A Snapshot of Community Access at a University Makerspace

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Introduction

Nebraska Innovation Studio (NIS) is a 16,000-square-foot, University of Nebraska-Lincoln supported makerspace in Lincoln, Nebraska, with a full wood shop, metal shop, rapid prototyping room, art studio, and textiles and ceramics areas. NIS is a membership-based facility open to the public, with monthly membership required for access to the equipment and training. At any given time, approximately 60% of NIS members are students, faculty, and staff. The remaining 40% come from the community. Community access has enabled NIS to support inventors, startups, local businesses, craft entrepreneurs, non-profits, and hobbyists. Allowing community access increases both the diversity of skills and density of makers at an academic makerspace, increasing the likelihood for innovation. [1] Providing easy access to tools for prototyping also promotes local business innovation and fosters University partnerships with private industry.

Organizational Structure

NIS operates under the University of Nebraska-Lincoln's (UNL) Office of Research and Economic Development. Operating costs split between the University, member fees, and private donations. UNL pays for rent, utilities, and approximately 70% of the salaries of three full-time employees. Membership fees and private donations pay for the remaining salary expenses, and all equipment purchases and maintenance.

NIS charges a sliding fee for membership. University of Nebraska students pay $20 per month; other students and family members of members pay $30 per month; alumni, NIS partners, faculty and staff, and alumni pay $50 per month; and community members pay $70 per month. Membership is month-to-month, meaning members can use NIS for a month and come back six months or a year later and sign up for another month. Members have access to all the tools, and there is no cost to use the equipment. Members pay for the materials they use, such as 3D printer filament or plywood. Training is free and required on most equipment.

History

In 2008, the state legislature passed LB1116 to move the state fair from Lincoln to Grand Island. [2] The University of Nebraska contributed just over half of the $42 million to pay to relocate the state fair [3], with the intention of building a technology research park on the site. The goal was to attract private sector businesses to the park, subsequently named Nebraska Innovation Campus (NIC), and to foster partnerships with University researchers. These partnerships would be supported by NMotion business accelerator and NUtech Ventures, which facilitates private sector partnerships and markets inventions and other innovations generated by university research. [2]

NIC recruits businesses to the research technology park by highlighting "seamless connections with University talent and the built-in resources and established culture to leverage those connections for innovation." [4] Having a makerspace on NIC is one of the "built-in resources" central to this value proposition. NIS has easily accessible, hardware-based tools available for businesses and business-University partnerships to develop rapid prototypes.

A formal proposal for the makerspace in 2013 described the goals of NIS as contributing to a dynamic, multi-disciplinary culture, promoting innovation and experiential learning, fostering entrepreneurship, and attracting companies to NIC to prototype designs. "The combination of this proposed Maker Space with the broader NIC community (tenant companies, business accelerator, researcher labs) will make this a globally unique facility that will greatly enhance both NIC and the education of UNL students," according to the proposal.

By operating as a publicly available, multidisciplinary space, NIS creates a mixing of ideas and expertise through what Marco Braga and Gustavo Guttman call "topologies of collaboration." [5]

NIC currently houses more than 58 private and public sector partners [6], occupying approximately 570,000 square feet. Tenants include a conference center; a hotel; the Dougherty Water for Food Institute; the Food Innovation Center; Greenhouse Innovation Center, the Biotech Connector; a coworking space; a coffee shop; and other offices. At full build-out, NIC is expected to occupy 2.2 million square feet and employ up to 5,000 people.

NIS opened in October 2015 with a small rapid prototyping space, housing 3D printers and a CO2 laser, an art studio with screen printing, a vinyl cutter, and ceramics and textiles areas. This $1.5 million Phase I buildout used only 6,000 of the available 16,000 square feet. With $1

million in private donations, Phase II construction, finished in February 2020, added a full metal shop and expanding the wood shop. In 2022, with the help of an additional $200,000 private donation, NIS began reconfiguring its space to add equipment for robotics.

NIS is now the largest makerspace in Nebraska. Other makerspaces in the state include Metro Community College, in Omaha, a fee-based, open-access facility open by appointment only, with 3D printers, laser cutters, welding and plasma cutting equipment, wood and metal working tools, and powder coating and painting [7]; and Do Space, a free community makerspace in Omaha, which offers a computer lab and equipment including 3D printers, a scanner and printer, small tech kits, and music equipment [8].

Other campuses within the University of Nebraska system have smaller makerspaces, and other colleges at UNL have some of the same tools as NIS. For example, the College of Architecture has CO2 lasers, the College of Arts and Sciences has throwing wheels, kilns, and screen-printing equipment, and the College of Engineering has mills, lathes, and 3D printers.

Research labs on campus, too, have some of the same equipment as NIS. As Björn Hartmann noted, however, in *A Research Agenda for Academic Makerspaces,* academic makerspaces "differ from traditional research labs in that they are open to a broader set of constituents and expertise levels, and often support a larger variety of possible uses." [9]

Having a makerspace on NIC is also seen as creating a culture of innovation at the University and the greater community. Innovation depends on the exchange of information among people and the knowledge spillover that results. [10] Providing an opportunity for a density and diversity of ideas and unplanned interactions among innovative people is a way to foster knowledge spillover and innovation. [11]

From the beginning, NIS membership was open to the public, with no University affiliation required. In a formal proposal to the university, NIS was conceived as a way to support NUtech Ventures and local companies by allowing for rapid prototyping and development of intellectual property. [2] NIS has a range of tools for rapid prototyping, including 3D printers, CO2 and Fiber lasers, and wood and metal CNC machines.

In *Classifying Academic Makerspaces: Applied at ISAM 2017,* Wilczynski and Hoover grouped makerspaces based on access, membership, size, staffing, and the scope of their role in education, research, service and entrepreneurship activities [12]. They divided access into four categories: limited to individuals enrolled in makerspace or departmental courses, limited to individuals from sponsoring department, limited to individuals associated with a specific school, and open to the entire University community. They added a trailing "S" designation to this for makerspaces open only to students or "P" for makerspaces open to the public. Their survey found academic makerspaces open to the public were in the minority. Only 7 of the 26 academic makerspaces (27%) surveyed allowed public access. The nature of the public access was not described.

Univ. of Nebraska Students	193	55.4%
Univ. of Nebraska Faculty & Staff	19	5.5%
Non Univ. of Nebraska Students	17	4.9%
Community	93	26.7%
Veterans Programs	26	7.5%
TOTAL	348	

Table 1 Nebraska Innovation Studio membership

Makerspace Usage

More than 3,400 people have joined NIS since it opened, with mean daily usage of 36 people (11-92). Active membership at any given time is approximately 290-360, trending higher during the academic year. NIS typically hosts four or five classes each semester. Classes have come from the colleges of engineering, art, architecture, and from the digital humanities, emerging media arts, and honors programs. When UNL students attend classes at NIS, they are required to become members of NIS. Depending on the class, the membership fees are borne by the students themselves, paid for by a University department, or paid for through a grant. Classes from nearby Nebraska Wesleyan University have also met at NIS. In addition to classes, undergraduate and graduate students use the space for personal and academic projects. Community members use NIS for personal projects, design prototyping, craft entrepreneurship, and work for local businesses.

A snapshot of membership (Table 1) on April 1, 2022, showed 348 total members, with 61.4% coming from within the university community (undergraduate and graduate students, faculty, and staff). The remaining 38.6% of members were non-University of Nebraska students and community members, including alumni, veterans, and others.

Community Usage

With the completion of Phase II and the addition of a metal shop, NIS is now fully capable of fulfilling its original mission of helping startups develop and prototype ideas. In terms of raw numbers, the vast majority of community members at NIS are hobbyists, followed by craft entrepreneurs, and then local businesses and startups. A snapshot of community usage (Table 2) on April 1, 2022, shows 136 members unaffiliated with the University of Nebraska. Included in this figure are 12 students from nearby Nebraska Wesleyan University taking a class at NIS, 26 veterans participating in special programs [see below], 12 from local businesses, and 3 from local startups.

Startups/Prototyping

From its inception, startups have made up a small, but important, percentage of NIS membership. The three startups who were members on April 1 were a robotic surgery startup, an automated beef processing startup, and a cattle tracking startup. Other startups who have used NIS include a prosthetic hand company based in Chicago; a modular pint glass maker; and a sustainable T-shirt maker.

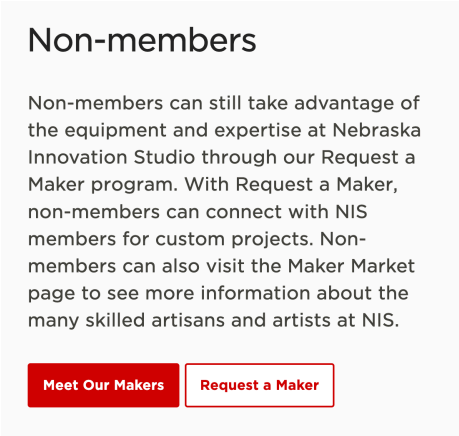

Fig. 1 Innovation Studio homepage includes an opportunity to "meet" NIS craft entrepreneurs and put in a request for custom work.

Several established businesses have also used NIS for prototyping. HUDL, a sports performance analysis company based in Lincoln, used NIS to prototype camera mounts, and a local glass company, designed and prototyped a garage-door like mechanism at NIS for retracting a small window. The design was used for the luxury boxes at Memorial Stadium, the University of Nebraska football stadium.

Local Businesses

NIS membership provides a cost-effective option for local businesses with the right skill set and an interest in saving money, saving time, and/or have more control over the process. Most who join take advantage of more than one part of the makerspace. A small software company at NIC built furniture, using the CNC, and created branded items, using the laser cutter. A new climbing gym used CO2 lasers, vinyl cutter, large-format printer, and woodshop for signage and furnishings. An autobody shop using the plasma cutter to cut metal parts. A miniature golf course used the woodshop to fabricate design features such as a miniature barn with a door that opened and closed. An attorney used the wood shop to build wooden furniture for his law firm. A video production company used the large format printer to print images to decorate the office. An online gong store used the wood and metal shops for fabrication. A boutique guitar maker used the woodshop, CNC, and CAD software to design and build guitars from reclaimed hardwoods. A local techno-metal band used the embroidery machine and screen printing equipment to make T-shirts and embroidered merchandise.

Artists/Craft Entrepreneurs

Artists and craft entrepreneurs made up 12% of community members and 5% of all members when the snapshot of membership was taken April 1. Craft entrepreneurs have used the space to laser engrave custom signs, coasters, glassware, and other items, to make laser-cut jewelry, to build furniture, to turn pens and bowls, to embroider caps, print T-shirts, turn ceramic bowls, cups, and vases, and hand sculpt figurines and other items.

Hobbyist	91	66.9%
Artist/Craft Entrepreneur	16	11.7%
Local Businss/Startup	15	11.0%
Local Non-Profits	2	1.5%
Non Univ. of Nebr. Class	12	8.8%
	136	

Table 2 Reasons community members join NIS

To highlight craft entrepreneurs using the space, NIS has a "Featured Maker" on its website (innovationstudio.unl.edu) each month and has profiles and links to their sites. NIS also has a "Request A Maker" feature [Fig. 1] to connect non-members who want something made with members. When the snapshot was taken, non-members had requested replicas of a token from their grandfather's restaurant, an STL file printed in high temp resin on the Formlabs Form3 printer, a laser engraving on baking dishes for gifts, and 3D printed molds for a sterile platform.

Community Programs

Opening a makerspace to the public also gives access to community programs.

NIS hosts the Veterans Administration' Veterans in Recovery and Whole Health programs. Veterans come in three afternoons a week as part of these programs. Their membership and the cost of their materials is paid for through a private donation. Since the program started in January 2018, 215 veterans have spent a total of 895 months at NIS [through March 2022]. A phenomenological pilot study focused on seven veterans participating in the program, with a mean age of 57.75, found they experienced increased mindfulness, well-being, learning opportunities, feelings of gratitude, and social support. [13]

NIS also hosts Nebraska Big Red Satellite, part of NASA's CubeSat Launch Initiative. In the program, local 8th to 11th grade students are mentored by UNL students as they work on a cube sat design [14].

Other community organizations using NIS include the Lux Center for the Arts, which uses the makerspace for signage and T-shirts., and The Combine ag startup accelerator, for signage and branding.

Conclusion

By allowing public access, NIS has provided tools and training for inventors, craft entrepreneurs, startups, and established businesses to design, prototype, and fabricate. In addition to tools, a makerspace is supposed to serve a community of makers, with a diversity and density of makers that allows for knowledge spillover. [10] Operating as an open access makerspace, NIS has increased both the density and diversity of makers using the space.

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