The University of Texas at El Paso

“The Mine - A Makerspace Approach to an Campus-Wide Innovation Mindset”

Executive Proposal
Introduction
As globalization has become a framework for success, a must for every nation is to strive for innovation and competitiveness. In order for the United States to remain competitive in this global economy there has to be an ongoing stream of innovation and advances that allows it to evolve with the times. According to the National Academy of Science, for the U.S. to continue to position itself as a leader among nations, there has to be a significant investment in research, innovation, and a workforce that understands and knows how to utilize science and technology.

Furthermore, different considerations must be made in terms of the current demographic composition of the nation and their needs. At the University of Texas at El Paso (UTEP), where 80% of our student body has their family roots in Mexico, students are faced with a set of challenges such as supporting themselves, and in some cases supporting their parents and other family members, which is only one of UTEP’s biggest obstacles to student success and retention. This particular situation coupled with a culture of risk aversion results in low translation of ideas into action. Therefore, it is paramount to expand and improve educational programs and spaces that nurture students’ innovative mindset, and to provide them with the tools necessary to translate that mindset into actions and be successful in doing so.

In an effort to aid in the educational development of UTEP’s population and to contribute to the creation of a more innovative workforce, the College of Engineering and the College of Business Administration, through the Mike Loya Center for Innovation and Commerce, are proposing to take the lead in the design and implementation of a campus-inclusive makerspace that would help students develop their assets through a variety of high-impact experiences, ultimately creating a culture of innovation and entrepreneurship.

Status Quo
Due to the natural evolution of libraries into digital service providers and the move of 15,000 sq.ft. of shelf space in the third floor of the library, a valuable opportunity to develop an accessible infrastructure for creative endeavors and skills development has presented.

The idea of implementing makerspaces in libraries has taken higher education by storm, leading to a change in perception from a “place we visit occasionally” to a portal that allows networks of people and ideas to be created and maintained by library’s resources. This transformation is based on the erosion of demand for libraries’ traditional services as a result of the predominance of the internet and the changes in public consumption of knowledge. Makerspaces provide an opportunity for libraries to build upon services they already offer while reaching out to students and faculty who do not frequent them on a daily basis.

Through the implementation of a makerspace in the campus library, the space becomes the core towards which all disciplines gravitate toward, leading to multidisciplinary interactions that could result in innovation. In fact, over the past decade the number of makerspaces has increased exponentially, to over more than 400 spaces in the US.
In addition to this shift in libraries paradigm, the university has vowed to develop its students’ talents, strengths, and dreams through a cross-campus culture of student success and empowerment via UTEP EDGE.

With this in mind, and as the leader on innovation and entrepreneurship on campus, the Mike Loya Center for Innovation and Commerce, firmly believes that a library-based makerspace that serves the needs of the students on campus, and opens new avenues of interactions with community stakeholders, would be the stepping stone to instill innovation as a mindset in our faculty and students.

**What is a makerspace?**
A makerspace is a physical space that provides access to equipment and guidance in a flexible format that responds to the interests and skill levels of users collaborating on self-directed projects. These spaces allow users or “makers” to explore their hobbies and passions in a creative and inclusive way while perfectly aligning with the objectives of equity of access, experiential development, and lifelong learning.

Based on the research and benchmarking conducted by the Mike Loya Center for Innovation and Commerce and after attending the Making Makerspaces training provided by the Higher Education Makerspaces Initiative (HEMI Group) at Georgia Tech, the center had developed a list of initial thoughts in terms of what this space will look like and the purpose it will serve:

- An open and inviting multidisciplinary space dedicated to:
  - Learning
  - Innovation
  - Collaboration
  - Creation

This space will be characterized for being highly flexible and adaptable with few structural partitions, that easily morphs to rapidly changing needs, focus and technology. This will be reflected in the architecture of the space which will highlight:

- Movable glass partitions
- Re-locatable industrial fixtures, power and communications ports
- Non-permanently mounted
- Open ceiling
- Stained concrete floor
- Industrial racks and storage

Additionally, in the initial conception of the space, the primary learning activities that will be supported would be mainly spurring innovation through fostering of a collaborative, fell-free-to-fail, practical environment, that coupled with educational components, could serve as a medium for students to express their needs and gain practical leadership experience.
This space will serve as a 24/7 making space that would cater to different user groups:

- **Tech User** – an expert who can independently utilize the facility
- **Ideator** – a non-expert seeking help to materialize and prototype their innovation
- **Ed-Only User** – an individual only interested in training, seminars, workshops, and continuing education
- **Programmatic** – users associated with specific curricular offerings such as cross-disciplinary capstone/project courses

Ideally, the makerspace would be open for students enrolled in project-based classes housed in any of the colleges. This would ensure that from 8:00am to 6:00pm, students and faculty can have a space to supplement their project-based classroom experiences. Moreover, the space will foster engagement with the community through continuing education courses that could run from 6:00pm to 10:00pm and that will help support the operations of the initiative. Along the same lines, the space would be available for university students from 10:00pm to 6:00am, leaving a two-hour window from 6:00am to 8:00am for maintenance.

It is important to highlight that this space would not be tied to any particular college, program, or campus unit. The basic idea is to create a space where innovation will happen at the confluence of all the disciplines and strengths of the university and its faculty and students. Moreover, the makerspace will not function as a funding source for laboratories that are over capacity, because its purpose is to foster innovation in a non-restrictive way which differs from the nature of regular labs.

Lastly, this space will not be utilized as an additional classroom to colleges nor a hangout place where students just interact passively, and certainly will not be a substitute for institutional purchasing or acquisition channels.

**Innovation as a mindset**
A mindset is a set of beliefs about ourselves and our most basic qualities, such as intelligence, personality and talent. Mindsets are also comprised of attitudes that manage and influence our actions and the way we perceive what we can and cannot achieve. Therefore, the right mindset is the key differentiator between failure and success.

To become innovators, it is necessary to be mindful of how the world is changing and how the expertise developed in the classroom can better serve that change. While awareness is the beginning of this shift, it is our responsibility to empower faculty and students to not only be ready for change but to also lead the way by engaging in creativity and experimentation taking bold actions that venture into the unknown, and for that it is necessary to commit significant resources and patience.

This is the overall objective of enabling a makerspace, to allow our constituents to modify their mindset and to push beyond the boundaries they have set on themselves. By nurturing their innovativeness, pro-activeness, and a risk-taking attitude, we can encourage them to be at the
edge of their disciplines and ultimately have innovation, creation, and collaboration built into everything we do at UTEP.

**Equipment and Initial Investment**
The proposed makerspace will feature four different areas that will take advantage of UTEP’s expertise and will allow students to materialize their ideas and spur innovative projects. The Center has envisioned the following areas with their respective equipment:

**Rapid Prototyping**
The Rapid prototyping area will provide students with the basic equipment needed to create proof-of-concept models to test out their ideas in terms of consumer feedback and practical design. We are proposing the following equipment:

- 3D Printers (4)
  - Makerbot Replicator+, $2,500 per unit
- 3D Scanner (1)
  - Roland LPX-600 3D Laser Scanner, $10,995
- Laser Cutter (1)
  - Epilog Zing Laser Cutter, $8,000
- Desktop Vacuum Former (1)
  - Formech 450DT Vac Former, $4,850
- Desktop Vinyl Cutter (1)
  - Roland CAMM-1 GS-24, $1,995
- Benchtop CNC Mill (1)
  - Roland MODELA MDX-50, $10,995
- Sewing Machine (3)
  - Singer SE340 Legacy, $1,145

This equipment will allow makerspace users to produce state of the art prototypes for their ventures. The total investment in equipment for this area comes up to $51,066 USD.

**Tinker Space**
The tinker space has been conceived as the place where students will utilize all the tools they could find in wood and metal shop. These tools allow students to imagine and materialize hands-on applications of their ideas. The following equipment will be needed for this space:

- Band Saw (1)
  - Laguna LT18, $3,999
- Panel Saw (1)
  - Milwaukee Panel Saw, $1,299
- Table Saw (1)
  - Sawstop CNS175-TGP36, $2,285
- Router Table (1)
• Kreg PRS1040 Precision Router Table System, $499
• Jointer/Planer (1)
  • Jet 708476 12", $3,450
• Sliding Bevel Miter Saw (1)
  • Dewalt 12", $599
• Scroll Saw
  • Dewalt DW788 20", $495
• Standing Drill Press (1)
  • Powermatic 18" Variable Speed Drill Press, $1,499
• Work Bench (2)
  • Sjobergs Preconfigured Work Bench, $2749 per unit
• Welding Table (2)
  • BuildPro 78", $4,299 per unit
• MIG Welder (1)
  • Miller Millermatic 252, $2,549
• TIG Welder (1)
  • Miller Diversion 180, $2,139
• Plasma Cutter (1)
  • Miller Spectrum 625, $1,879
• Horizontal Band Saw (1)
  • Jet J-3130, $949
• Vertical Band Saw (1)
  • Jet 14", $1,030
• Drill Press (1)
  • Jet 15", $799
• Milling Machine (1)
  • Tormach PCNC 1100, $8,412
• Shear/Press Brake/ Slip Roll (1)
  • Baileigh SBR4020, $995

The above listed equipment will be secured for a total of $46,973 USD.

**Media Production**
The media production space has been conceived as an alternative for students to produce audiovisual projects that would complement their ventures or will aid them in the commercialization process of such. The equipment available for them to use will include:

• Audio and Video Editing Stations (2)
  • Mac Pro, $6,500 per unit
• Guitar Rack (1)
  • Pro Tools Eleven Rack, $699
• USB Audio Interface (2)
  • Scarlett 2i4, $149
• Midi Board (2)
  • Novation SL MkII, $399
• Microphones (4)
  • Shure SM27 (2), $299 per unit
  • Yeti Pro (2), $249 per unit
• Shotgun Microphone (2)
  • Sennheiser MKE600, $329 per unit
• Headphones (4)
  • Sennheiser HD280Pro, $100 per unit
• Boom Pole (2)
  • Pyle PMKSB12, $89 per unit
• Camcorders (2)
  • Canon XC10 HD, $2,499 per unit
• Tripods (4)
  • Vanguard Alta Pro, $190 per unit
• DSLR Camera (2)
  • EOS 5D Mark IV, $3,399 per unit
• Lightning Equipment Set (1)
  • Lowell Creator 55Kit, $1,327
• Green Screen (1)
  • Muslin Chromakey Kit, $169
• Lavalier Microphones (1)
  • Sennheiser AVX-MKE2 Kit, $1,599

This list of equipment will provide students with basic necessary tools to create their projects and to innovate in media production. The total investment for audio visual equipment is $32,778 USD.

Tech and Electronics
The tech and electronics area will be equipped with all the tools needed to help spur projects in the technology generation realm ranging from mobile apps and software development projects to robotics. The equipment needed for this area is the following:

• Robotics Kit (10)
  • Mindstorms EV3, $349 per unit
• Instrumentation Equipment (4)
  • National Instruments VirtualBench, $2,139 per unit
• Programmables and Microcontrollers
  • Arduino CTC 101 (2), $2,000 per unit
  • Raspberry Pi Kits (Several), $2,000
• Visualization Wall (1)
  • AV3 High Res LED Video Wall, $9,105
• VR Ready Computers (10)
- Asus Desktop- G11DF, $1,399 per unit
- Computer Monitors (10)
  - Samsung CF791, $849 per unit
- Multimeters (5)
  - Innova 3320, $28 per unit
- Soldering Stations (5)
  - X-Tronic 9020, $229 per unit
- Workstation Furniture
  - Tables and chairs, $10,000

The total investment needed for this area is $60,925 USD.

Additionally, there are some equipment requirements that need to be taken into account, such as safety equipment, fire exhaustion, fume extractors, etc. that will be necessary to safeguard our students and staff. We are estimating the total amount needed for that equipment to be around $75,000. Furthermore, the space is going to need furniture and clear wall movable partitions to segment the space and to avoid some cross contamination from one area to the other. Coupled with this, the place will need to be prepped and industrialized since it is a production area that will withstand industrial work. The estimated cost for this is around $240,000.

To summarize, the overall initial investment for this makerspace should be close to $510,000. As a first line of funding, the Mike Loya Center for Innovation and Commerce is considering the possibility to initiate conversation with our donor to seek support to finance the entirety of the project. Along the same lines, the Center is willing to seek external funding via grants. In an effort to scout some opportunities, the Center has identified the following funding opportunities:

- Texas State Library and Archive Commission, Special Project Grant – up to $75,000
- Institute of Museum and Library Services, National Leadership Grants for Libraries - up to $2,000,000

The Center will also work closely with the Office of Research and Sponsored Projects, to identify funding possibilities that could contribute to the seed funding round.

**Proposed Layout**

When designing a makerspace it is necessary to take several factors into account. The first one to consider is the user and the archetypes of users that will conform your clientele. As explained before, the Center has identified four types of users regardless of their status as faculty, student, or staff.

This analysis allowed us to define what processes and activities will support a learning environment that could lead to an innovative mindset. Second, it is necessary to take into account the current constraints so that measurable functional requirements can be defined.
Based on our initial assessment, a review of successful makerspaces in higher education, and best practices, we are proposing the following layout and use for the available space:

Operations
As expected, a space this intricate needs to have amongst its resources an appropriate staffing model. Based on best practices there are currently three different models for operations:

- **Student Lead** – In this model, students are in charge of everything ranging from operations, to training and maintenance. In most institutions, the students keep communication with a staff member to make sure they are policy compliant.
• **Staff/Faculty Lead** – In this model, staff members are in charge of operating the space. The staff required are basically a technician, a machine shop professional, an academic professional and an administrative assistant.

• **Mixed Model** – This model promotes a combination of both. Students run the operations of the space under the coaching of a staff member that is available during the normal hours of operation.

The Center is proposing to utilize a mixed model. This decision will foster a non-restrictive environment for the students to feel comfortable with, and will ensure that the inherent risks of the space can be minimized.

**Assessment and Evaluation**
It is of the utmost importance to be able to adapt to the ever-changing needs of the university community, and equally important to do so based on tangible feedback on performance. In order for the makerspace to be respondent to these needs, it is necessary to define measures of success; this includes defining indicators of goals accomplished and the appropriate sources for these indicators.

The Center proposes the following metrics:

- **Direct** – these measures will assess the students’ actual work and usage of the space
  - *Access to space* – hours, entry/usage capacity, etc.
  - *Tools usage* – logs
  - *Supplies* – inventory, rate of depletion, cost, etc.
  - *Demographics* – college affiliation, age, gender, etc.

- **Indirect** – these measures will indicate student learning based on their perceptions
  - *Surveys and rating scales*
  - *Focus groups*
  - *Interviews*
  - *Testimonials*

Additionally, the center will provide an annual report of these measures along a plan of continuous improvement, that will help define the annual work agenda.

**Intellectual Property Considerations**
The makerspace is designed to be a center of innovation for UTEP faculty, staff, students, and no additional Intellectual Property (“IP”) obligations should be created for the user. In this case, students who are using the Makerspace own the IP they create, unless:

1. The student is also an employee of the U. T. System or any U. T. System institution and the intellectual property is developed within the course and scope of his or her employment
2. The student works on a work-for-hire or institutional project
3. The student participates in a research project where any intellectual property created under that project has already been committed to, or encumbered by an agreement with, a governmental, philanthropic, corporate or another sponsor

However, any existing IP obligations from an employment agreement or employer policy, whether that employer is UTEP or a private company, will apply to what the user creates in the Makerspace. For example, IP created by UTEP faculty and staff while using the Makerspace will be owned by the UT System.

**References**
A list of successful makerspace as well as some literature on the makerspace movement has been provided for your convenience:

- Georgia Tech Invention Studio
- Makers@PITT
- Longhorn Maker Studios at UT Austin
- Makerspace at Ryerson RTA School of Media
- Lassonde Entrepreneur Institute
- *A Review of University Maker Spaces*, Mr. Thomas William Barrett, James Madison University, Matthew Cole Pizzico, James Madison University, Bryan Levy, Georgia Institute of Technology, Dr. Robert L. Nagel, James Madison University, 122nd ASEE Annual Conference and Exposition, June 2017