Making Makerspaces:
An updated review with classification
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Abstract

As more engineering programs have embraced hands-on learning in their curricular and extra-curricular offerings, university makerspaces have proliferated. The increasing incorporation of making resources into higher education necessitates an understanding of these facilities. Similarities and differences are discerned with a classification system. This study considers the top 100 U.S. institutions with makerspaces. Data is collected from publicly available information on the institution's web pages and results are presented using an existing classification system from peer-reviewed literature.

Introduction

A modern version of facilities that support hands-on education were visible in the early 2000's by a few institutions, most of which maintain top 10 rankings for undergraduate engineering programs [1]. In the past 10 years, university makerspaces have been adopted by many of the top 100 U.S. higher educational institutions [2]. This trend was noticed by many in STEM fields, and in 2021 Sharma quantified the popularity of makerspaces by counting the number of documents on Scopus relating to "makerspaces" and finding an "accelerating growth rate" starting with 2 documents in 2012 and ending with 654 documents cumulatively in 2020 [3].

As the popularity of makerspaces grew, the question arose to give the term meaning. To begin answering this question, in 2014 Holm searched content on the internet for how making facilities self-identified by assessing the content of 326 organizations for the frequency of their text to use a pair of words, one term (space, people, activities, business, education, equipment, or philosophy) and one concept (making, hacking, art, programming, craft, tinker, projects, music, robot, college, university, etc.) [4]. In 2015, Barrett et al. [5] published a more comprehensive review of university makerspaces using the following method: 1) List the top 100 universities as ranked in the 2014 edition of U.S. News and World Report's *Best Undergraduate Engineering Programs* rankings and visit websites to perform keyword searches and identify makerspaces, 2) sort through these and eliminate any that did not have existing makerspaces, and 3) organize information related to each space (including location, membership, departmental access, management, and equipment) in tables to enable comparison between spaces. The results were summarized in four tables and one Venn diagram. In 2017, Wilczynski proposed a formal classification system for higher educational makerspaces that was applied to the seven original HEMI institutions [6].

Years have passed since the Barrett et al. and Wilczynski publications without any studies citing their methods to present a comprehensive follow up study. The research presented in this poster will leverage the methodology in [5] to create an updated list of university makerspaces. Additionally, the classification system suggested in [6] to will be used provide a systematic representation of the existing state of university makerspaces. The five indices used for classification are scope, accessibility, user-base, footprint, and management/staffing, and each index has several parameters. This comprehensive review will enable departments and institutions to make comparisons between university makerspaces in order to plan new spaces and improve existing ones.

Method

The 2022 version of the U.S. News and World Report's *Best Undergraduate Engineering Programs* rankings was used as a starting point. We chose the top 100 institutions where a doctorate is the highest degree [7] as in [5], and also included the top 50 institutions where a doctorate is not offered [8]. This resulted in 145 institutions overall. The research team then visited each university website and used a set of keywords as search terms similar to [5]: makerspace, maker space, design lab, fab lab, design studio, hacker space, innovation space, solution space. From there, the team determined if the institution had one or more makerspaces and recorded the name(s). Then the research team checked to determine the current status of the makerspace(s). Only universities with existing makerspaces met the inclusion criteria. From there, the team determined the scope, accessibility, user-base, footprint, and management/staffing based on publicly available online data (and took note of information sources). The different indices have parameters as described below:

Scope
S-1: Grassroots and initial efforts
S-2: Programs that significantly support at least one university mission
S-3: Programs that significantly support three university missions

Accessibility
A-1: Access limited to individuals enrolled in makerspace or departmental courses
A-2: Access limited to individuals from the sponsoring Department
A-3: Access limited to individuals associated with a specific School
A-4: Access provided to the entire University community

Users
U-1: less than 100 members
U-2: 100-1,000 members
U-3: 1,000-3,000 members
U-4: greater than 3,000 members

Footprint
F-1: less than 1,000 square feet
F-2: 1,000-5,000 square feet
F-3: 5,000-20,000 square feet
F-4: greater than 20,000 square feet

Management
M-1: Primarily Student managed and staffed
M-2: Faculty/Professionally managed and professionally staffed
M-3: Faculty/Professionally managed with a hybrid (professional and students) staff

Additionally, notes on type of equipment available were made using a similar list to that used in [1]: 3D printer, laser cutter, wood shop, metal shop, electronics.

Preliminary Results

Although the entirety of the table is outside the scope of a 2-page poster abstract, subsets of the table data will be on the poster itself. An example of the higher education makerspace classification system is shown in Table 1. Results will also be converted to visualizations as appropriate, similar to Figure 1.

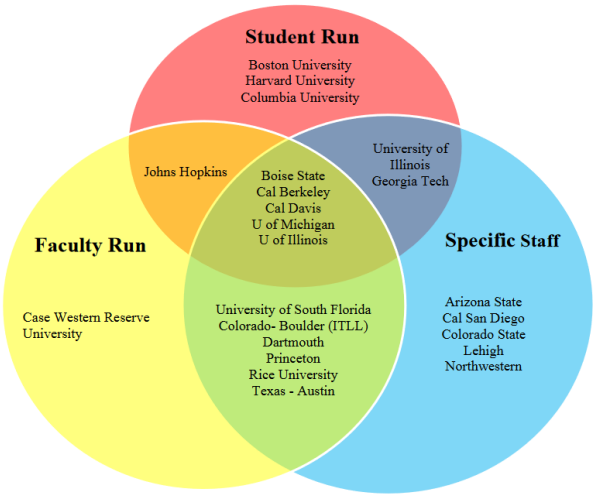

Figure 1: Venn diagram from [5] showing identified operational models for maker space management

Table 1: Classification of Seven Higher Education Makerspaces from [6]

	Scope	Accessibility	Users	Footprint	Management
CMU IDeATe	S-3	A-4	U-3	F-3	M-3
Case Western think[box]	S-2-E	A-4-P	U-4	F-4	M-3
Georgia Tech Invention Studio	S-3	A-4-S	U-3	F-3	M-1
MIT MakerLodge	S-1	A-1-S	U-3	F-1	M-1
Stanford PRL	S-3	A-4-S	U-3	F-3	M-3
UC Berkeley Jacobs Institute	S-3	A-4	U-3	F-4	M-3
Yale CEID	S-3	A-4	U-3	F-3	M-3

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