverse community of learners. According to MCC's Mission Achievement Plant, this includes evolving instruction by re-engineering curriculum to address changing workforce needs in MCC's service region.

This Prototype Design program supports the mission of Nebraska community colleges and specifically MCC by providing direct educational pathways to existing and emerging technology-enabled occupations in design and production. The proposed program also addresses goals for community colleges included in the Comprehensive Statewide Plan for Postsecondary Education, enabling MCC to "Meet the Needs of the State" through industry responsive workforce training and "Meet Educational Needs through Partnerships and Collaboration" with area employers and workforce organizations. The Prototype Design program also addresses the Comprehensive Statewide Plan goal to "Meet the Educational Needs of Students" by providing engaging, real world, cross-disciplinary learning and work experience leading to work relevant competencies and credentials.

B. Evidence of Need and Demand

1. **Need for the program**

The demand for job candidates with prototyping skills is on the rise across the MCC region and the U.S. Advancements in applications and technology are contributing to high growth in demands for Rapid Prototyping (RP). Improvements in cost and time to market are creating a growing demand for rapid prototyping (RP) and individuals who are skilled in RP processes and technology. Industries such as manufacturing, medicine, engineering, architecture, and art are forecast to produce the strongest demands for prototype production technicians. According to a recent study from IndustryARC (analytics, research, consulting,) the 3D scanning market generated revenue of $8.2 billion in 2014 and is projected to grow at 4.7% annually through 2020.

Prototyping skills are valuable and increasingly essential for a range of occupations – electro-mechanical technicians, engineering technologists, commercial and industrial designers, industrial engineering technicians, and mechanical and electronics drafters – not to mention budding entrepreneurs. For the types of occupations listed, it is projected the MCC region will need nearly 900 technicians by 2020 – 900 technicians who will need to acquire prototyping skills. Over the next four years, the demand for these occupations will increase 4-9%.

A two day Developing a Curriculum (DACUM) job analysis (over 16 hours) was recently held with six members of an industry panel, where prototype production technician duties and tasks were identified. Industries and occupations represented in this assessment included engineering, architecture, manufacturing, and individual prototype developers. The industry panel pinpointed trends that a degree in prototype design would impact, such as advancements in digital fabrication, decentralization of manufacturing, increased technology integration with manufacturing, increased automation in manufacturing, as well as changes in intellectual property, software, and materials. The panel validated the need for training to build a range of skills related to prototyping. The results of the industry DACUM process served as the foundation for the development of the proposed Prototype Development degree and courses.

Industry's sense of urgency to develop and hire technicians skilled in prototyping is also evidenced by significant industry commitments to partnership in the development and delivery of the prototyping program. Specifically, Sympateco, Inc., and its Kul Factory have committed to providing over $600,000 in personnel and equipment to launch co-located training for prototype design and development in MCC's new Center for Advanced and Emerging Technology.

2. Student Demand for the Program

Student demand for the new Prototype Design program is supported through multiple sources and it is expected this demand will grow further through industry co-location and work based learning partnerships in the new Center for Advanced and Emerging Technology. Currently, MCC is challenged to meet the needs of students who want to learn prototyping, as this instruction typically occurs only through one class (How to Make Almost Anything) and through time-intensive one-on-one. There is a very long wait time for individuals who are developing 3D prototypes through the new Do Space and there is little instruction to accompany this product development. Instruction that does occur is not tied to occupational training.

Demand for the new program is also suggested in steady enrollments in MCC programs that complement prototyping, such as business, entrepreneurship, AutoCAD, and manufacturing design and growing community participation in area product pitch competitions. As a result of the area pitch events, increasing numbers of individuals are seeking resources to prototype their product concepts. MCC's partnerships with area accelerators will also result in an increased demand to learn and participate in prototyping.

Finally, over the last three years, MCC has launched a range of new offerings that integrate hardware and software with project based, hands-on learning – as will occur through the new Prototype Design degree. Student response to these offerings has been consistently positive. Students report an appreciation for the level of engagement and skill building that comes through project based, hands-on learning with new technologies and they are requesting additional hands-on, work relevant, learning opportunities. It is

expected many students will recognize that the new Prototyping degree will provide a good "fit" not only for their occupational goals, but also for their learning preferences.

During the first year of the program (prior to the opening of CAET and Sympateco's co-located programming), it is anticipated that ten students will begin the course sequence for the Prototype Design degree. Over fifty students will participate in courses directly related to prototyping, such as Rapid Prototyping, Vector Graphics in Prototyping, and How to Build Almost Anything. This somewhat limited number of students will be appropriate for piloting new courses and for operating in the smaller lab facilities currently available. This number is also close to the minimum number required to make the program viable. Following the opening of CAET and Sympateco-s co-located training partnership in year two, the goal is to double the number of students declaring the Prototyping Design degree (20) and participating in prototyping courses (100). It is anticipated student enrollments will increase 5% in year three and 3% per year in years four and five.

C. Adequacy of Resources

1. Faculty/Staff

Existing faculty and staff are key to the successful development and delivery of the Prototyping program. In collaboration with multiple industry partners, program design has been accomplished through the work of a ten-member team of faculty and staff, including Information Technology faculty, the Associate for Technology and E-Learning, a Workforce Innovation Division Instructional Designer, three facilitators for the Developing A Curriculum (DACUM) industry panel, the Dean of Information Technology and E-Learning/Executive Director for the Workforce Innovation Division, and the Coordinator for the Prototyping (Fabrication) Lab.

While all ten members of this team will play a role in implementing the new Prototype Design program, a core group of four faculty and staff will guide implementation. To support curriculum development and/or implementation, the team will engage four additional faculty from Business, Drafting, IT, and Electronics, as well as an adjunct faculty member who serves as prototyping engineer for an industry partner. Implementation will also involve support from staff in marketing, outreach, and advising. Together, it is expected 18-20 individuals will enable successful implementation.

2. Physical Facilities

The core location or "hub" for the Prototype Design program will be in MCC's new Center for Advanced and Emerging Technology (CAET) on the Fort Omaha Campus in north Omaha. CAET facilities will include an 8,600 sq. ft. prototyping lab, technology-enabled classrooms, office hoteling for corporate partners and adjuncts, faculty and staff offices, and spaces outside the classrooms for students to work independently or in small groups. CAET also includes an additional 2,500 sq. ft. prototyping lab dedicated to a work-based learning partnership with co-located partner, Sympateco and its Kul Factory division. These facilities support real world, project based learning experiences for

students, in an environment that reflects the expectations and operations of a corporate setting, while honoring high academic standards.

While CAET will serve as the core location for the Prototype Design degree, the facility will not be ready for occupation until the fall quarter of 2017. Until that time, the program hub will be at the Fort Omaha Campus (FOC), with prototype design and development occurring primarily through the FOC Fab Lab, MCC's lab located at the Mastercraft building in north Omaha, and MCC's mobile production lab. Classroom spaces will be utilized primarily at the Fort Campus, with the opportunity to provide some classes at the Mastercraft, other MCC campus sites, or online.

3. **Instructional Equipment and Informational Resources**

While MCC currently has resources adequate to initiate the new Prototype Design program, MCC is in the process of procuring additional equipment and expanding its technology infrastructure. These equipment and technology enhancements will enable a fully operational, high quality Prototype Design program. Currently, a range of prototyping equipment is available through the Fort Omaha Campus prototyping ("fab") lab and the mobile production lab. The equipment in these labs was originally selected based on recommendations for MIT affiliated Fab Labs, input from area industry, and feedback from other advanced technology centers. Examples of equipment available in the MCC labs include 3D scanners, 3D printers, table top CNC machines, laser cutters, and computers outfitted with industry grade software for 2D and 3D design.

MCC is in the process of purchasing an expanded range of equipment to establish distinct labs for CAET prototyping, such as for metals, electronics, 3D printing, and fit and finish. CAET will also include a new, upgraded academic data center and a range of technologies to support learning and communications in classrooms, meeting spaces, and office areas. MCC also invested in a dedicated Wide Area Network, connecting MCC's campus sites and significantly expanding bandwidth for instruction and communications. Together, these technologies ensure that students, faculty, and industry partners engaged in MCC's new Prototype Design program have a high quality learning experience.

4. **Student Resources** (special advising, registrations, tutoring, etc.)

MCC's role of Student Services is to support the academic mission by providing a comprehensive range of services designed to facilitate student engagement with the College and success in the classroom.

- The College's Learning and Tutoring Centers provide resources, technologies, and services to support the learning needs of student through state-of-the art equipment, computers, and specialized software.
- Libraries provide research materials and instruction in the support of the College's curriculum.
- Advocacy counselors utilize counseling skills to support the development of academic and life skills of students.

- Academic advisors assist students by developing an educational plan, promote successful student practices, and provide general direction to support student academic and career goals.
- Math Centers provide free drop-in assistance from qualified personnel for all math and /or math-related courses.
- Free drop-in assistance in many academic subjects is available at scheduled day, evening, and weekend hours in the MCC's Learning and Tutoring Centers.
- Writing Centers, staffed by experienced English teachers and writing consultants, provide professional assistance, writing workshops, and assignment design feedback to help students and faculty with written communication across academic disciplines and beyond.
- Career Services fosters collaborative relationships with both internal and external partners, to facilitate the development of responsible career decision-making skills, and to provide comprehensive career development.
- Learning communities comprise a cohort or group of students who share interests and take classes together. The goal is to provide student and course connections that make classes and learning more interesting and students more successful.
- TRIO programs are Federal outreach and student services programs designed to identify and provide services for individuals from disadvantaged backgrounds.
- The Single Parent/Displaced Homemaker program provides a wide range of workshops and personal assistance to single parents, single pregnant women, and displaced homemakers who are accepted into the Student Support Services/TRIO program.

5. **Budget Projections for the first five years of the program.**

TABLE 1: PROJECTED EXPENSES – NEW INSTRUCTIONAL PROGRAMS

EXPENSE TYPE	FY 16 – YR 1		FY 17 – YR 2		FY 17 – YR 3		FY 18 – YR 4		FY 19 – YR 5		TOTAL	
Personnel	FTE	Cost	FTE	Cost	FTE	Cost	FTE	Cost	FTE	Cost	FTE	Cost
Faculty	2.0	190,000	2.0	195,700	2.0	201,571	2.0	207,618	2.0	213,847	2.0	1,008,736
Prototyping Lab Coordinator	.5	33,896	.5	34,913	.5	35,960	.5	37,039	.5	38,150	.5	179,958
Subtotal Personnel		223,896		230,613		237,531		244,657		251,997		1,188,694
Operating												
General Operating 36% of Personnel		80,603		83,021		85,511		88,077		90,719		427,931
Equipment		385,000		600,000		60,000		180,000		650,000		1,875,000
New or Renovated Space		0		2,000,000		0		0		0		2,000,000
Library/Information Services		1,200		1,000		1,000		1,000		1,000		5,200
Subtotal Operating		466,803		2,684,021		146,511		269,077		741,719		4,308,131
TOTAL EXPENSES		690,699		2,914,634		384,042		513,734		993,716		5,496,825

TABLE 2: REVENUE SOURCES FOR PROJECTED EXPENSES – NEW INSTRUCTIONAL PROGRAM

FUNDING SOURCE	FY 16 – YR 1	FY 17 – YR 2	FY 17 – YR 3	FY 18 – YR 4	FY 19 – YR 5	TOTAL
Existing Funds						
Reallocation of Existing Funds	190,000	195,700	201,571	207,618	213,847	1,008,736
Required New Public Funds						
1. State Funds						
2. Local Tax Funds						
3. Tuition and Fees Yr 1: 10 students x 36 credits @ $64 100 x 4.5 x $64	39,240	78,480	82,404	84,876	87,422	372,422
Other Funding						
1. SBIR	50000	50000	50000	50000	50000	250000
2. Corp Partner Staff/Adjuncts*	60000	450000	470000	500000	600000	2,080000
3. Capital/Gift**		2,000,000				
TOTAL REVENUE	339,240	2,774,180	803,975	842,494	951,269	5,711,158

*Time and expertise contributed by corporate partners for training development and delivery, including CAET co-located partners

**Reflects a portion of total gifts to support the construction of the new Center for Advanced and Emerging Technology

D. Avoidance of Unnecessary Duplication

There are currently no Prototype Design programs in the state of Nebraska.

E. Consistency with the Comprehensive Statewide Plan for Postsecondary Education

Major Statewide Goals

The proposed Prototype Design program is designed to be consistent WITH THE STATEWIDE GOALS FEATURED IN Nebraska's Comprehensive Statewide Plan for Postsecondary Education by:

- Meeting the needs of students:
  - The availability of this program in Nebraska will meet students' needs statewide for high-skill, high-wage employment.
  - Students who enroll in the Prototype Design degree program courses will have access to all MCC support services that help students reach their educational goals.
  - MCC will provide students in the proposed program with a quality curriculum so that they may learn and succeed as capable employees as a prototype design technician or prototype production technician.

- Meeting the needs of the state:
  - The proposed Prototype Design program is being initiated by Metropolitan Community College in direct response to changing industry needs. The program will serve industries utilizing rapid prototyping, product design, engineering-manufacturing, and digital design laboratory processes.
  - Providing this degree program will allow MCC to respond in a timely manner to the evolving training needs of employers in related industries. Employers/businesses in Nebraska, and the Omaha metropolitan area in particular, are demanding a workforce that can keep pace with business. Therefore, MCC needs to create a multidisciplinary program that meets the needs of the employers who require such skills from their employees.

- Meeting the needs by building exemplary institutions:
  - By responding to industry needs and building competencies in high-skill, high-wage jobs, Metropolitan Community College will continue to be an institution on the forefront of education and technology.

- Meeting educational needs through partnerships and collaboration:
  - Metropolitan Community College's industry partners have been present and participative through the conception of the program and identification of the content. Through a process called Develop A Curriculum (DACUM), industry partner's provided their expertise to identify seven core duties, over forty-

eight tasks as well as eleven essential courses that are needed in a program such as the one being proposed. Continued involvement with industry partners is built into the program in the form of advisory committee and collaborations for the student achievement of course competencies.

- Facilities planning to meet educational needs:
  - Metropolitan Community College has an established master facilities plan of which this program is a part. The Center for Advanced and Emerging Technologies building (CAET) is currently under construction. This new facility will serve as home for the prototype design program, as well as other industry responsive training. The program will utilize this new facility for classrooms, lab space, and multipurpose learning areas. For a short time, classrooms and labs for this program are currently available in one campus location and one community location.