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Classifying Academic Makerspaces: Applied at ISAM 2017

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INTRODUCTION

The terms 'academic makerspaces' and 'higher education makerspaces' generally refer to facilities and the associated communities where individuals and teams design and fabricate devices and systems. Based on examples from the institutions that participated in ISAM 2016, the range of academic makerspaces extends from portable carts to entire buildings, with the number of participants scaling with the size of the facility [1]. While general concepts, such as the importance of community and implementing safe operating procedures, apply to all spaces, other topics such as funding, staffing and purpose vary significantly with the facility's size and scope. A preliminary classification model for academic makerspaces based on scope, size, accessibility, programming, and staffing is presented in this paper.

A methodology for classifying academic makerspaces has the potential to make three contributions to the academic makerspace community. For existing makerspaces, the classification model creates a subset of similar institutions that can be examined to identify the best practices relevant to a specific class of academic makerspaces. For example, managers of large makerspaces can review the programming offered by similarly sized spaces to ensure that their programming meets the norm for this size of space. Similarly, cross-class comparisons can be made by smaller programs to establish aspirational goals. In this example a small makerspace may look at the typical equipment inventory of large makerspaces to create equipment/tooling expansion plans. Lastly, it is suggested that a classification system benefits administrators and facility professionals who are designing new spaces. These individuals can use similarly scaled facilities to guide their planning efforts and focus on a subset of spaces as models for their new facilities.

ACADEMIC MAKERSPACE CLASSIFICATION SYSTEM: METHODOLOGY

The proposed academic makerspace model is based on work presented at the 2017 American Society of Engineering Education Annual Conference [2]. The five attributes of the classification model are summarized in this paper (with the referenced paper providing additional information on this methodology).

The ***scope of a higher education makerspace*** signals the degree the makerspace is established on campus. Contributions to the university mission based on education, research, and service activities classify spaces in this dimension. The scope of a higher education makerspace is classified using the following three parameters:

- 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

It is proposed that all programs in the first two years of existence be designated as S-1 programs. That designation allows a simple format to identify new (and still developing) programs. A designator ("E") appends this classification for programs with substantial entrepreneurial activities in their makerspace.

Accessibility of a makerspace as a classification category denotes the degree that the space is used. These range from access limited to participants in specific courses, members of the host department, or all faculty, staff, and students at the university. The accessibility of a higher education makerspace is indicated using the following parameters:

- 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

This index includes the trailing designation "S" for spaces open only to students. For example, a space open only to students in a specific course would be designated as "A-1-S." The trailing designation "P" denotes spaces that are also available for use by the public, with an example designation being the classification "A-4-P."

The ***number of users of a higher education makerspace*** measures the potential energy, engagement, and impact of the space. Based on the number of individuals who have access to the space, this classification attribute is defined as:

- 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

The ***footprint of a higher education makerspace*** accounts for all area within a higher education makerspace. For example, workshops, studios, meeting rooms, storage areas, support spaces, classrooms/lecture halls, and staff offices contribute to the footprint if the areas are dedicated to (and controlled by) the makerspace. The size of an academic makerspace is classified using four levels:

- 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

The ***management and staffing of a higher education makerspace*** is essential to the long-term viability of the space as well as its ability to create positive experiences for the space's members. Three forms of management and staffing exist within higher education makerspaces:

- 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

ACADEMIC MAKERSPACE CLASSIFICATION SYSTEM: ISAM 2017 APPLICATION

This proposed academic makerspace classification system was applied to spaces affiliated with presenters at the 2017 International Symposium on Academic Makerspaces. ISAM 2017 authors were invited to respond to an on-line survey describing their makerspaces. Tables 1(a) and 1(b) list the 26 participating institutions and classifies the five attributes of each space. The survey respondents included 25 academic institutions and 1 industrial makerspace. This classification model was first applied to a group of 7 institutions that participated in ISAM 2016 [2, 3].

RESULTS AND DISCUSSION

The classifications presented in Table 1 as well as Figures 1-6 provide an efficient method to analyze this collection of 26 spaces. For example, 9 of the spaces have been created in the last year (S-1 class), with most of these spaces available to the entire university community (A-4 class). These data may signal a trend for these spaces, moving away from some of the earlier accessibility limitations based on course, department or school affiliation. As another example of the utility of the collected information, most spaces range between 1,000 and 5,000 square feet (F-2 class). Regarding staffing, the data illustrate that the use of students to manage these spaces includes spaces with a small number of users (U-2 class) as well as spaces with many users (U-4 class). It is noted that the presented data regarding the number of users includes an asterisk (for example, U-4*) for those programs where it was not clear if all who were provided access make use of the spaces.

The classification system presents a methodology for current makerspaces to identify similarly classed spaces (within that class). Equipped with this understanding, an existing space may desire to learn more details about similar spaces, such as their programming and tooling. After such comparisons, existing gaps can be identified and resolved. Likewise, existing spaces can compare themselves to programs external to their own class to identify growth trajectories. It is proposed that the classification system can also be a tool for those developing new spaces as comparisons to comparable facilities can easily be made.

For example, a review of makerspaces that support education, research, and service (S-3 class) identifies a subset of 11 programs. This collection can be further sorted to identify the 8 programs in the same scope class that are managed using a hybrid model (M-3 class). The results from this sorting may help new programs develop a staffing model that best supports the scope of the new space. Similarly, the single student-staffed program that supports education, research, and service may be examined for insights on how this range of activities is achieved with a student management/staffing model.

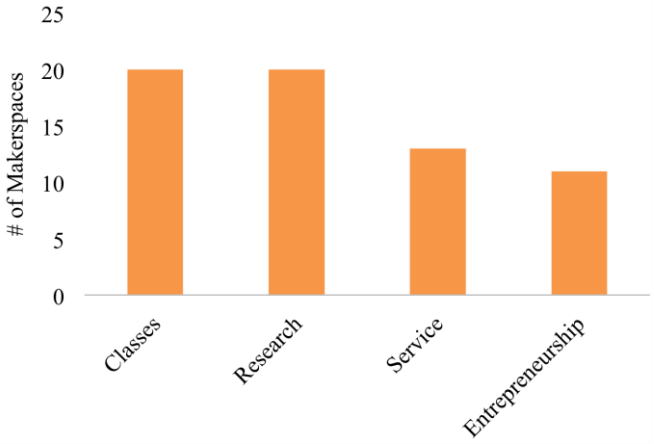

Fig.1 Summary of activities supported

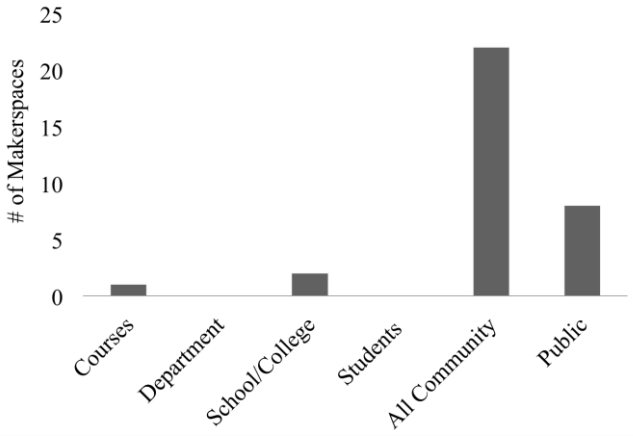

Fig.2 Summary of access limits

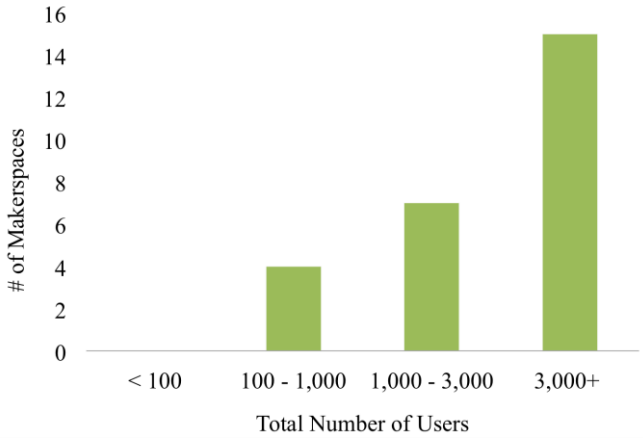

Fig.3 Histogram of total numbers of users *(The authors note that the survey did not distinguish between the number of people with* access *to the space and number of* active *users. Responses may have overestimated active user statistics.)*

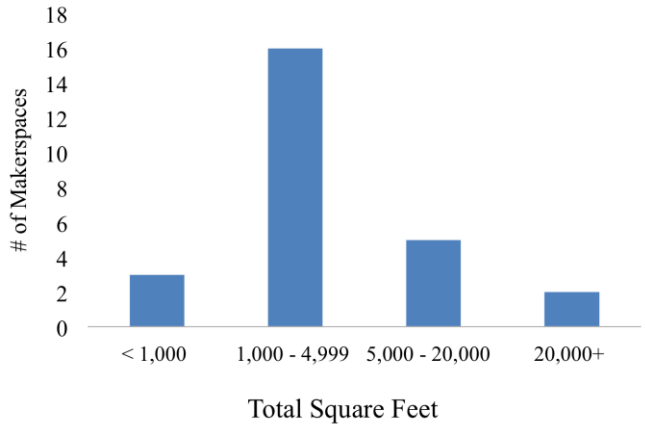

Fig.4 Histogram of square footage dedicated the makerspace

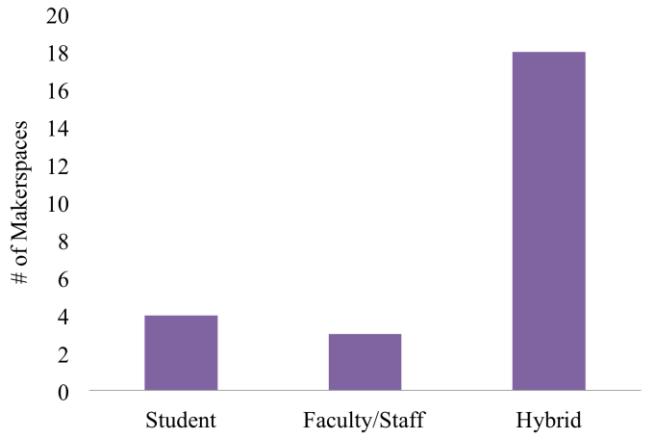

Fig.5 Staffing model breakdown among survey respondents

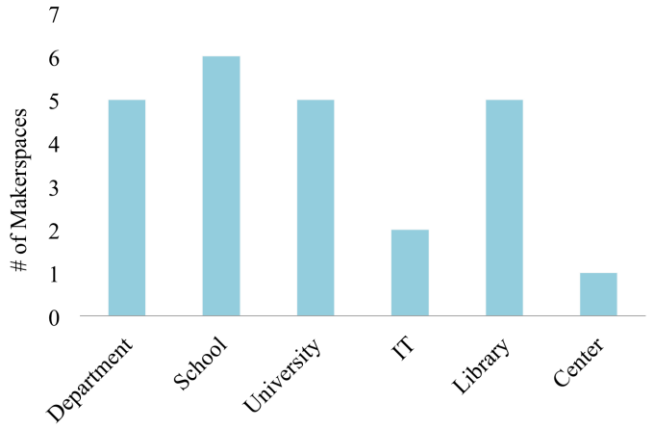

Fig.6 Breakdown of where within the college or university the makerspace is "hosted"

OBSERVATIONS

The classification system standardizes comparative nomenclature for academic makerspaces. Even if a specific space has not been classified, the concepts of scope, access, user-base, footprint, and management provide a comprehensive landscape to quickly describe spaces. The five parameters were selected to cover essential features and this collection of comparators (as well as the quantified classes) can be modified to better serve the needs of the academic makerspace community. The use of designators (E-entrepreneurship, P-public access, S-student access) reflect modifications made to capture academic makerspace practices.

In future versions of the classification system, indications of the administrative origin may be included to capture interesting trends. For example, 5 of the 26 makerspaces are administered by the library, and this trend may be valuable information for institutions that are planning new spaces.

The presented data also illustrates that academic makerspaces are not all the same. It is suggested that best practices may be most relevant within classes since available resources are more uniform within specific classes.

The value of the classification system is proportional to the number of compared spaces. The authors appreciate the participation in the survey by ISAM 2017 attendees as well as the opportunity to explore the utility of this classification system as a component of the symposium.

REFERENCES

[1] Proceedings of the 2016 International Symposium on Academic Makerspaces (2017, November), Cambridge, MA.

[2] Wilczynski, V., (2017, June), A Classification System for Higher Education Makerspaces, ASEE Annual Conference Proceedings, 2017, Columbus, OH.

[2] Ali, P.J., Cooke, M., Culpepper, M.L., Forest, C.R., Hartmann, B., Kohn, M., and Wilczynski, V. (2016, November), The Value of Campus Collaboration for Higher Education Makerspaces, International Symposium on Academic Makerspaces 2016, Cambridge, Massachusetts.

	Scope	Accessibility	Users	Footprint	Management & Staff
California College of the Arts Backlot	S-1	A-4-P	U-3	F-4	M-3
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
Elon University Maker Hub	S-2	A-4	U-4	F-2	M-3
ETH Zurich Student Project House	S-1-E	A-4	U-4	F-2	M-1
Georgia Tech Invention Studio	S-3	A-4-S	U-3	F-3	M-1
Graz University of Technology FabLab Graz	S-3	A-4-P	U-4*	F-2	M-2
Information Technol-ogy University of the Punjab - Makeistan	S-1	A-4-P	U-2	F-2	M-3
MIT Maker Lodge	S-1	A-1-S	U-3	F-1	M-1
Montana State U. MSU Makerspace	S-1	A-4	U-4*	F-2	M-3
Olin College of Engineer-ing The Shop	S-3	A-4	U-2	F-2	M-3
Southern Methodist Uni-versity Deason Innovation Gym	S-3	A-4	U-3	F-2	M-3
Stanford PRL	S-3	A-4-S	U-3	F-3	M-3
Universidad de Valle de Guatemala MAKER502	S-1	A-4	U-2	F-2	M-2

Table 1(a). Classification of Higher Education Makerspaces

*The authors note that the survey did not distinguish between the number of people with *access* to the space and number of *active* users. Absent this distinction, some responses may have overestimated active user statistics.

	Scope	Accessibility	Users	Footprint	Management & Staff
Universidad de Valle de Guatemala MAKER502	S-1	A-4	U-2	F-2	M-2
UC Berkeley Jacobs Institute	S-3	A-4	U-3	F-4	M-3
UC Davis TEAM Lab	S-3	A-4-P	U-4	F-2	M-2
University of Chicago Polsky Center Fab Lab	S-1	A-4-P	U-2	F-2	M-3
UT Arlington UTA FabLab	S-3	A-4	U-4*	F-3	M-3
University of Toronto Semaphore Studio 307	S-1	A-3	U-2	F-1	M-1
University of Vermont UVM FabLab	S-3	A-4	U-4*	F-1	M-3
University of Virginia Scholars' Lab Makerspace	S-2	A-4-P	U-4*	F-2	M-3
Virginia Commonwealth University The Workshop	S-1	A-4	U-4	F-2	M-3
Yale CEID	S-3	A-4	U-3	F-3	M-3
Mount Holyoke College – Mount Holyoke Makerspace	S-3	A-4	U-2	F-1	M-3
Stanley Black & Decker Makerspace	S-1-E		U-4	F-2	M-2

Table 1(b). Classification of Higher Education Makerspaces

*The authors note that the survey did not distinguish between the number of people with *access* to the space and number of *active* users. Absent this distinction, some responses may have overestimated active user statistics.