



NATIONAL ENDOWMENT FOR THE

Humanities

DIVISION OF PUBLIC PROGRAMS

Narrative Section of a Successful Application

The attached document contains the grant narrative and selected portions of a previously funded grant application. It is not intended to serve as a model, but to give you a sense of how a successful application may be crafted. Every successful application is different, and each applicant is urged to prepare a proposal that reflects its unique project and aspirations. Prospective applicants should consult the Public Programs application guidelines at <http://www.neh.gov/grants/public/americas-historical-and-cultural-organizations-implementation-grants> for instructions. Applicants are also strongly encouraged to consult with the NEH Division of Public Programs staff well before a grant deadline.

Note: The attachment only contains the grant narrative and selected portions, not the entire funded application. In addition, certain portions may have been redacted to protect the privacy interests of an individual and/or to protect confidential commercial and financial information and/or to protect copyrighted materials.

Project Title: Shaping America: Machines and Machinists at Work

Institution: American Precision Museum, Inc.

Project Director: Carrie Brown

Grant Program: America's Historical and Cultural Organizations: Implementation Grants

American Precision Museum NARRATIVE & SPECIAL REQUIREMENTS

Shaping America, Machines and Machinists at Work

NARRATIVE

1. NATURE OF THE REQUEST

At a site uniquely positioned to tell the story of precision manufacturing in America, this project interprets the American Precision Museum through a permanent exhibition and related programs about the people who made and used machine tools and the rise of the “American System” of manufacturing.

With support from an NEH Planning Grant (2008-2009), the museum developed an interpretive plan that will use our site and our collections to explore broad themes of innovation and problem solving, craftsmanship, and the influence of precision manufacturing upon American history and culture. Focusing on the people whose work made great societal changes possible, the new exhibition will fill the main exhibit floor, which occupies nearly 4,000 square feet. It will include 31 historic machine tools, approximately two-dozen smaller artifacts, along with archival materials, photos, hands-on activities, audio clips, and videos. The plan also calls for installation of a working machine shop, staffed by student interns. To complete the design and installation of the permanent exhibition and to fully develop accompanying public programs, APM plans an implementation project with a total budget of \$889,380 of which \$389,308 is requested from the NEH. The exhibition will open May 2014.

2. PROJECT INTRODUCTION

The museum is housed in the 1846 Robbins & Lawrence Armory, a National Historic Landmark, in Windsor, Vermont. It was in this building that Richard Lawrence and his associates perfected the system of making guns with interchangeable parts. This will be the first major, permanent exhibition anywhere to explore Vermont’s industrial history in depth, and it will overturn many a visitor’s pre-conceived notions about New England industry. **Ours is not the well-known story of the New England textile mill operators, but the lesser-known story of inventors, machinists, and skilled craftsmen who made possible the production of interchangeable parts.** Windsor is considered the cradle of “Precision Manufacturing,” and developments here led to the founding of the machine tool industry in America. That industry in turn led to mass production, which makes possible mass communication, rapid transportation, modern standards of sanitation and medical care, abundant food and clothing, and the leisure for universal education. Our working exhibition title is *Shaping America: Machines and Machinists at Work*.

Themes. The exhibition will explore three major humanities themes: (1) **Innovation**—What is it? How does it occur? (2) **Work**—How are technical training, craftsmanship, and skill passed along? How important are these attributes today? (3) **American Culture**—How did the machinists and tool builders of “Precision Valley” influence the course of American history, helping drive rapid industrialization, the emergence of the United States as a world power, and the development of the consumer culture? Our work on these themes builds upon the scholarship of Merritt Roe Smith and David Meyer on the role and nature of innovation in 19th century America; Edwin Battison, David Hounshell, and Donald Hoke on the development of the American System; and Steven Lubar and Brooke Hindle on the role of machinery in the broad sweep of American history. (Dr. Lubar and Dr. Smith are both members of the planning team.) Exploring our three themes through the lens of the history of our site and the history of precision manufacturing, the new exhibition and related programs will encourage visitors to make connections between American history, their own lives in the present, and the future of the American culture and economy.

The place. The Robbins & Lawrence Armory building provides the ideal site for telling the story of how precision manufacturing transformed American industry and American culture. The first phase of the Industrial Revolution had been imported from Europe to America in the late eighteenth century and was largely modeled on the English system of textile manufacturing. In 1846, when the Robbins & Lawrence Armory was built, the second phase—the American System—was about to be launched. In the remote

village of Windsor, entrepreneurs and artisans had already constructed a series of dams on Mill Brook, to power sawmills and a gristmill. Census records also list a stonemason, several carpenters, a printer, a bookbinder, and the owner of a foundry. There were at least two gunsmiths in town. In small workshops such as these, inventors came up with ideas for making new products and for making both new and old items more quickly. In Windsor and other towns up and down the Connecticut River Valley, new industries attracted more people and stimulated the creation of commercial downtowns. Mills and stores and homes were clustered together between the river and the steep hillsides.

In 1846, Samuel Robbins, Nicanor Kendall, and Richard Lawrence took the bold step of bidding on a government contract for 10,000 rifles. Having won the contract, they constructed a four-story brick armory building beside Mill Brook. They brought in workers and mechanics, invented new machines, adapted old ones, and perfected techniques for producing interchangeable parts. Within a few years, they were exporting not only rifles but also their new metal cutting machines across North America, to England, and around the world. The technology for making guns was quickly adapted to the making of consumer products as well as parts for many other machines.

The museum's holdings include an unparalleled collection of industrial machinery spanning the first hundred years of precision manufacturing, along with fine examples of early machined products including rifles, sewing machines, and typewriters. Photographs and archival records provide additional resources for interpreting this critical phase of the Industrial Revolution.

The armory building itself is significant for its architectural integrity. Both inside and out, it shows visitors the size, scale, and operation of a 19th century factory. The building is a *National Historic Landmark*. In 2001, it was designated a special project of *Save America's Treasures*; and in 2003, APM received a *Save America's Treasures* award of \$200,000 for the installation of a new slate roof to replace the deteriorated original. In 2007, APM and other town partners in Windsor, Vermont, were awarded a *Preserve America* grant to create interpretive signage and to update and expand an architectural walking tour. APM is a heritage site along the *Connecticut River Byway*, designated a national scenic byway by the federal Highway Administration in 2005. The museum was designated an *International Heritage Site and Collection* by the American Society of Mechanical Engineers in 1987. For each of these designations, the site was deemed not only a place where pivotal events occurred in the history of American industry, but also a site that lends itself to thorough interpretation of that history.

Why a new interpretation? Despite the significance of its site and its collections, this small museum has never been able to fully interpret its own story. For many years, the collection of historic machine tools occupied most of the main exhibit hall. Each machine had its own label, but over-arching themes were never developed to provide context. Only visitors who already knew and cared about machine tools—mostly machinists and engineers—could appreciate the significance of what they were seeing. The museum's staff, board, and advisors recognized that to fulfill its mission, APM needs a new interpretation that speaks to a far wider audience.

Project History. APM interpretive planning efforts were formally launched in 2006, with a two-day convening of scholars, historians and educators, supported by the Vermont Humanities Council and the Walter Cerf Fund. That meeting resulted in an Interpretive Planning Report that was adopted by the museum's Board in the fall of 2006. In April 2008, the museum was awarded an NEH Planning Grant under the *Interpreting America's Historic Places* Program. Along with matching funds from individual donors, foundations, and corporate supporters, this grant supported development of a detailed interpretive plan. Work included a full year of research and script development for the project curator, including examination of archival material never before used in APM's interpretation of precision manufacturing. The Vermont Folklife Center conducted 21 oral history interviews with current and retired members of the local machine tool industry. A subset of the planning team visited several other museums and historic sites in New England, studying the treatment of related themes and gathering ideas on how to explain

technical topics through a combination of artifacts, interactives, and multi-media components. The full interpretive planning team met four times in Windsor, and members read and discussed the exhibit plans at every major stage, from original theme development to a draft of the complete script. The exhibit designer participated in all meetings and developed a floor plan and design philosophy with support from the entire team. In 2008, with funding from the Museum Assessment Program (MAP) of the Institute for Museum and Library Services (IMLS) and the American Association of Museums (AAM), APM conducted a Public Dimension Survey, which culminated in a site visit and report by Edward Pershey, Vice President for Museums at Western Reserve Historical Society. The self-assessment and Dr. Pershey's report helped shape the interpretive plan. In the spring of 2009, APM convened a Teacher Advisory Group to help outline a school visit program. In 2009-10, additional research was completed in preparation for an exhibit about the Civil War home front to open in 2011.

Related Projects at APM. After completing a MAP study of the collections in 2005, APM was awarded a three-year grant from IMLS, enabling us to hire our first Collections Manager. APM now has a complete inventory and electronic and paper records of the object collection, a necessary first step in exhibition planning. A series of smaller projects led to creation of a workable inventory of the archival collections. Progress in public programming has occurred simultaneously. During 2006-07, APM developed for classroom use a traveling curriculum kit on the Industrial Revolution in Northern New England, using themes closely tied to the Interpretive Plan. With support from the Challenge Cost Share Program of the National Park Service, APM also has developed two Quests that aid families and students in exploring the museum and its neighborhood. In 2008-09, support from the Vermont Department of Labor enabled APM to develop a cultural heritage-manufacturing partnership with a local high school technical education center. We created a prototype of the working machine shop called for in the Interpretive Plan, and staff it with student interns. In 2009, industrial historians from the Historic American Engineering Record program of the National Park Service completed a study documenting the evolution of the building from its erection in 1846 to the present, with focus on the water wheel and millwork system that provided power during its period of significance, the Robbins and Lawrence era. Interpretive drawings produced during the study were mounted into an exhibit that opened in 2010, accompanied by a print version of the entire report for sale in the museum shop.

Collaborations with other neighboring organizations also support our themes. In 2006, APM was one of the lead partners in a collaboration of municipalities, museums, historic sites, and chambers of commerce in seven historic industrial villages that created a print brochure called "From Mills to Main Streets on the Connecticut River Byway." The new exhibition at APM will strengthen the visitor's understanding not just of Windsor, but of towns all along the route.

Related Projects at Other Sites. No other museum in Vermont treats Vermont's industrial history in any depth. Displays of beautiful and historic carriages, the occasional exhibit on a local inventor or a local industry, and exhibits that explore the changing Vermont landscape and workplace all suggest the connection between Vermont industry and the larger national experience. The APM site and collections offer the unique opportunity to treat Vermont's industrial history more fully and to demonstrate the national importance of technical innovation that occurred here. APM is also unique in the broader region. While other museums and historic sites in New England, most notably the Lowell National Historical Park, do a superb job exploring the early textile industry, the APM story is not primarily about textile mills. The textile model was developed in England and adapted to the New World. The American System, with its precision machines and techniques, was indigenous to America and was exported back across the Atlantic. While textile mills were staffed primarily by low-skilled, transient labor, the workers who built and operated machine tools were often highly skilled, lifelong craftsmen. Furthermore, the concepts of technical change and innovation are not well developed at Lowell, whereas invention and innovation are key themes in our project. The National Park Service site at the Springfield Armory in Massachusetts does offer the opportunity to examine the development of precision manufacturing, but their focus is

necessarily on the military uses of the technology, and they emphasize the rifles much more than the making of them. The Eli Whitney Museum (Hartford, CT) is grounded in a similar subject matter, but their focus is almost entirely on education programs that foster the inventive spirit, rather than on exhibits and interpretation of historic artifacts. The Charles River Museum of Industry (Waltham, MA) has a historical scope similar to that at APM, but the original mill building has been converted to apartments, and the museum, which closed unexpectedly in 2010, is housed in a 20th century addition. At the National Museum of American History (Smithsonian), the exhibition “Engines of Change” has closed, and there are no plans for new projects on industrial history.

Unique Contribution. At the American Precision Museum, we have the ability to combine the atmosphere of a genuine nineteenth century factory building with a world-class collection of historic machines; to overturn common perceptions about Vermont history by placing a comprehensive exhibition on industrial history at the foot of the Green Mountains; and to interpret America’s “other” Industrial Revolution—a revolution in precision manufacturing.

3. DESCRIPTION/ASSETS

The greatest assets of this historic site are the armory building and its setting. Both inside and out, visitors can experience how the armory’s design contributed to the efficiency of the factory. The tall, four-story structure rises from a stone foundation adjacent to a rushing brook that provided immediate and efficient use of waterpower. Inside the building, power was distributed throughout each floor with line shafting, and the shafts were connected to individual machines by leather belts. The overhead shafting and belting still exist, and a few of the machines will be made to run. Repetitive and ample windows, and the building’s narrow width relative to its length (40’ x 100’), brought daylight into the interior work areas. An open exhibit design will be faithful to the original long expanse of factory floor crowded with machines. Outside, the immediate neighborhood is still home to worker housing that was built at various times in the factory’s history. The nearby Connecticut River and the still-operating railroad tracks attest to the importance of transportation in the development of the site.

Within the original factory space, we will develop our story chronologically. The major artifacts in the exhibition are historic machine tools ranging from an 1825 lathe with a massive granite bed to a modern, computer-controlled milling machine. While the museum’s exhibits have always endeavored to explain how these machines work and how they evolved, the new interpretation will focus on connecting the machines to *people*—how innovative people created improvements in manufacturing techniques, how they worked together to solve problems, and how their knowledge and skill passed from one person to another and from one factory to another.

Each historical section will feature one or more machinists, brought to life through photographic or illustrative depictions, along with their letters, mechanical drawings and payroll records. Their skills and the ever-increasing precision of their work will be conveyed with machinists’ tool chests, hand tools, and precision measuring devices, along with smaller artifacts including historic guns, sewing machines, a high wheel bicycle, and typewriters—early products of mass production that changed everyday life and work. The twentieth century section will feature clips from oral history interviews with people who built and operated machines that helped win two World Wars, along with early examples of computer-controlled machining. The final section of *Shaping America* points toward the future: the working machine shop is staffed by student interns who may be the tool designers of tomorrow. Visitors will be encouraged to think about problem solving, collaboration, and technical innovation in their own lives, and the challenges our nation faces today and in the future.

Nearly all of the artifacts, documents, and photographs in the plan are in the museum’s own collections. The National Museum of American History (Smithsonian) has tentatively agreed to the long-term loan of an 1850 machinist’s tool chest. Three photographs selected from the Library of Congress are in the public domain. Two more are in the collection of the Connecticut Historical Society. We have secured video footage of modern machine tools from corporate friends of the museum and historic footage from a retiree

of a local machine tool company. We have obtained permission from the National Park Service to use a film clip showing the operation of the Blanchard gunstock lathe, one of the earliest machines to mechanize the production of muskets. Important footage from a World War II "March of Time" newsreel filmed in Vermont will require a \$3,000 permission fee to Time/Warner. One key hands-on interactive is being designed by a museum trustee who is an inventor and industrial designer. A computer animation will be created as a student project at Brown University. The working machine shop has been planned and overseen by a local industrial arts teacher who is also a master machinist.

4. AUDIENCE

During the 40 years since its founding, the museum's primary audience has been older white males already interested in the mechanical arts. Its greatest challenge has been finding ways to reach families, women, children, and school groups. The self study portion of the MAP Public Dimension Report reinforced this need. The MAP reviewer also challenged APM to make our esoteric topic meaningful to an audience far removed from the subject: "Fewer and fewer Americans engage in, are employed by, or come in contact with manufacturing in any meaningful way, except as consumers.... APM needs to consider how it will embrace and interpret manufacturing...that is going on NOW so that it can meet its mission of making the topic relevant to 21st century American lives." Our interpretive plan, with strong encouragement from the historians on the team, faces this problem by developing the themes of innovation and problem solving, which are as important today and tomorrow as they were in 1846.

The museum's strategic plan adopted in 2009 calls for reaching out to three audiences: (1) school groups and the local general public, (2) heritage tourists, and (3) machine tool enthusiasts.

School groups and the general public. The Upper Connecticut River Valley is dotted with former manufacturing towns struggling to find a new economic base in the twenty-first century and to maintain civic pride in the face of economic difficulty. Young people, especially, have little knowledge of the region's strong industrial past. The APM traveling kit and the new exhibition at the museum will foster pride in students' own communities while addressing state standards for local history, American history, and technology. The working machine shop, staffed by local students, provides a strong link to the young audiences that we are trying to reach with our messages about innovation, craftsmanship, and mechanical creativity. For families, the new exhibition's human stories, hands-on activities, and live demonstrations will make APM a place where families come to learn together about Vermont's industrial heritage and to explore their own connections to machinery, mechanical ingenuity, and mass production.

Heritage Tourists. In a 2007 survey conducted by the Vermont Department of Tourism and Marketing, 79% of visitors to Vermont reported that they participated in cultural learning activities; and among those tourists, visiting historic sites was by far the most popular activity.¹ APM is well positioned to reach these visitors. Windsor is the birthplace of the Republic of Vermont, an independent entity formed in 1777, before Vermont joined the union as the 14th state. The Windsor Village Historic District was admitted to the National Register in 1975 and was recently expanded. The Saint-Gaudens National Historic Site is just across the Connecticut River. The 460-foot Cornish-Windsor Covered Bridge, a National Historical Civil Engineering Landmark originally built in 1796, draws tourists from around the globe. By tying Vermont's industrial heritage to that of the nation at large and by exploring how mechanical ingenuity has influenced the course of American history, our new exhibition will make a visit to APM more appealing to these heritage tourists. Our upcoming publicity campaign will increase our ability to reach them. Tourists who come to Vermont for its rural beauty, covered bridges, rich artistic heritage, and spectacular fall foliage should not go home without also learning about the region's key role in the development of American industry.

Machine Tool Enthusiasts. The museum will not forget the group that has been its primary audience for forty years. Older machinists and engineers from the area are mentoring our young interns. Retired machinists and their families, those who work in the machine tool industry, scale model enthusiasts, and

¹ Portland Research Group, EPR/VDTM VT Visitor Profiling, September 2007

those interested in industrial archaeology will still want to explore our building and our collections. The new exhibition will add new dimensions to their experience by describing the historical importance of the armory and of the machines that it houses. Visiting enthusiasts often note with regret that the general public—and even their own families—do not understand and appreciate the special culture and way of life that machinists love, value, and fear losing. Our core audience is embracing and supporting APM's effort to address that concern. The Association for Manufacturing Technology (AMT), the industry's trade group, is assisting us in completing an 8 minute video about the museum that will premier along with a 10,000 s.f. panel exhibit accompanied by artifacts at our booth at the industry trade show in Chicago in September 2010. 90,000 visitors are expected at this biennial event. The exhibit will come home to be reused at other offsite venues.

Publicity. Throughout the planning phase of the project, the museum has publicized the ongoing work in several issues of its newsletter and in its annual report. The museum places print brochures at standard distribution sites in Vermont, New Hampshire, Massachusetts, and Connecticut. We have small exhibits at three visitors' centers in Vermont, and we participate in print and digital marketing through the Vermont Department of Tourism and Marketing and the Vermont Attractions Association. *Shaping America* and its related activities will be featured in each of these locations. When the exhibition opens, we will mount a region-wide publicity campaign, reaching out to our statewide media network, which includes two regional television stations; a multitude of newspapers; the magazines *Vermont Life*, *Upper Valley Life*, *Yankee*, and *Vermont Magazine*; and both New Hampshire Public Radio and Vermont Public Radio. The museum's web site is easily found through the major search engines, and we will prepare a new page that describes the exhibition, including photos of key artifacts.

Evaluation. Front-end evaluation included study of several years' of visitor surveys, input from our Teacher Advisory Group prior to development of the school kit, and the MAP survey, which included both a self-assessment and a reviewer site visit. A prototype of the working machine shop was installed in the summer of 2008, and visitor feedback has been overwhelmingly enthusiastic. In the implementation and installation phase of the project, the shop will be relocated to a more visible place on the exhibit floor, and training materials will be developed to help the interns better integrate their presentation with the historical exhibits. During the implementation phase of the project, we will build two major hands-on components of the historical sections and test them for an entire season. After the exhibition has opened, the museum will conduct three types of evaluation. Using Beverly Serrell's model of analyzing "time on task," "sweep rate," and "percent of diligent visitors,"² we will place volunteers in the gallery, on four typical days of the first two seasons, to study and record how visitors use the exhibits. We will also create and distribute a questionnaire, based on the "visitor outcomes" developed by the planning team.³ Finally, at the end of three years, we will compare visitor attendance, special program attendance, and new memberships with figures for those categories in the three years preceding the opening of *Shaping America*. The museum will make use of the findings to improve the permanent displays and also to help formulate new ways of reaching audiences through temporary exhibits, programs, publications, and the web site.

5. ORGANIZATION PROFILE

Mission Statement: *The American Precision Museum is a national center for the collection, preservation and interpretation of the history of precision manufacturing. Our mission is to enhance public*

² Beverly Serrell et al., *Paying Attention: Visitors and Museum Exhibitions*, (Washington, D.C.: American Association of Museums, 1998).

³ These visitor outcomes are listed and discussed in the "Special Requirements" section of the application. The planning team developed the visitor outcomes based upon the work of Barry Lord, Lynn Dierking, John Falk, and others. See bibliography.

understanding of the importance of precision manufacturing, the ingenuity and entrepreneurial spirit that drive it, and its effect on our everyday lives. (April 30, 2007)

In 1966 APM was founded by and for 30 years directed by Windsor native Edwin A. Battison (formerly Curator of Mechanical Engineering, National Museum of American History, Smithsonian Institution). He secured the old Robbins & Lawrence Armory to house the museum and assembled a world-class collection of historic machine tools and related books and archival materials. In 1999 new leadership began professionalizing the operations, preserving the physical assets, and marketing to a wider audience. Guided by 1999 Conservation Assessment Program (CAP) reports on the building and collections, APM undertook a major restoration effort, installing a new slate roof, completing interior structural repairs, restoring 2/3 of the historic wood windows, re-wiring the building, updating security and fire detection systems, and launching a masonry restoration program. APM strengthened governance and financial operations with revisions to the Bylaws, code of ethics, new strategic plans, and updates to policies concerning collections management, personnel, gift acceptance, membership, and investments. Through a three-year IMLS grant, in 2007 the Collections Manager undertook a full inventory of the object collections and set new management and recordkeeping standards. A new 2010 IMLS award will enable us to hire a collections assistant. The Interpretive Plan was developed between 2006-2009. In 2009, APM completed a HABS/HAER study of the remains of the water wheel pit and millwork.⁴ In 2010-11, thanks to an NEH Sustaining Cultural Heritage grant, a conservator / preservation architect team will review temperature and relative humidity data gathered since 2005 and develop a plan to address conditions adversely affecting the collections and building. The plan may include ways to address heating and cooling so as to extend the visitor season. At present, the main exhibit area in the armory building is unheated, and exhibits are open to visitors only from Memorial Day weekend through October. Recent projects have enabled us to serve audiences throughout the year. The school kit takes our main themes into the classroom over the winter, with the option of visiting the museum in the fall or spring. Our “Windsor in the 1860s Quest” can be explored whether the museum is open or not, and instructions to follow it are widely available.

Since the mid 1990s we have featured special exhibitions about every two years. In 2007, we presented a SITES exhibition, *Doodles, Drafts and Designs: Industrial Drawings from the Smithsonian*,⁵ along with an exhibition of paintings by Vermont artist Charlie Hunter, entitled *Windsor Post-Pastoral: The Changing Landscape of the Birthplace of Vermont*. From 2008 -2010, *From Muskets to Motorcars* celebrates the 2008 centennial of the Model T by showing how precision manufacturing made mass production possible. Public programs have included an antique car rally, a high wheel bicycle expo, and a gallery talk about precision timekeeping. In 2008, the museum began highly successful “Behind the Scenes” tours that give visitors a look at the artifacts in storage.

APM visitation during our five-month season ranges around 5,000, peaking July through September. The museum has nearly 400 individual and family members, and many of our keenest supporters are from distant parts of the country. Operating budgets for the prior and current fiscal years ending April 30 are \$401,407 and \$485,350 respectively.

The museum’s staff consists of three full time and two part time employees. The Board of Trustees includes members of the machine tool industry, a museum professional, historians, and a retired preservation professional. An Advisory Board includes several historians, educators, community leaders, and representatives of current machine tool companies.

⁴ Historic American Building Survey/Historic American Engineering Record, <http://www.nps.gov/hdp/standards/index.htm>

⁵ The exhibition at APM consisted of reproductions from the original traveling show. <http://www.sil.si.edu/exhibitions/doodles/index.htm>

6. PROJECT TEAM

APM Staff and Board Team Members:

Ann Lawless has served as APM Executive Director since 2003. She has been responsible for the professionalization of museum governance and operations and has led the building stabilization and restoration effort, collections improvements and the interpretive planning projects that began in 2006. During this project, she will continue to lead the overall effort, integrate the development of the new exhibition with ongoing museum operations, and lead the effort to find implementation funding.

G. Boden Harris, Collections Manager, holds a master's degree in Museum Studies. He will oversee preparation of artifacts for display, secure loan agreements, provide label information support, and track all objects to be used in the exhibition.

Nancy Hoggson, communication and development, has 20 years' experience in fundraising and publicity for non-profit organizations in New England and New York. She will work with the Executive Director in securing support from individual and corporate donors and will plan and oversee the marketing effort for the new exhibition and its related public programs.

Hub Yonkers, a current and past Trustee, who co-chairs the Development Committee, is president of an engineering company that designs and prototypes mechanical solutions for medical and biotech applications. He served on the interpretive planning team and will help with the interactives.

Humanities Scholars:

Carrie Brown, Ph.D., is a consulting curator, independent scholar, and author who has guest curated five temporary exhibits for APM. She also has eight years' experience in non-profit management. She will continue as the Project Manager, local researcher, and lead curator.

Gray Fitzsimons is Project Director of a Teaching American History project at University of Massachusetts, Lowell. He served as Chief of Interpretation and as Historian at Lowell National Historical Park from 1986 to 2005. His museum experience is enhanced by his initial training as a civil engineer. He will read the draft script again and serve in an advisory capacity.

Steve Lubar, Ph.D. is Director of the John Nicholas Brown Center, Brown University and previously worked for more than 20 years at the National Museum of American History, Smithsonian Institution, first as historian and curator, and then as Chairman of the Division of the History of Technology. He will continue in an advisory capacity, reviewing the final exhibition script. He will also oversee the student project that produces the computer animation.

Greg Sharrow, Ph.D. is Director of Education at the Vermont Folklife Center. During the planning phase, he conducted 20 oral history interviews, and in 2009 and 2010 facilitated round-table discussions at APM machine tool employee reunion programs. He will continue in an advisory capacity, helping the team integrate his findings with the overall exhibition narrative and organizing public programs that draw in machine tool retirees.

Merritt Roe Smith, Ph.D., is professor of the History of Technology at MIT and Director of MIT's Program in Science, Technology, and Society. The author of many articles and books on the history of technology, Professor Smith is a Fellow of the American Academy of Arts and Sciences and past president of the Society for the History of Technology. He will continue as a consultant to the project, providing a final review of exhibit text.

Julie Wosk, Ph.D., is professor of Art History at SUNY Maritime College. She is the author of books and articles on art and technology, including *Breaking Frame: Technology and the Visual Arts in the Nineteenth Century*. She will consult on the visitor handout "The Art of the Machine."

Design Team:

Neal Mayer is lead designer for Wondercabinet Interpretive Design in Lexington, Massachusetts. Through more than twenty years of experience, he has designed exhibits for museums, science centers, and historic sites across the U.S. and as far away as Australia. As a member of the interpretive planning team, he produced the exhibit floor plan and sample elevations. He will complete the design during the implementation phase and oversee fabrication.

Joanna Bodenweber, graphic designer, holds an M.F.A. in graphic design from Yale University. Her work has included projects ranging from the Antwerp Zoo to the Museum of Fine Arts in Boston to the Chicago Museum of Science and Industry to the National Museum of the American Indian. She has worked closely with Neal Mayer of Wondercabinet on many projects, including APM’s exhibition, *From Muskets to Motorcars*.

Web Designer, to be hired in Year 3, according to the Request for Proposal in the Resume section, design team. We plan to engage a new design firm in fall-winter 2010-2011 to do some upgrades to the current site, and hope to continue to work with the same person. The designer will create new pages for the visitor feedback bulletin board.

Practitioner Consultants:

Susan Bonthron is an educator and documentation consultant who works on curriculum development and service learning initiatives. She will continue to help develop school programs and to coordinate with the Teacher Advisory Group.

Carolyn Frisa, conservator, holds a master’s degree in conservation of works on paper. She has been employed at the Tate, the Boston Society Library, and the Northeast Document Conservation Center. Currently she works independently in Vermont. She will be responsible for conservation of design drawings dating from the mid-nineteenth century and will advise on appropriate display techniques. (<http://www.worksonpaperconservation.net/index.html>)

7. WORK PLAN

APM is planning a temporary exhibition on the Civil War in Vermont to open in 2011, that will utilize some of the research also to be used in the Civil War segment of *Shaping America*, although the themes as well as the look and feel will be different. While the Civil War exhibit is in place, we will complete the design and plan for fabrication of *Shaping America*. The permanent exhibition will open on May 1, 2014. This somewhat protracted schedule provides a realistic allocation of time from the museum’s small staff and also allows the museum ample time for raising matching funds. A detailed, 3-page work plan may be found in Attachment #11.

Key:	Exhibition	Programs	Marketing	Fundraising	Plan. Team Meetings
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YEAR 1 May 2011 – April 2012	YEAR 2 May 2012 – April 2013	Year 3 May 2013 – April 2014
Plan hands-on elements.	Install one hands-on element, further testing. Refine plans for other elements.	Final version of hands-on elements
Plan computer animation. Identify all video components and audio clips.	Complete animation project. Audio editing (oral histories)	Video editing (machines in action)
		Develop public programs, school programs. Train interns & docents
		Marketing—including print, radio, TV, internet, conference presentations.
Secure large grant(s) and prepare fundraising materials for obtaining matching funds.	Apply to Byrne Foundation and Haas Foundation; seek individual & corporate sponsors	All funds in place before construction of main exhibit begins.
Exhibition text revisions. Final review by scholars.	Exhibition text final revisions. Copy editing. Permissions &	

Write artifact label text.	licenses. Arrange loans.	
Planning Team/Scholars meeting for review		“Art of the Machine” consultation w/Prof. Wosk
Artifacts & Images—final list	Specs for photos.	
Artifact & document conservation	Major artifact preparation	Framing, matting, mounting, final artifact preparation
Exhibit Design: detailed drawings	Lighting design; Fabrication specifications	Fabrication and installation of exhibitry, lighting
Begin Graphic Design, establish exhibit “identity”.	Panel and label layout	Printing & production of labels and brochures

8. FUND-RAISING PLANS

Exemption B4

SPECIAL REQUIREMENTS

1. INFORMATION ON ADMISSION

Because our exhibit area is not heated, APM exhibits are open seasonally from Memorial Day weekend in late May through October, daily 10am to 5pm, a total of approximately 160 days per year. General admission policy: \$6 for adults, \$4 for students, and an \$18 family rate. In 2010 we began offering free admission on Sundays, amounting to 22.8% of our days open. Admission fees are not included in project income. All exhibit areas are wheelchair accessible.

2. VISITOR WALKTHROUGH

The 1846 armory building, the new permanent exhibition, and the accompanying programs will explore industrial history in the context of innovation, creative problem solving, and the impact of precision manufacturing on American history and culture. When Robbins, Kendall, and Lawrence took their rifles

to the Crystal Palace Exhibition in London in 1851, the British reaction was two-fold. First: astonishment that the Americans had succeeded in creating a product with truly interchangeable parts. Second: a realization that the American political and economic system had created an *industrial* system focused on creating quality products for everyone, rather than ornate, expensive products for the wealthy elite. Precision manufacturing reinforced the growth of the American middle class and laid the foundation for the consumer culture that developed during the 19th and 20th centuries. Technical innovation, in some form, will provide the foundation for the economy of the 21st century. Our project weaves together the history of our site and our collection with the innovative spirit that must lead us into the future.

Visitors approach the museum one of three ways: (1) winding up a two lane road from the south, with Mount Ascutney on the left and the Connecticut River flowing by on the right; (2) crossing the river from New Hampshire over the longest covered bridge in the U.S.; or (3) traveling south down Windsor's historic Main Street, past the Old Constitution House, small shops, and stately homes built over three centuries, some now converted to offices and senior housing. In the museum's immediate neighborhood, small houses originally built for factory workers and a brick apartment building dating from 1920 cluster around a large brick factory



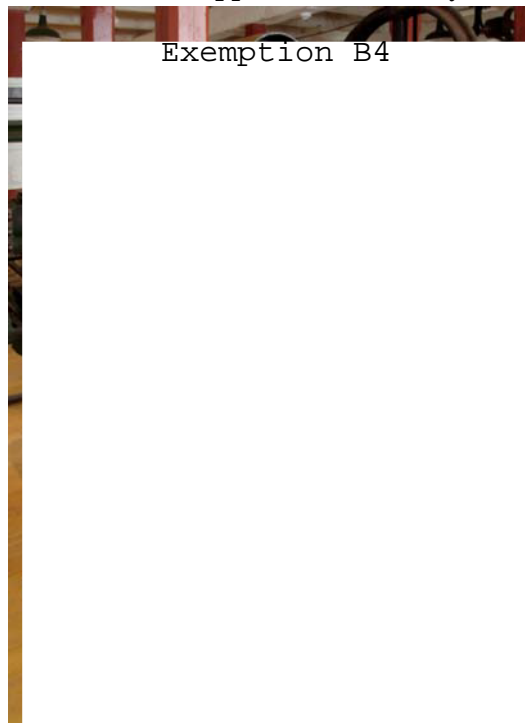
building that sits at the very edge of Mill Brook, right where the brook passes under Main Street. When you get out of your car or step down from your bus, the first thing you hear is the rushing of the brook as it passes over a waterfall. The four-story factory building towers above you. On the roof, a gilded rifle sits atop a cupola that originally housed a factory bell, signaling the change from agricultural time to factory time. The existence of such a building halfway up Vermont, on the eastern slope of the Green Mountains, at the foot of a ski resort is surprising in itself. For the heritage tourist, this is the Vermont that nobody knows: a site where innovation and technical know-how perfected new machines and helped launch a system of manufacturing that would change the world. For local families and school groups, accustomed to seeing deteriorating or re-used factory buildings in nearby towns, our exhibition and programs will illuminate the proud industrial heritage of their communities. For the machine and manufacturing enthusiast or retiree, we will provide a more complete story of precision manufacturing by placing comprehensible exhibits in one of the original buildings where the technology was perfected.

In front of the building, a new interpretive sign, scheduled for installation in 2010, will explain why the factory was erected on this site and will provide an overview of how waterpower works. A few steps down to a brick patio allow a clear view of the water tumbling over a dam. Returning to the front door, the visitor encounters bronze plaques announcing the site's importance as a National Historic Landmark and an International Engineering Heritage Site. Visitors pass into the building through a double, wooden door. Just inside the door, a large panel will introduce the Robbins & Lawrence Armory as a site where two unknown Vermont gun makers won a contract to make 10,000 U.S. Army rifles using interchangeable parts, and then went about the business of assembling the machines and the workforce to make it happen. Standing in the entryway, the visitor will look across the lobby into the main gallery—and the main factory floor. Inside, a teenager wearing a work apron and protective glasses will be operating a historic lathe. If a visitor's first impressions are about the power of the water rushing by and the surprising birth of a major industry in rural Vermont in 1846, the second impression will be that this is

a story about people designing, building, and using complex and powerful machines. Why did they build them? How did they invent them? What role did these people and these machines play over the course of American history? These are the questions that we hope to evoke in visitors, and that our new exhibits and programs will help them explore.

The Permanent Exhibition—*Shaping America: Machines and Machinists at Work*

A. Intellectual Approach: Machinery collections have their own special challenges and opportunities



beyond those of other classes of historical artifacts. In 1991, John Bowditch of the Henry Ford Museum explained why curators of industrial history struggle to interpret machines: “*The problem is that machinery tends to confound the average visitor. For most people, looking at it is like listening to very foreign music – a boring and unrewarding experience... The paradox is we live in a technological society that is totally dependent on a class of artifacts so foreign that the average person cannot comprehend their importance.*”⁶ To help address the difficulty of interpreting APM’s esoteric story and unusual artifacts, the museum called upon Steven Lubar, curator of the seminal exhibition *Engines of Change* and many other projects during his 22 years at the Smithsonian; Merritt Roe Smith, noted scholar and author, a Fellow of the American Academy of Arts & Sciences, and past president of the Society for the History of Technology; and Gray Fitzsimons, who led a major reinterpretation of the exhibits and programs at the Lowell National Historic Park. (All three scholars have remained on the planning team throughout the project.) The project curator, Carrie Brown, specializes in the connections between technology and cultural change. She has

completed major projects on the history of transportation and on the role of women doing non-traditional work in wartime. These scholars brought to the project not only their own perspectives, but also knowledge of the recent work of others, including David Meyer on *Networked Machinists* (2006), Ross Thompson on technological convergence and machinists as inventors (author’s pre-print, 2009), and Matthew Roth on how machinery speaks to museum visitors (*The Public Historian*, summer 2000). (See Attachment 5, Bibliography.) **Together with an education consultant, an exhibit designer, and the museum staff, this team of scholars probed the relevance of APM’s site, collection, and story in a world that is often called “post industrial.”** The planning team drew two important conclusions. First, APM must not simply display machine tools as they have been shown at this museum in the past—massive, inscrutable hunks of metal— as self-contained artifacts and complex technical marvels. Rather, the exhibition must emphasize the relationship between the machinist, the machine tool, and the larger culture. Second, we must connect historic and contemporary persons who designed, made and operated historic machine tools, to the 21st century, through the theme of innovation. The conventional concept of the great inventor working in isolation and coming up with a new idea that changes the world has little relevance and little factual support in modern times. Indeed, Professor Eric von Hippel of MIT notes that most technical innovation today is produced by *users* of equipment, not patent holders or “inventors.” Our team of scholars believes that in the nineteenth century machine tool industry, incremental innovation and collaborative problem solving were also the norm. At APM, we are not telling the story of a well-known,

⁶ Keynote address, “Motion: The Soul of the Machine”, John Bowditch, symposium published as an edition of the Hagley Papers titled Risks and Rewards: Perspectives on Operating Mechanical Artifacts, 1991.

great inventor, but of a network of machinist/innovators who gradually developed new tools, created the machine tool industry, and thereby helped create a modern, technological society.

Our planning team has developed an interpretive plan that braids together three strands: the nature of innovation, the role of craftsmanship and skill, and the story of how precision manufacturing became the backbone of American industrial power. We believe that these themes can speak to a wide audience, and that the American Precision Museum can make a distinctive contribution to our visitors' understanding of the past and to their curiosity about the role of technology and innovation in the present and future.

B. Our interpretive strategy is based upon educational theory that emphasizes inquiry and exploration. Given our focus on innovation and creative problem solving, we chose an inquiry-based approach rather than an interpretive strategy that presents information through a single, authoritative curatorial voice. Our project themes have been developed as “essential questions” that will be stated directly on the introductory panel in the lobby: “**Innovation**—What is it? How does it occur? **Work**—How are technical training, craftsmanship, and skill passed along? How important are these attributes today? **Culture**—How did the machinists and tool builders of “Precision Valley” influence the course of American history and culture?” Text panels often include further questions: “Who builds the machines that make factory equipment?” and “In the heat of battle, guns sometimes break. Who repairs them and how?” and “If you wanted to build ten thousand engines a year, and if those engines required parts that fit *very* closely and accurately, how would you do it?” Because we are telling a large story covering a period of more than 150 years, we are mindful of the danger of overwhelming visitors with too much information. Section headings provide short, descriptive statements, so that visitors who want to read very little of the text will still be able to follow the argument: e.g. “Factories Need Tools,” and “Military Needs Often Drive Innovation.” At the same time, ample information is available in introductory section panels, secondary panels, and artifact labels. Font size, color-coding, and repeated icons will help visitors follow particular strands and layers of importance within the text. Drawers to be opened, panels to be lifted, and buttons to be pushed will allow visitors to choose how much information they want.

There will also be opportunities, in every section, for visitors to make use of multiple learning styles. Visitors will be able to examine original drawings and documents. Five “Touch Me Tables” will be spaced through the exhibit hall, providing the opportunity to handle machine parts, to measure, to draw, and to operate small hand-powered machines. Interspersed among the artifacts, images, and text labels, there will be small video screens showing machines in operation. Several push-button listening stations will play clips from oral history interviews in which machinists talk about their work. Other listening stations will feature actors reading from archival documents that help tell our story. In the working machine shop, interns and docents will demonstrate and explain the workings of basic machine tools. These many voices not only provide access for auditory learners; they also reinforce the concept that this is a story about *people* and machines. There will be a great deal of information available for the visitor to absorb, but it will be layered and varied in ways that allow visitors to create their own experience, based upon their own needs.

Finally, our interpretive strategy adheres to Barry Lord's notion that what matters most is not how much information the visitor takes away, or how much of the curatorial interpretation the visitor absorbs. “What matters is whether the exiting visitor takes away a new interest in or attitude toward the subject.”⁷ By approaching the Industrial Revolution from the point of view of innovation—rather than the more typical focus on the degradation of labor—we will be giving visitors something new to think about from the very start. By showing how the creators of the tools and techniques of precision manufacturing helped make the modern world, we hope to get visitors thinking about their own relationship with machines. The

⁷ Lord, *The Manual of Museum Learning*, ed. Barry Lord, AltaMiraPress, 2007.

questioning approach of the curatorial voice, the variety of hands-on activities, the focus on problem solving to bring historical material into the present—all are strategies for promoting visitor engagement with our themes.

The exhibit text has been written by Carrie Brown, Ph.D. and reviewed extensively by the planning team, at every step from original outline to draft label copy. The entire team will review and comment on the complete text again during the implementation phase, with historians Merritt Roe Smith and Steven Lubar providing another, final read-through for historical accuracy.

C. The design philosophy developed by our interpretive plan calls for remaining faithful to the site: we will make good use of contemporary interpretive techniques without diminishing the experience of being inside an 1846 factory building. The 40 X 100 foot main factory floor, with post and beam construction, overhead line shafting, and wood floors will remain open and mostly unobstructed. Text and two-dimensional objects will be placed on partial wall panels, scattered sparingly through the exhibit hall. For a section that re-creates part of the original 1846 shop, rather than building a “black box” theatrical space, we will create a sense of separation with a perforated metal screen that provides an enclosure without completely obscuring the rest of the large room. Thus, visitors entering the exhibit hall will see before them a large expanse of machinery across the open floor, yet they will also see clear interpretive signage and strong guidance for how to follow a chronological path through the exhibition. The exhibition will also create the sense of the factory floor as a lively place. The working machine shop creates a low clatter. Video monitors will show machines in motion. Attractive graphics and colorful images will contribute to the vibrant look of the exhibit hall. Many of the machine tools themselves have graceful lines, fanciful cast iron decorations, and colorful paint schemes.

From its founding as a museum in 1966 up to recent years, APM’s design philosophy was one of minimal interpretation. The main exhibit floor was lined with row-upon-row of machine tools, each accompanied by a simple paper label indentifying it and explaining how it works, sometimes in great technical detail. Windsor-made firearms in display cases, and a few historic sewing machines and typewriters, suggested the application of these machines in their early years. The building itself was frozen in time at 1967—a static and deteriorating shell. Only during occasional, special programs have visitors been able to see the machines cutting metal or to have docents explain what the machines actually do, and only through occasional temporary exhibits has there been any serious attempt to explain the importance of the machines. The new interpretive plan provides a rich interpretation of the collection and the site, bringing the machines and the human story together by exploring our three themes.

Exemption B4

D. Exhibition Walk-Through. Upon entering the main exhibit area, at the east end of the main hall, the visitor will first encounter the working machine shop, inside a three-foot high wooden enclosure. A large text panel will introduce the concept of interchangeable parts and explain—at a very basic level—what a machine tool is. (Machine tools cut or form metal to a predetermined shape. They generally use some source of power other than muscle. They use a rigidly held and accurately controlled cutting or forming tool.) Inside the working shop, the student interns, sometimes accompanied by or replaced by retired machinists, will demonstrate a historic lathe, a planer, and a turret lathe. The interns will

show how the lathe allows them to turn cylindrical shapes, create curved shapes, and cut screw threads. They will demonstrate how the revolving tool holder of the turret lathe allows them to rotate new tools into place, to perform different operations on a work piece without the interruption of fastening, adjusting, and unfastening each new cutting tool. They will talk about creating flat, smooth surfaces with the planer. A hand-cranked, table-top-sized planer, set up to shave long chips off a piece of flat plastic, will be available at the edge of the shop for the visitor to try. Our interns are proud of their skills and have much more to show, but after providing this basic introduction, they will invite the visitors to turn to the right (north) and enter the historic section of the exhibition. The path through the historic section will ultimately lead visitors back around to the west side of the shop, where the interns will show them more modern machinery.

The historic progression of the precision manufacturing story will be divided into three large sections: (I) *The Tool Revolution*, (II) *Expansion*, and (III) *Maturity*. Each of the major sections contains two or more subsections.

Section I, *The Tool Revolution*, explores the period 1825-65, when metal-working tools emerged and began to transform manufacturing. At the entrance to this section, we emphasize that this is a story about innovators by presenting life-sized renderings of three figures representing Richard Lawrence, Frederick Howe, and Henry Stone—three of the men who came together in Windsor in the 1840s to work on a government gun contract and ended up creating a center for excellence in the new-born industry of precision manufacturing. The influence of these three men will be followed throughout the exhibition, as they move on to new places, develop new tools, and mentor younger workers. While the exhibition highlights the work of several specific innovators, it continually reminds the visitor that technical innovation most often occurs not through the work of some lone, great inventor, but through collaboration, incremental innovation, mentoring, networking, and long years of experimentation. Behind the three life-sized figures, a black and white photomural of the outside of the building is mounted on a perforated metal screen. From the front, one sees figures standing before a strategically-lit mural; from the back, the perforated screen allows a partial view back toward the interns and the working shop. Thus the openness of the shop floor is maintained as visitors move through the sections of the exhibit. Within *The Tool Revolution*, the first sub-section (“Factories Need Tools”) presents the question “Who makes the machines that make machines?” The text panel explains that many of the first machine tools in America were designed for making textile machinery and were built in the machine shops of textile mills. A massive 1825 lathe, supported on a 14-foot bed made of granite, represents these early machine tools. The section also includes a milling machine used by Frederick Howe during his apprenticeship in Massachusetts. (In a lathe, the work piece spins rapidly, and the cutting tool moves gradually along a slide rest. In a milling machine, a cutting tool with a particular profile spins, and the work piece slides along under it, being cut to the inverse of the profile on the cutter.) The milling machine was one of the most important machine tools originated in the nineteenth century, and it played a critical role in the development of gun-making equipment in the 1850s and '60s. Beside the milling machine, the visitor first encounters a display that will be repeated two more times, at different historical places in the exhibition: a machinist's tool chest of the period, along with the hand tools and measuring instruments available to the machinist at the time. A machinist's tools are among his most prized possessions. The tools signify his level of skill and enable him to do his work. Tools also represent his heritage: an excellent tool is the product of generations of thought and practice. Thus we introduce the theme of craftsmanship, incremental change, and pride in one's skill. A listening station in this section plays a clip from one of the oral history interviews, with the machinist talking about the satisfaction of producing an efficient and effective machine. The hands-on component in this section reinforces what visitors have just learned from the interns about the basic function of machine tools: a small, treadle-operated lathe allows visitors to shape a cylinder made of hard wax.

Exemption B4

The second sub-section within *The Tool Revolution*, “The Robbins & Lawrence Shop,” is a re-creation of a portion of the 1846 gun-making shop, representing the armory building in its first years of operation. A war with Mexico was looming, and innovation in machining was driven by the government’s need for identical guns made in quantity. Eight actual machines used in the armory will stand on the shop floor, belted to the overhead line shafts. Small video screens will show the machines in action, cutting various gun parts. A workbench, a shop drawing, a leather apron, and assorted hand tools will help recreate the space. A display case will hold three Robbins & Lawrence guns from the late 1840s. At the push of a button, the visitor will hear an actor reading short excerpts from Richard Lawrence’s memoir and letters. The Touch Me Table in this section will allow visitors to try out the primitive measuring gauges used to assure standardization of parts in the 1840s. An additional text panel will explain how the British became interested in American manufacturing methods, visited Windsor, and ordered R&L machine tools for their own armory—the first significant exporting of American tools and technology back to the old world.

To protect the artifacts from ultra-violet light, most of the windows in the exhibit hall will be covered with translucent white shades that still reveal the size and framing of the window. As the visitor moves on to the third section of *The Tool Revolution*, one uncovered window provides a clear view of falling water just outside the building—a reminder of the source of power for the overhead line shafts when the armory was first built. This view through the window reinforces the waterpower message from the panel outside.

The third sub-section of *The Tool Revolution*, “Facing a Great Crisis: Arms for the Civil War,” ties our story to historical events that have broad public interest. In all, more than a million rifles were produced for the Union troops during the war. Though only a small fraction of those rifles were made in Windsor, the majority of them contained parts made on *machines* designed and constructed here. At the entrance to the section, a photomural of soldiers holding rifles is enhanced by a reproduction rifle placed to look like part of the photo. The major artifacts in this section are advanced machine tools—more accurate and flexible than anything built before—that were used for making gun parts. Another life-sized rendering of a machinist will stand beside a drill press, as a reminder that each machine was operated by a skilled worker. The section introduces previously unknown individuals who worked at the Armory. George Coates, a 14-year old apprentice gunsmith, learned math, drawing skills and machine design. He later worked for Ethan Allen Firearms, and by the end of his life held 40 patents. John Field, a Vermont-born African American, was the son of a local barber. He was 24 when the war began, and his younger brother James may have also worked at the Armory. In the 1860 census, John Field is listed as “mechanic.” A mechanic, at that time, was any man who did skilled work with tools or machinery. In Massachusetts, Albert Ball had designed and built several small lathes that were used for making needles for the Windsor sewing machine. During the early part of the Civil War, he began to experiment with designing repeating pistols and carbines (short rifles). During the war, Ball developed and produced the carbines. Ball held more than 130 patents. Though originally designed for quarrying marble, his mining machinery eventually revolutionized the production of coal for fuel. Eben Stocker was born on a farm near Hartland, Vermont, and when he was 17, went to work as an apprentice gun maker at Lamson, Goodnow & Yale at the Armory, working on parts for the experimental Ball Repeating Rifle. Some years after the war, he moved to Hartford, to work for his brother-in-law Charles Billings of Billings & Spencer—famous for their drop-forged hand tools. Quimby Backus, 23 years old, a high school graduate, married with one

young son, arrived in Windsor in 1861, as part of the big influx of machinists needed throughout the war. After the war, he would design several new vises, a stationary drill bit, a bit brace, an adjustable wrench, and many other tools. Late in life, he developed steam radiators and gas logs. William Hale Foster, a 25 year old machinist from Massachusetts, came to Windsor to work in the Armory for Lamson, Goodnow & Yale making Springfield rifle-muskets. He then enlisted in a Vermont Civil War regiment. After the war, he returned to Massachusetts, working until about 1907. Family letters, newspaper clippings, and photographs trace his life as an ordinary machinist.

A display case on the wall will hold standard military rifles along with two experimental firearms produced in the armory during the war years. In this section, we also begin to see the dispersion of the original R&L workmen, as Lawrence moves to Connecticut and Howe to Rhode Island, taking with them their skill, their approach to mechanical problem solving, and machine tools made in Windsor. Stone remained behind, overseeing the manufacture of guns and of gun-making machines. An enlargement of a local newspaper article will describe activities in Windsor during the war, and a page from an armory ledger will show sales of gun-making equipment to private factories and government armories making weapons for the Union army.

The Touch Me Table in this section focuses on design and drawing. In a large flat file case, we will place original drawings by Howe and Stone, one to a drawer, covered with Plexiglas, so that visitors may open the drawers one at a time to view the drawings. Beside this chest there will be a drawing table, paper, pencils, and drawing tools, along with a sample machine part for the visitor to draw. A reproduction of Henry Stone's drawing of the same piece will be mounted above the table. Designers and engineers use drawings to help them think through a design and to communicate the details of the design to others. This activity will encourage visitors to explore not just drawing, but the reasons for making design drawings, and will therefore help them explore our themes about collaborative problem solving and the development of technical skill. Through another interactive component, the visitor will have an opportunity to operate mechanical controls that move a tool around over a work piece, in imitation of the operation of the adjacent profile milling machine designed by Henry Stone. Design drawings for this machine and drawings of gun parts made on it will help connect the machine to the drawing table interactive as well as to the Civil War rifles mounted in a case on the wall.

The three parts of *The Tool Revolution* have led the visitor down one side of the entire 100-foot length of the factory floor. A left turn between the profile milling machine and an early turret lathe leads into the next major section.

Section II, *Expansion, 1865-1914*, treats the growth of an industry dedicated to making machine tools and explores the many applications of the new machines. The first sub-section, "Machinists Spread Precision Work," features a computer animation showing the dispersion of the R&L inventors and workmen across a map of the Northeast and upper Midwest. A sequence of arrows and images show the Robbins & Lawrence alumni taking their skill and their machines to Remington Arms (later typewriters), Brown & Sharpe (makers of exquisitely accurate measuring tools), Columbia (makers of bicycles and autos), Cadillac Automobiles, the Jones & Lamson Company (at mid-twentieth century, known around the world for fine machine tools), Pratt & Whitney (who would eventually make aircraft engines), and many others. Through the workmen who left Windsor in the second half of the nineteenth century, all of these companies are descendants of the original Robbins & Lawrence armory. While the animated map demonstrates the long reach of the work done in Windsor, nearby artifacts and images begin to connect machine tools with everyday life. Colorful advertising posters will hang on the wall. A display case will contain early sewing machines, typewriters, shoe lasts and shoes, and other products made possible—and made affordable—by quantity production and interchangeable parts. The typewriter label will note that new office jobs for women encouraged families to let their daughters stay in school longer, instead of pulling them out of school at 12 or 13 to work as unskilled factory operatives. Visitors will be given the

opportunity to try typing, at both a manual and an early electric typewriter. A high wheel bicycle will represent the beginnings of a personal transportation industry and the “Better Roads” movement that would lead to the automobile culture of today. This section directly addresses the theme/question about how the innovators of Precision Valley in Vermont influenced the history and culture of America.

While the dispersion of Robbins & Lawrence’s legacy was underway, some key figures in the next generation remained in Vermont, both in Windsor and in the larger Precision Valley, as the industry expanded to nearby towns in the Connecticut River Valley corridor. The second sub-section of *Expansion*, “Machine Tool Companies Specialize,” highlights several of those companies, their founders, their machines, and their workers. A life-sized photo of James Hartness will stand beside his flat turret lathe—a clean-lined, efficient machine patented in 1891 but descended from Frederick Howe’s mid-century turret lathe. Hartness headed the Jones & Lamson Company of Springfield, Vermont, 20 miles south of Windsor, leading the company to world prominence. A listening station will allow visitors to hear an actor reading from his writings about industrial efficiency. One of the Jones & Lamson workers, Mack Mower, will be represented by his original apprentice document, signed in 1884, and by a machinist’s tool chest from around 1890, with Brown & Sharpe micrometer and calipers, a pocket reference book, and training materials for teaching trigonometry to apprentice machinists.

The third sub-section in *Expansion*, “Supplying the Auto Industry,” features a Gridley automatic lathe, developed in Windsor by a protégé of Hartness. This is one of several machines that helped make possible the mass production of automobiles. Another—the Cone automatic lathe—will be accompanied by a video showing the machine automatically going through six different cutting operations, churning out one part after another, all exactly alike. A display case will hold magazine advertisements, a salesman’s notebook, and other ephemera linking machine tools with the auto industry in the early 1900s. Clips from oral history interviews with retired machinists and office support staff from machine tool companies (recorded in 2008) feature comments about the accuracy of their work, the level of training and care required, and the social fabric of the corporate culture. The Touch Me Table in this section will provide measuring activities to help visitors understand the development of ever-more-accurate precision machines. Using a dial caliper to measure the width of a human hair is an activity that we have tried and that visitors have found compelling. As early as the 1880s, machinists had measuring tools accurate to thousandths of an inch. (A human hair measures about 3 thousandths). The combination of multi-media, artifacts, images, and text in this section weaves together our themes of innovation, craftsmanship, and influence on material culture. The introduction of Hartness and his protégées reinforces the notion of innovation resulting from collaboration, mentoring, and incremental change.

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In one corner of Section II, at the far southwestern corner of the exhibit hall, there will be two large display cases that contain a model machine shop built by John Aschauer (1896-1978), a machinist who, as a lifelong hobby, spent 40,000 hours creating miniature machine tools. When the visitor pushes a button, the tiny lathes, drill presses, milling machines, and planers start up one by one, until all are whirring together. This display has been on view at the museum for many years and has always been enormously popular with visitors. Within the new exhibition, it will provide a view of a twentieth century machine shop, but it will also speak to the craftsmanship and intense focus of its builder.

Section III, *Maturity*, first explores how the precision tool industry helped make the United States a world power and played a critical role in two World Wars. A sub-section titled “The Arsenal of Democracy” covers both World Wars. In the World War I area, motivational posters, documents, photos, and machine tools made in Vermont’s Precision Valley will be accompanied by a dress-up area, where young visitors may try on bib overalls, safety glasses, and bloomers (also called “womanalls”) like those worn by female munitions workers in 1915-1918. Photos and text will tell the story of one of those workers, Vivian Wilson, who supported the war effort by operating a milling machine at Jones & Lamson, but then after the war, had to return to her work as a restaurant cook. At a listening station, a reading by a young female actor will give voice to the pride of another female munitions worker. An adjacent area treats the Second World War. At another listening station, visitors may hear a clip from FDR’s speech calling for the United States to be “the great arsenal of democracy.” A film clip from 1945 will show footage of men and women working at J&L, producing machines that would make parts for tanks, planes, ships, and firearms. Section III also includes the fullest use of the oral history interviews conducted during the planning phase. Accompanied by photos of the speakers in their younger days, audio clips will feature descriptions of the frantic pace of work during the war (local shops ran two, twelve-hour shifts, and workers put in 60-70 hours a week). The audio clips also demonstrate the pride of the workers, who boast that Springfield, Vermont, was listed as one of the top seven potential bombing targets, should the Nazis ever attack the continental U.S. Large artifacts in this section include a massive Bryant Grinder that was built in 1911 and saw service through two World Wars, and a Bridgeport Milling Machine, built in 1938. In a small display case near the Fellows Gear Shaper, there will be a Norden Bomb Sight—a delicate and lethal device that contained many small gears made on Fellows machines.

Just to the left of the Bridgeport Milling Machine, the visitor leaves “The Arsenal of Democracy” and begins to explore post-war industry in a sub-section titled “Numerical Control.” Here we will feature another of our oral history subjects, Don Whitney, who taught himself computer programming in the 1950s, to help with the complex calculations required in designing gear-cutting equipment. He later programmed computers that actually controlled machines. With the war over, machine tool makers again became deeply involved in consumer products, making auto parts, cameras, and even the molds used for making everyday items like toothbrushes.

Today, the Connecticut Valley seems on the verge of a machine-related resurgence. Selden Labs is now making nano-technology water filters for the US military in Windsor. Hypertherm makes plasma cutting tools in Hanover, New Hampshire. New training centers, funded by the state and federal governments, are developing a new high tech workforce. The final section of *Shaping America* will include a panel that highlights some of these new industries, placing them in their historical context.

By this time, the visitor has nearly completed the circuit of the exhibit gallery/factory floor and has returned to the west side of the working machine shop. Inside the enclosure, the interns now demonstrate the Fellows Gear Shaper, making a two-inch diameter gear and then engraving the museum’s logo on it and giving the gears to visitors as souvenirs. On two small, moveable carts, using a computer-controlled milling machine and lathe, the interns make chess pieces from brass and aluminum. (The chess sets will be sold in the museum shop.) In the broad, historical sweep of the exhibition, the working shop represents the present and the future. The computer-controlled machines—on loan from the River Valley Technical Center—will be updated to keep pace with the teaching in RVTTC’s machine shop in the coming years.

Before leaving the exhibit floor, visitors are invited to stop by a section that draws our story to a close and points to the future. A 16-foot long lathe made in Windsor in 1867 sits opposite the early computer-controlled milling machine. Above the lathe, a text panel will describe the decline of the machine tool industry in the United States, using the words of our oral history subjects who mourn the loss of their industry. It will also describe the beginning of a 21st century resurgence, as new high-tech companies in the Upper Connecticut River Valley begin to succeed with plasma cutting tools, nano-technology, and

various computer-based industries. Two computer stations, along with a wall-mounted bulletin board and writing materials, will invite visitor feedback, not so much on the exhibition-as-exhibition, but on the themes that they have just explored. Prompts will include questions such as “What challenges do we face right now that might be solved by advances in machinery?” and “What problems has machine technology created that we now must learn to solve?” During the 2008 and 2009 seasons, we experimented with gaining visitor feedback on such questions through a large notebook on a table in the gallery, and visitors left many thoughtful comments. The computers will be set up for response using a bulletin board page on the museum’s web site, and two museum volunteers will be assigned to monitor the site daily. We hope that visitors will access the computer bulletin board again after they go home, continuing to engage with the museum and with other visitors in exploring the themes of the exhibition.

The museum’s interpretive plan also calls for two small exhibits that fall outside the general narrative of *Shaping America*. Just off the lobby there is a small classroom space used for public lectures and orientation for school groups. Along two of the walls in this space, we will place three gun cases and interpretive panels. These cases will contain examples, from the APM collection, of handcrafted firearms made in Vermont and New Hampshire in the years leading up to industrialization. Beautiful woodwork, elaborate engraving, and exquisite hand finishing make it clear that these guns were made one at a time by highly skilled craftsmen. The text will also introduce Nicanor Kendall, one of the gunmakers who originally worked with Richard Lawrence to establish the armory in Windsor, but who was more interested in hand-crafting than in machine design and left the company at his first opportunity.

A second, single panel exhibit will document the years during which our building served as a cotton mill, from 1870-1886. The story of large spinning machines and looms operated by young women and of child labor in the textile mills has been told at other sites and in many different media. We have chosen to focus instead on our building’s unique role in the development of precision manufacturing. Nevertheless, we want to make the cotton mill information available to visitors as well. We have no photographs of the workers from our building’s cotton mill years, but we can use a Lewis Hine photograph of cotton millworkers in nearby North Pownal, Vermont. From archival materials in the museum’s collection, we *do* know names, ages, and wages paid. There were boys and girls as young as 13, their pay was low, and many of the workers were French Canadian immigrants struggling to make a new home. Another original piece from that era is a small sign warning employees not to use cotton waste in the bathrooms. Those who do will be dismissed and charged at settlement with the value of the goods wasted. This interpretive panel will provide contrast to our story about skilled workers in the high tech industry of their day, and will provide some balance by suggesting—though not fully exploring—the darker side of the industrial revolution. Our main exhibition celebrates mechanical ingenuity, documents the gradual development of ever-more precise machines, and explores the characteristics of the skilled craftsman. The cotton mill panel will serve as a reminder that—at one remove from the precision machine tool industry—machines made it possible to create vast quantities of consumer goods using low-skilled labor.

3. PUBLIC PROGRAMS

A. The intern program—developed with the help of our consultant from the River Valley Technical Center (RVTC) and piloted in 2008 and 2009—provides a central component of the exhibition. We also think of it as a program that serves the community by creating intensive training for the interns. Feedback from the students, their parents, and museum visitors has been uniformly and enthusiastically positive. As we implement the interpretive plan, we will continue to bring high school and college students to the museum for summer jobs operating machinery, developing new skills, and interacting with the public. Two levels of interns will rotate through, one experienced student working with two or more newcomers each year. All of them are trained and supervised by the machine shop teacher from the RVTC.

B. Docent and intern training materials for a standard public tour will be developed to help groups explore the main exhibition. The training will prepare our docents and interns to integrate the working

machine shop with the historical sections of the exhibition, to focus on the project themes, and to encourage visitor participation in the hands-on opportunities. The planning team has developed a set of five visitor outcomes for the museum: (1) Visitor will develop a deeper ability to look at mechanical devices and imagine how to make them or figure out how they work. (2) Visitor will develop positive associations with technical innovation and craftsmanship (key words: skill, respect, progress, hard work). (3) Visitor will be able to articulate a basic understanding of Precision Valley's role in creating American culture (key words: mass production, precision measurement, interchangeable parts, innovation, standard of living, industrial strength). (4) Visitor will be able to make connections between precision manufacturing and everyday life. (5) Visitor will think about the future of problem solving through innovation. Our training materials will be aimed at helping tour guides and interns foster these outcomes, and our evaluative materials will explore how well the outcomes are being achieved. A public tour will be regularly scheduled for one Saturday each month and will be available upon request to visiting groups who contact the museum in advance.

C. The school visit program will complement our existing traveling kit for grades 5-12, which explores themes closely related to those of the exhibition: innovation and innovators, the industrial history of local towns, and the impact of the Industrial Revolution on everyday life. The school program will be enriched by use of the kit, but will not require it as either a pre- or post-visit activity.

We will develop three basic programs: (1) An upper elementary program will focus on simple machines (screws, levers, planes) and the connection between machines and everyday life. A visiting class will be divided into three groups that will rotate through three activities. Activity 1 will be a scavenger hunt on the exhibit floor, where students, armed with clipboards, will be asked to find (and sketch) at least two simple machines within parts of the machine tools, and to find and sketch or write a note about a product (e.g. typewriter) that they can relate to some product they have at home today. Activity 2, the "History Challenge," will send each of the three groups to a different historical part of the exhibit to gather information about the people represented in that era: who were they, what did they do, why is their work important? After returning to school, the groups may report back to each other on their findings from the different historical periods, in a format chosen by the teacher. Activity 3 will be conducted in our classroom space, where students will have a chance to experiment with punching and pressing shapes in a soft material. (2) A program for grades 7-8 will be similar in format to the upper elementary program. The simple machines activity will be replaced by questions about waterpower and the structure of the factory building. The "History Challenge" will again send students to a particular area to study the lives and contributions of the people featured there. The hands-on activity will be an exercise in creating and assembling an object with interchangeable parts. (3) The program for high school students will incorporate a more detailed scavenger hunt that directly links the text and artifacts in the exhibition with the New Hampshire and Vermont Social Studies curriculum. Our traveling kit includes advanced activities for high school students, involving investigation of census records and the analysis of photographs of their own towns at different historical periods. Activities in the on-site program will complement the advanced activities in the kit.

D. Adult Programs will be developed for ILEAD—the Institute for Lifelong Learning at Dartmouth—which provides low-cost courses to adults in the Upper Valley Community. The organization has more than 1,400 members, many of whom are retirees with an un-sated thirst for intellectual stimulation. Course topics range from the poetry of Emily Dickinson to Vermont's stone walls and cellar holes to energy policy. Members of the ILEAD program have encouraged APM to develop a course on the Industrial Revolution in the Upper Valley, but we have never before had the resources to do so. The planning phase of our Interpretive Planning Project has enabled our project curator to perform the research and theme development that will serve as a basis for this adult course. During the implementation phase, we will develop a four-session course. Three sessions will be taught on the Dartmouth campus and the fourth at the museum. This program, aimed at mature adults, will assume a

basic level of knowledge about the Industrial Revolution. To satisfy the participants' interest in large issues of national importance, the course will use our project themes to explore the issues on a national scale. Session I. Roots of the Second Industrial Revolution: What was it about New England geography, political structure, and culture that inspired and enabled the second phase of the Industrial Revolution and the development of an American System of Manufacturing? Session II. Precision Valley: What part did local industries play in the growth of American industrial strength in the nineteenth and twentieth centuries? There will be a special focus on the role of precision manufacturing during the two World Wars. Session III: The Post War Period: How did precision manufacturing change in the late twentieth and early twenty-first centuries? Session IV: Field Trip to the American Precision Museum. The course will be facilitated by project curator Carrie Brown, Ph.D., who will also invite other speakers to participate. Class size for ILEAD courses is generally around 20, and the program may be repeated if there is a demand in subsequent years. After this course has been fully developed and presented once through ILEAD, we will make the programs available to other organizations in the region, including Elderhostel. The University of Vermont runs an adult education program in eight Vermont towns: the Osher Lifelong Learning Institute. (The Osher foundation provides programs and courses for adults over 50, through 115 colleges and universities around the country.) The Osher format differs from ILEAD in consisting of individual lectures rather than multi-session courses, but our materials will be presented as several different options in the Osher catalogue. Again, the audience for any single Osher program seems to run at about 15-20 adults, but programs are made available to all eight sites across the state. **The materials developed for these adult education programs will also be used to present programs for the museum's regular Sunday afternoon on-site lecture series.** The lectures will also be made available through the speakers' bureaus of the Vermont and New Hampshire Humanities Councils.

During the first season of the new exhibition in 2014, we will again host a machine tool reunion day for former workers of the machine tool companies that were located in Windsor and Springfield, Vermont. The museum has conducted two such reunions, in 2009 for former employees of Windsor's Cone Blanchard Machine Company, and in 2010 for former employees of Jones and Lamson Co., Fellows Gear Shaper, and Bryant Chucking Grinder. Each event included a special tour of the museum, refreshments, and a round-table discussion facilitated by Greg Sharrow of the Vermont Folklife Center, who conducted most of the oral history interviews as part of the planning project. Both reunions were very popular, with over 60 people attending each one.

4. PUBLICATIONS

There will be no single, expensive exhibition catalogue associated with this permanent exhibition. Rather, we will produce two inexpensive handouts that will provide additional information to be used within the exhibit space. Laminated copies of these materials may be picked up and returned to the visitor services desk; or visitors may take clean printed copies home. (1) A full-color, two-sided single sheet will present an alternative walkthrough of the exhibition focusing on "The Art of the Machine." Interesting design features, unnecessary embellishments, and changes in design style over the years will be highlighted on various machines throughout the exhibition. This handout will also point visitors to the uses of machines in art and advertising that occur through the exhibition. Background information and a short introductory essay for the publication will be provided by Professor Julie Wosk of SUNY Maritime College. (2) A second, two-color handout will be aimed at the visitor with an intense interest in the workings of machine

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tools. It will provide specific details about the progression of different types of machines: lathes, milling machines, drill presses, planers, and punching and pressing machines. These two publications allow us to provide more layers of information and alternative ways of seeing the exhibition, without overloading the gallery with text on panels.

5. MULTIMEDIA COMPONENTS

A. Videos showing machines in operation. Years of visitor feedback tell us that most people, confronted with an idle machine tool, have a very hard time understanding what the machine does, even if nearby text or a docent explains the workings. There is simply no substitute for seeing the machines in action. Our working machine shop will be the primary solution to this problem, but we will also provide video of machines in operation at various points in the exhibit gallery. (1) The first will be on the rail around the working machine shop, showing a simple lathe cutting a cylinder and describing how it works. In the event that a visitor comes to that point in the exhibition at a moment when no one is available to demonstrate the basic lathe inside the shop, this one-minute video will provide the general idea of how a machine tool works. (2) Inside the re-creation of the 1850s Robbins & Lawrence gun shop, there will be four small, picture frame monitors, running continuously, showing these historic machines in motion. These machines are among the most rare and important in the museum's collection, and the requirements of preservation dictate that they not be operated on a regular basis. We have existing film footage, made some years ago, in which several of these machines are shown cutting actual gun parts. (3) In the Civil War section, where we introduce the turret lathe, we will show a video of a turret lathe cutting with one tool, rotating another tool in, making a different cut, rotating another tool in, and so forth. The film will be made on a slightly more modern machine, but the operation of the turret will be clear. (4) In the twentieth century section of the exhibition, we will show video footage of the Cone Automatic, a Windsor-made machine that played a key role in the mass production of automobile parts during much of the twentieth century. Again, the video will demonstrate how a single machine could perform multiple actions on each part, moving quickly through the different cutting processes, machining six pieces at a time. We have tried these simple, inexpensive video picture frames in our current temporary exhibit and have found that they are reliable and effective.

B. Video showing historic footage. Near the end of the Second World War, a newsreel from the *Time Marches On* series was filmed at the Jones & Lamson Company in nearby Springfield, Vermont. The film shows machinists, both male and female, at work on war products and also shows engineers working on designs for post-war production of machines to make consumer products. We will purchase the rights to the footage and obtain permission to edit it down to a 3-minute segment showing the highlights.

C. Audio components. There will be listening stations throughout the exhibition. For the early historical sections, actors will read from letters and memoirs of nineteenth century innovators. Two additional stations in the early sections will play clips from the 2008 oral history interviews, featuring the speakers' ideas about craftsmanship and pride in one's skill. In the twentieth century section, the oral history audio clips will be correlated with photos of the speakers, biographical information, and machines tools typical of their activities.

D. Computer Animation. In Joseph Wickham Roe's standard text *English and American Tool Builders* (1916), the enormous influence of the Robbins & Lawrence shop on the machine tool industry is displayed as a "family tree" diagram. The missing element for bringing this concept alive is the dimension of time. Our computer animation will feature a map of the northeastern United States and the Upper Midwest. A small arrow will enter from the east across the ocean, with the image of a textile machine popping up in Rhode Island in the 1790s, to represent the importing of that technology and establishment of a textile industry in America. A picture of the government armory in Springfield, Massachusetts will appear, with small arrows to and from machine shops in southern New England represent the give and take among private gun makers and the federal armory during the early 1800s.

Previous arrows disappear as an arrow shows Richard Lawrence and Henry Stone moving from central Vermont to Windsor, and Frederick Howe moving up from Massachusetts in the 1840s. Images of gun-making machinery cluster around Windsor. The arrows grow more numerous and the rhythmic pace increases as Lawrence, Howe, and others disperse to Hartford, Providence, and other cities becoming major machine tool centers. A sewing machine made in Windsor moves to Cleveland. Small images of measuring tools, rifles, bicycles, and automobiles pop up in the various cities as arrows show R&L workmen on the move. Finally, the animation shows Henry Leland, who worked under Howe in Providence, moving to Detroit and founding the Cadillac Company in 1902, and Walter Flanders going from Vermont to Detroit to help Henry Ford mechanize his factory and install the moving assembly line in 1913. The entire animation will take approximately two minutes, covering the period from 1790-1920.

The animation will be produced by students at the John Nicholas Brown Center for Public Humanities and Cultural Heritage (<http://www.brown.edu/Research/JNBC/maprogram.php>), during the 2012-13 academic year. Drawing from resources at Brown University and the Rhode Island School of Design, these master's level students are preparing for careers in public humanities and cultural resource agencies. Their work will be performed for course credit and will be overseen by Professor Steven Lubar, one of the humanities scholars on the planning team (See letter of commitment in Attachment #4.)

E. Visitor Feedback On-line Bulletin Board. The museum put up its first web site in the mid-1990s, and the site has gone through several re-designs over the years (<http://www.americanprecision.org/>). Routine updates are handled by museum staff. In fall/winter 2010-11, the museum plans another series of improvements that retain the basic design but bring the site to accepted standards of accessibility for people with visual disabilities. We will be seeking a new web design firm to do this work, and hope to continue with the same firm to add a new Visitor's Feedback Bulletin Board page components as part of the *Shaping America* project. (The Request for Proposal may be found in Attachment #3, Resumes.) The Visitor's Feedback Bulletin Board page on the existing APM web site will be accessed by two computers in the gallery, near the concluding text panels, Visitors will be invited to comment on the project themes. The page will include images from the exhibition, along with quotations from our historic documents and from the oral history interviews. These images and text may serve as prompts, but we will also pose specific questions that probe the themes. Visitors will also be encouraged to comment on each other's postings. By asking for comments before visitors leave the exhibit gallery, the on-line bulletin board will encourage reflection on our themes, help people to consolidate what they have learned, and encourage families to talk about the issues raised. Visitors and others may also access the page off site, reflecting on our themes after they have gone home. Images and quotations on the page will be changed monthly by the visitor services staff, using materials compiled by the project curator during the Implementation phase or provided by the collections staff.

Before the on-line bulletin board page becomes generally available on the internet, we will experiment with it in the gallery, allowing it to collect comments but not providing a link from the public pages of the site. Visitors who post comments will be given information on how to access the page from home, using a password. After a two-month trial, we will make any needed changes and make the bulletin board open to anyone who visits the museum's web site. Two museum volunteers will be assigned to monitor the site, checking it daily for any inappropriate material. Feedback will be compiled once a month by the museum's visitor services staff. Security, and server maintenance will continue under our current system.

6. ORAL HISTORY COMPONENT

Because "Precision Valley" played an important role in the machine tool industry through the first half of the 20th century, there are still many living residents able to share their memories of machine work. The exhibition draws on 20 oral history interviews conducted by professional folklorists from the Vermont Folklife Center during the Interpretive Planning phase in 2008-09. These interviews provide background and insight into the experiences and traditions of machinists and explore life in a machine tool town. VFC

research staff consists of five university-trained folklorists, all of whom are familiar with the Oral History Association's (OHA) research guidelines and are professionally bound by the American Folklore Society's Statement of Ethics. VFC research staff members have decades of combined experience conducting interviews and creating broadcast-quality audio recordings using state of the art equipment. All interviews are governed by a release agreement that is signed by the interviewees. Use of interview recordings, transcripts and related materials are limited to those specified by interviewees on the release form. The Vermont Folklife Center maintains a climate controlled storage environment for its archival holdings and a professionally-staffed archive reading room. Digital audio and still images generated through the course of this research project are being stored in compliance with best practices outlined by the International Association of Sound and Audio-Visual Archives on a RAID-enabled, multi-terabyte file storage server. Back up copies have been created on LTO data tape and gold CD-R discs. Access to archival materials is provided in accordance with release agreements on-site or via our digital interface on the World Wide Web. Dr. Greg Sharrow, who conducted most of the machine tool interviews, is a member of the planning team and is advising the curator on how best to use the materials within the exhibition.

7. UNIQUE CONTRIBUTION

The Robbins & Lawrence armory served as a breeding ground for innovation in the mid-nineteenth century and as a center for excellence in the high tech industry of its day. Military leaders and industrialists traveled to Windsor to learn about the new American System of manufacturing, and workers from Windsor were aggressively recruited by other emerging industries. By continually increasing productivity, the machine tool industry spread the notion that material abundance was possible for a broad cross section of the American people. At its full maturity, in the mid twentieth century, the machine tool industry provided the backbone of American industrial strength and helped make the United States a world power. Today, the industry's history of mechanical creativity stands as a model for future innovation. Our planned exhibition explores American industrial history by examining the machinists and machines that shaped that history. It probes the nature of innovation and the importance of skill and attention to detail in creating new tools and products. It introduces the public to "the machines that make machines" and encourages them to think about mechanical ingenuity and the influence of machines on their own lives. Finally, *Shaping America* provides a rich and deep interpretation of one of the most important sites in the emergence of precision manufacturing.

Sample text of exhibit panels and labels may be found in Attachment 12. Design drawings of the exhibit floor plan and two elevations may be found in Attachment 9. Images of artifacts may be found in Attachment 10.

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