Oregon Museum of Science and Industry

Maker Center: A New Framework for Learning Labs

Assessment of need

The Oregon Museum of Science and Industry (OMSI), in partnership with the Multnomah County Library (MCL), seeks a Learning Labs grant to convene expert advisors, community advocates, and a teen advisory council (TAC) for an in-depth planning and design process to support implementation of a community *Maker Center* at OMSI. Digital media learning labs such as YouMedia in Chicago have proven effective engaging teens by providing a space and context to express their creativity (Austin 2011). OMSI and MCL intend to adapt these proven methods to engage teens with a different set of digital media production tools in a space dedicated to "Making." We believe this type of space is a critical resource for youth to gain the 21st Century Skills needed to participate in a productive civic life.

"Making" is the interdisciplinary idea of people creating things that interest them—using a wide range of tools and techniques. It is found worldwide, with projects ranging from backyard wind turbines to fire breathing dragon sculptures (Gauntlett 2011). These creative individuals do not work alone. They participate in a number of networked publics such as *instructables.com*, *thingiverse.com,* or *makeprojects.com* to exchange ideas and methods. They gather at events such as a Maker Faire or craft show. Sometimes these networked publics are driven by a particular interest, such as a fan group dedicated to *Star Wars* costuming, but they also exist to support those who just enjoy the idea of Making itself. These interactions with peers and adults serve as vast resources for those who want to create but need guidance along the way (Ito 2008).

In recent years the Maker community has grown into a movement with a growing network of Maker spaces, TechShops, and community workshops to provide the necessary resources for entrepreneurs and inventors to make their ideas a reality. Maker Faires and similar events have been drawing tinkerers and do-it-yourself enthusiasts of all ages and backgrounds to share ideas and celebrate creativity (Honey 2010). Sparks of inspiration from these incubators may drive resurgence in American manufacturing and business. The Maker movement is being heralded as the 21st Century Industrial Revolution (Anderson 2010). Our national leaders have identified Making as a critical element to regaining our nation's creative and innovative edge (Kalil 2010).

Maker movement growth has been catalyzed by advances in digital design and fabrication technology that have made tools such as 3D printers more readily available. Similar to the "new media" ecology characterized by a convergence of traditional and digital media, an evolution is occurring in the realm of Making, creating a "new tool" ecology (Ito 2008). Just as youth make their own video, music, and games, artists and crafters now design their ideas using digital tools such as Google Sketchup and then output their creations to CNC tools such as 3D printers or laser cutters while retaining the ability to use traditional tools such as sewing machines, glue guns, and screwdrivers (Anderson 2010).

Research is lacking to show if Maker tools can promote digital literacy and 21st Century skills (Honey 2010). Early studies indicate digital production tools can deeply engage teens with the making process, perhaps because projects are interest driven and allow teens to express themselves (Devaney 2011; Ito 2008; Ariely 2010). Using these tools offers similar opportunities as other digital media tools—such as working with experienced mentors at multiple levels of engagement of Hanging Out, Messing Around, and Geeking Out (HOMAGO)—which has proven successful at YouMedia in Chicago (Austin 2011; Ito 2011).

Making something requires 21st Century Skills including creativity, communication, collaboration, and problem solving. Makers must use multiple literacies, including digital, visual, and textual, to effectively research, design, create, test, and refine. In many cases, a maker will need to learn the basics of a new tool or technique midway through a project, helping them develop a high level of technological literacy. Maker skills are broadly transferable and important to many aspects of life (IMLS 2009). Making also

engages participants in constructionist learning. As they are building something with their hands, they are building new understanding and new ways of learning (Heim 1991; Papert 1991).

There is currently little support for technical skill building for youth in schools or at work. Although there is a shortage of technical skills in the workforce, most U.S. K–12 schools no longer have career and technical education (CTE) or apprenticeship programs. The recent recession has affected working teens more than any other age group, leaving more than 70% unemployed and unable to gain work experience (Symonds 2011). To address this gap, states are beginning to include engineering design in their standards. The recent framework for National Science Standards features engineering design as a core discipline (National Research Council 2011). In 2009 Oregon adopted science standards featuring the engineering design process as a core strand (Oregon Department of Education 2009). Oregon teachers have been struggling to implement these new standards with limited resources. Many teachers have little familiarity with engineering concepts and struggle to fully integrate them. OMSI's manager of Science Education (PI on this project) created an engineering curriculum and accompanying teacher professional development series that is beginning to address this need (Perry 2011). To strengthen the impact of the limited programs available in schools and the workplace, youth who are interested in these fields will be well served by additional experiences in informal settings such as after school programs, museums, and extracurricular activities (National Research Council 2009; Jenkins 2009).

Portland is known as a center for "do it yourself" (DIY) creation. Crafters, zine-makers, independent musicians, artists, and filmmakers are only a few of the types of creators drawn to the area. Events such as Crafty Wonderland and the Portland Zine Symposium, library programs including knitting clubs, and a *Destination DIY* radio show all demonstrate excitement and engagement with the movement. But within this vibrant community, receptive to DIY and Making, the high school dropout rate is alarming. In Portland Public Schools' class of 2009 fewer than 60% of students graduated on time and 20% dropped out (PPS 2010). The community is mobilizing to address the dropout rate, most notably through Ninth Grade Counts, which connects youth entering grade nine with the support they need to begin high school on the right track (NWEA 2011). The *Maker Center* and planning process funded by this grant will align with Ninth Grade Counts by providing opportunities for youth to engage in creative activities, be valued as resources, and work with adult role models. All these activities contribute to healthy adolescent development and strengthen the chances that youth will succeed in school and life (Search Institute 2006).

Finally, it is relevant to mention that OMSI has identified Innovation and Engineering as one of three content areas of strategic focus. OMSI believes that fostering 21st Century Skills is essential and sees the *Maker Center* as a critical step on that path. MCL has identified Support for K–12 learning as a priority area. While public libraries including MCL collect science, technology, engineering, and math (STEM) resources and offer STEM-related programming, there are few community spaces able to provide youth with skill building and hands-on access to Maker tools. MCL believes that the *Maker Center* will extend the library's capacity to engage teens in innovative ways and provide valuable information about potential future directions for the library. Partnerships such as this strengthen learning communities and have proven successful at improving student performance and preventing dropouts (NASBE 2009; Henderson 2002).

Project design

Description of the space

OMSI is a leader in creating interactive labs where open-ended engagement with scientific process occurs. In 1996 OMSI completed the nation's first wet chemistry lab, where visitors don safety goggles and conduct experiments with reactive chemicals, facilitated by youth volunteers and educators. Museums followed OMSI's lead, guided by OMSI's *Experiencing Chemistry*. In 2006 OMSI completed redesign of its Technology Lab with interactive technology stations and is now enhancing engagement in its Earth labs.

This project will allow OMSI to build on its lab experience to develop plans for a *Maker Center* that will add the engineering design process and an opportunity for skill building to the interactive lab experience.

Maker Center audience constraints: 1) it will support middle and high school teachers and their classrooms; 2) it will serve as a public space during non-classroom hours; and 3) it will be accessible for a general teen audience. OMSI's scholarship program will support Title I school programs. The space will facilitate use of educators and community advisors to provide expert guidance and mentor teens and teachers. The intent is to plan for teens after school or on the weekends, with a career ladder program to develop a cadre of teens as peer mentors. While OMSI's labs are free with museum admission, and widely accessible on monthly $2 Sundays, the *Maker Center* will expand access for teens by regularly offering free admission to teens with their library cards. In 2012 access for teens will increase with a new OMSI public transit station and in 2015 light rail will also connect to this station from the MCL Central Branch.

The final design of the *Maker Center* will be shaped during the planning process by the TAC, making it OMSI's first lab designed specifically for teens. The TAC will inform how visitors to the *Maker Center* engage with the engineering design process as they design, build, test, and refine their ideas. We envision highly trained education staff, including teens, guiding visitors through activities using digital tools and techniques, providing assistance as needed.

A design area may feature traditional design tools such as paper and pencil along with digital 3D and 2D design stations defined by the planning process. Perhaps the planning group will recommend that visitors' designs be uploaded to social media sites for critique by others, modification, and reposting. This is also where members of the community may hear about the latest design challenge posed by the Teen Advisory Council or flip through DIY reference media from an MCL satellite location.

In an area dedicated to making things, visitors don safety glasses as they mess around with a variety of tools and materials to make their ideas real. Some projects may be completed in a few minutes at the 3D printer while others may require a complex series of steps. Reused or up-cycled materials from OMSI's exhibit production shop and other sources may encourage participants to think sustainably. A gallery will display some of the latest products from participants, with teen curated shows traveling to branch libraries.

Key deliverables
OMSI recognizes the need for thoughtful and strategic planning to realize this vision for a *Maker Center*. As part of the planning process OMSI and MCL propose to develop the following key deliverables:

- A *Maker Center* design and programming guide, informed by expert and community advisors
- A teen engagement strategy and sustainable implementation plan
- A mentor recruiting, training, and retention framework
- An evaluation plan for the *Maker Center* and associated programs

The planning process will occur in six phases. In **phase one**, **project launch**, OMSI and MCL staff will function under OMSI's established project management system, defining a timeline to align milestones, benchmarks, and tasks with dates, roles, and responsibilities. Clear parameters and communication strategies are set. The team will connect with advisors and partners to plan for subsequent phases.

Phases two, three, and four will be centered on three **design charrettes** focused on Teen Audiences, *Maker Center* Design, and Program Development. Commonly used in the design field, a charrette brings together a diverse group of stakeholders to capture the best depth and breadth of thinking around a challenge. In each charrette, key staff, advisors, community representatives, and local teens will gather for presentations and small group work sessions to discuss issues, present ideas, and refine the vision of the *Maker Center*. After each charrette, findings will be summarized in a white paper and the project's logic model will be revised. Each charrette will inform subsequent charrettes and final *Maker Center* plans.

Sara Ryan, MCL's Teen Services Specialist, will lead the **Teen Audience Charrette,** focusing on strategies for engagement. Teen participants will be recruited from MCL's programs, the Multnomah Youth Commission (MYC), OMSI's youth volunteer program, and Portland metropolitan area middle and high schools serving populations with greater than 50% receiving free or reduced lunch. Preeti Gupta, vice president of Learning from the New York Hall of Science (NYSCI), will provide guidance based on best practices from NYSCI's Career Ladder program, which effectively recruits and retains underserved youth (Sickler 2009). This charrette will facilitate teen involvement for all aspects of the project and planning process—recruitment and retention, design and eventual implementation of the space, accompanying programming, the use of social media, and the role of mentors.

MCL will design and recruit the Teen Advisory Council (TAC) to help shape the *Maker Center*. Youth stipends and transportation assistance will allow participation of youth who require paid work and give a sense of value to the work. Participating youth will build valuable skills for collaborative project planning. A subset of teens will attend a Maker Faire in San Francisco and participate in case study site visits to similar spaces. Throughout the process, TAC members will communicate impressions through iRemix.

Building on each institution's successful volunteer programs, OMSI and MCL will explore a system of adult mentor recruitment, training, and retention. The structure will be advised by Oregon Mentors to ensure the use of best practices. Deb Mumm-Hill of the local FIRST (For Inspiration and Recognition of Science and Technology) organization will advise the recruitment and training of mentors with needed technical skills.

Chad Jacobsen, OMSI's creative director, will lead the ***Maker Center*** **Design Charrette**, working with the TAC, the project team, the local creative community, and advisors including architects and engineers. *Maker Center* specifications will be defined, including key features, staffing requirements, layout, and look and feel. Designers working with teens may create 3D models of furniture for use in the space. An OMSI space to meet the defined specs will be identified. A *Maker Center* design document will be produced with iterative feedback from the TAC and professional consultants, including Jim Newton, Founder of TechShop.

Project PI David Perry will lead the **Program Development Charrette** working with the TAC, advisors, and project team members to create a rubric for development of teen friendly activities. These activities will use digital design tools to engage teens with the design process and encourage use of 21st Century Skills such as creativity, collaboration, communication, problem solving, research, and use of technology. The framework will ensure there are activities at all three levels of HOMAGO engagement (Ito 2010). Several workstation concepts will be developed using this framework, based on input from the *Maker Center* Design Charrette. Program developers will work closely with the TAC and evaluators to develop instruments to measure the degree to which activities encourage creative exploration and tinkering with technology and meet criteria identified by teens for accessibility.

During **phase five**, the team will select one workstation concept for **prototyping**. The prototype might include digital design software on a computer workstation and output to a Computer Numerical Controlled (CNC) fabrication device such as a 3D printer, laser cutter, or milling machine. An example activity may include modifying a 3D model of a popular gaming character for output to a printer or designing a simple image to engrave on a mobile device. Prototyping of the activities and workstation will occur with the TAC, followed by OMSI youth volunteers and an OMSI Teen Night. Additional prototyping at MCL branch library locations will reach teens who may not be regular OMSI visitors.

Experienced adult mentors will facilitate teens' equipment use during initial prototyping. In a second round of prototyping, teens will act as facilitators for testing with the public. Teens most engaged with the planning process will be selected to receive additional training to support visitors as they use the equipment and create projects. This iteration of testing will determine if the *Maker Center* concept can be a platform to provide teens with the opportunity to practice communication skills and take on leadership.

The **sixth phase**, **synthesis and reporting**, will include refining plans for implementation and ongoing operation, refining the framework for teen and adult mentor recruitment, and development of a guiding rubric for ongoing assessment and evaluation of alignment with identified 21st Century Skills with programming in the *Maker Center*. During this phase, the project team will assemble a final report for use in securing partnerships and funding for full implementation.

Project goals and impact

Efforts toward accomplishing project goals will be informed through evaluation, professional critique, and iterative development. A developmental evaluation of the planning process and deliverables will be implemented in collaboration with OMSI's evaluation team, project partners, and project participants.

The *Maker Center* evaluation plan will be based on an outcomes-based logic model developed iteratively during the project. An attached logic model describes the team's current thinking on the *Maker Center* and youth engagement impacts. The logic model organizes desired outcomes of the *Maker Center* and mentorship program into the three levels of the HOMAGO framework, with impacts in the categories of 21st Century Skills, learner interest, and identity. Evaluation activities will inform improvements to an outcomes-based *Maker Center* logic model that will be used in the full project.

Target audience participants will test prototypes of activities to inform final activity development. OMSI's evaluation team will lead visitor testing of an early prototype activity to establish a protocol that measures the 21st Century Skills of creativity, problem solving, and using digital design technologies. Team members will conduct subsequent participant testing on additional prototype activities and revisions until they have the information needed to ensure selected activities have the potential to achieve desired outcomes.

The team will monitor results of efforts to engage youth in planning and development. OMSI's evaluation team will communicate directly with the youth to assess the extent to which they participated in planning and development and the extent to which participation resulted in intended and unanticipated outcomes related to the 21st Century Skills of creativity, problem solving, and using digital design technologies.

Use of technology and staff

Programming at the *Maker Center* will use the iRemix social network to allow teens and mentors to post projects and give each other feedback. Some content will be private, while some will be able to be shared, such as OMSI and MCL online presences, school sites, and within teens' own online communities.

In addition to these avenues of social learning, MCL and OMSI will create an in-depth mentorship program to specifically support teen participants. The mentors will operate under the supervision of an OMSI senior educator in collaboration with MCL staff and with administrative support from OMSI's Volunteer Services department. Adult mentors will support teens who are hanging out in the *Maker Center*. Adult mentors will also support development of leadership skills in the youth who take a more active role and are looking to become teen peer mentors. The adult and youth peer mentors will work together under the leadership of the senior educator to support the use of the space by general museum visitors or by teens that use their library cards to visit the *Maker Center* on teen-only afternoons.

The general public will hang out and create simple pre-designed projects under the guidance of youth and adult mentors. The *Maker Center* will also offer programs for youth in middle and high school as part of field trips or during teen nights to further mess around, gaining deeper skills with design and technology use. Those teens who are exceptionally interested may decide to visit the *Maker Center* more often, participate in more instructional programs, or ultimately become mentors themselves. These youth will be able to share their interests and skills with others and define the evolution of the space.

Project resources: budget, personnel, and management

OMSI will provide leadership and oversight of the planning process, drawing on resources and expertise internally and from MCL. OMSI has successfully planned and executed large scale projects, including the

design and construction of numerous interactive lab spaces. OMSI will act as physical agent, provide administrative support, coordinate advisor meetings, lead charrettes 2 and 3, develop prototype activities, refine and manage the evaluation plan, and provide project oversight. OMSI will provide prototyping venues, identify a space for the *Maker Center*, and support teen/adult mentor recruitment.

An OMSI project manager will oversee a timeline that aligns milestones, benchmarks, and tasks with due dates, roles, and responsibilities. BaseCamp will be used to ensure that timelines, meeting minutes, and working documents are accessible to MCL and OMSI staff and advisors. Key staff and the TAC will use iRemix to communicate and collaborate with other Learning Lab sites. A kick off meeting for stakeholders will be used to align expectations, decision making processes, and communication channels.

MCL has committed the staff and resources to support the *Maker Center* planning. MCL will lead the creation and coordination of the TAC, in collaboration with the Multnomah Youth Commission, and will lead the Teen Audiences Charrette. MCL will consult on *Maker Center* design and program development, assist in teen and adult mentor recruitment, host prototyping sessions at branch libraries, and be a venue for displaying teen projects. MCL will leverage the process to develop strategies for ultimately providing resources to the *Maker Center*, such as print and digital media for check out by *Maker Center* participants.

Key Personnel

David Perry, MEd, OMSI Science Education manager, has 10 years of informal science education (ISE) experience. As Principal Investigator, will ensure that project goals are reached and design for the *Maker Center* is successful, have oversight of project scope, and lead the phase four Prototyping charrette.
Ray Vandiver, PhD, vice president, Center for Learning Experiences, has 18 years of ISE experience. He will advise the overall organization and direction of the project as Co-PI.
Sara Ryan, Teen Services specialist, MCL, will lead phase 1 Teen Audience charrette. She will be project lead on developing and coordinating the activities of the TAC throughout the planning process.
Chad Jacobsen, creative director, has 15 years of exhibit design and production experience. He will oversee design of the physical space and lead the phase 3 Design charrette.
Marcie Benne, PhD, manager, Evaluation & Visitor Studies, has 12 years experience in research and evaluation. She will lead evaluation activities.
Rachel Mills, Director of Digital Media, has over seven years of relevant experience. She will lead the integration of social media and the development of a marketing plan.
Kristin Bayans, MA, senior educator, OMSI's Vernier Technology Lab, has five years experience in ISE. She will be responsible for implementation of prototype activities and advising *Maker Center* design.

Advisors

Tedros Abraham, Community Engagement Coordinator for the Ninth Grade Counts initiative will consult on teen engagement strategies.
Mark Fernandes, Youth Development Coordinator for The Multnomah Youth Commission will collaborate with MCL to create the TAC and help ensure the project is accessible to diverse youth audiences.
Preeti Gupta, vice president of Learning from the New York Hall of Science, will consult with the project team on the design of the teen peer mentor program.
Deb Mumm-Hill, Pacific Northwest regional director of FIRST (For Inspiration and Recognition of Science and Technology), will advise the project design team and assist with *recruitment* of TAC members.
Jim Newton, founder of TechShop, will advise on design and function of *Maker Center* including equipment setup/maintenance, safety/liability, and mentor training and a key role in strategies for future fundraising.
Julie Sabatier, producer of the *Destination DIY* radio show, will advise on recruitment of mentors.
Celeste Trull Janssen, Program Manager at Oregon Mentors will consult on design of the mentorship program to ensure use of best practices and assist with recruitment of mentor candidates.

BUDGET FORM - PAGE FOUR

Section B: Summary Budget

	$ IMLS	$ Cost Share	$ TOTAL COSTS
1. Salaries and Wages	37,077.00	12,602.00	49,679.00
2. Fringe Benefits	8,959.00	3,054.00	12,013.00
3. Consultant Fees	17,430.00	37,882.00	55,312.00
4. Travel	3,130.00		3,130.00
5. Supplies and Materials	12,368.00		12,368.00
6. Services			0.00
7. Student Support			0.00
8. Other Costs			0.00
TOTAL DIRECT COSTS (1—8)	78,964.00	53,538.00	132,502.00
9. Indirect Costs	21,014.00	18,283.00	39,297.00
TOTAL COSTS (Direct and Indirect)	99,978.00	71,821.00	171,799.00

Project Funding for the Entire Grant Period

1. Grant Funds Requested from IMLS	99,979.00
2. Cost Sharing:	
a. Cash Contribution	
b. In-Kind Contribution	71,821.00
c. Other Federal Agencies*	
d. TOTAL COST SHARING	71,821.00
3. TOTAL PROJECT FUNDING (1+2d)	171,800.00
% of Total Costs Requested from IMLS	5,819.00%

* If funding has been requested from another federal agency, indicate the agency's name: