

IMLS FINAL PERFORMANCE REPORT FORM
For Projects with Award Dates between October 1, 2015 and September 30, 2018
(i.e., award number ends in -16, -17, or -18)

Please consult the IMLS Final Performance Report Instructions when filling out this form.

<p>1. Federal agency and organization element to which report is submitted:</p> <p style="text-align: center;">Institute of Museum and Library Services</p>	<p>2. Federal award or other identifying number assigned by federal agency:</p> <p style="text-align: center;">LG-87-18-0057-18</p>	<p>Page 1</p>	<p>of 58 Pages</p>
		3a. D-U-N-S® number:	
		3b. EIN/TIN:	
<p>4. Recipient organization (name and complete address, including ZIP+4/postal code):</p> <p style="text-align: center;">Missouri Botanical Garden 2345 Tower Grove Ave Saint Louis, MO. 5 63110-3420</p>		<p>5. Recipient identifying or account number:</p>	
<p>6a. Award period of performance start date (MM/DD/YYYY): 05/01/2018</p>	<p>6b. Award period of performance end date (MM/DD/YYYY): 04/30/2020</p>	<p>7. Reporting period end date (MM/DD/YYYY): 07/30/2020</p>	
<p>8. Project URLs, if any:</p> <p>http://www.missouribotanicalgarden.org/plant-science/plant-science/consumers.aspx</p>		<p>9. Report frequency:</p> <p><input type="checkbox"/> annual</p> <p><input type="checkbox"/> semi-annual</p> <p><input checked="" type="checkbox"/> final</p> <p><input type="checkbox"/> other</p> <p>If other, describe:</p>	
<p>10. Other attachments? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Contact the appropriate IMLS program office to receive instructions for transmitting additional attachments.</p>			
<p>11a. Name and title of Project Director:</p> <p style="text-align: center;">William Ulate Sr. Project Manager</p>		<p>11b. Telephone (area code, number, extension):</p>	
		<p>11c. Email address: William Ulate</p>	
<p>12. Certification: By submitting this report I certify to the best of my knowledge and belief that this information is correct and complete for performance of activities for the purposes set forth in the award documents.</p>			
<p>13a. Signature of Authorized Certifying Official:</p>		<p>13b. Date report submitted (MM/DD/YYYY): 07/29/2020</p>	
<p>13c. Name and title of Authorized Certifying Official:</p> <p style="text-align: center;">Ms. Susan Winkler Grant & Contract Administrator</p>		<p>13d. Telephone (area code, number, extension):</p> <p style="text-align: center;">314-577-5182</p>	
		<p>13e. Email address: Susan Winkler</p>	

Burden Estimate and Request for Public Comments: Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Institute of Museum and Library Services, 955 L'Enfant Plaza North, SW, Suite 4000, Washington, DC 20024-2135.

The purpose of the Final Performance Report is to provide a record of grant-funded project accomplishments at the conclusion of the grant. IMLS uses these narratives to report to Congress and the Office of Management and Budget about the agency’s progress on addressing its strategic goals. If you have questions concerning the final performance reporting requirements, you may address them to the Program Officer assigned to your grant and whose name and contact information appears in your Official Award Notification. IMLS may share Final Performance Reports with grantees, potential grantees, and the general public to further the mission of the agency and the development of museum and library services. Reports may be disseminated in a variety of ways and formats, including online.

14. Recipient Organization: Missouri Botanical Garden

15. Project Title: Consumers as Creators

Understanding the annotation needs of the scientific community through the domain of botany

16. Project Summary:

The Missouri Botanical Garden (MOBOT), with partners at Saint Louis University (SLU), proposes a Planning Grant to analyze Web annotation needs of the scientific community and develop a prototype of how those needs may be met within a digital library platform. This project will advance the annotation needs of the scientific community in its broadest sense, with the goal of developing concepts that are expandable to other communities. Assessment of the practicality of an existing tool to satisfy the annotation needs of botanical users, including technical, economic, and operational considerations, will inform developers on best practices to integrate an annotation tool within a virtual library. The intended outcome of the proposed project is to illuminate literature annotation needs of scientific and other research communities by honing in on the annotation needs of a well-defined user group in systematic botany.

17. Activities

Activities Proposed in Your Application	Activities Completed during the Award Period of Performance	Explanation of Any Variance
<p>Conduct annotation needs assessment for botanists in order to understand the needs that users of a specialized digital library could have in relation to annotate their content, at least ten users of a botanical virtual library from at least five different institutions will be thoroughly interviewed to compile their needs for such tools. When available, current users of an annotation tool would be questioned about their procedures and workflow while annotating. All answers will be analyzed to get annotations needs described</p>	<ul style="list-style-type: none"> • Interviewed 15 users of a botanical virtual library from 5 separate institutions • Answers were analyzed and classified taking into account the user type, purpose and function • Desirable functionalities of annotation software were classified into three orders of priority (Must, Should and Could). Initially, out of 43 functionalities stated by the members of the botanical community interviewed, 18 were classified as a priority that Must be included in any solution, 15 were categorized as functionality that Should be 	<ul style="list-style-type: none"> • We were able to contact more users with different profiles from more institutions than initially planned. • Further evaluation of the requirements against the tools available, allowed us to find more requirements that were considered pertinent for this analysis.

<p>and classified in terms of user type, purpose and function.</p>	<p>included in a fully developed proposal and 10 were considered as desired features that Could be added to a system.</p> <ul style="list-style-type: none"> • Additionally, 11 additional were added in the analysis, 5 were classified as a Must, 2 as a Should, and 4 as a Could, for a total of 20 Must, 17 Should and 14 Could. 	
<p>Four existing annotation tools (Hypothesis.is, Digilib, Annotorius, RERUM) will be thoroughly evaluated against the previous needs analysis to develop a feasibility study for how they could satisfy botanists' needs. After delimiting technical considerations, the suitability of each tool to address, either partially or completely, the previously identified needs. Hardware and software requirements should be assessed, as well as user roles profiles for each identified candidate solution. Finally, if necessary, an estimation of time for installing and setting up the tools should also be considered, plus the difficulty in learning to use the tool should be estimated and included into the assessment.</p>	<ul style="list-style-type: none"> • All of the four tools were evaluated for each requirement, a summary of the pros and cons of the tools was drafted and the complexity of installing each tool from a user perspective was estimated. • The proposed prioritization was reviewed and verified against the new tools and needs identified. 	<ul style="list-style-type: none"> • Additionally, we evaluated two additional open-source annotation tools (i.e Recogito, Pundit & VGG Image annotator).
<p>According to the previous feasibility assessment, a tool would be chosen to install as a proof-of-concept on how an existing annotation tool could support the different types of annotations needs that the botanical users may have. This prototype will run against an digital library to test the</p>	<ul style="list-style-type: none"> • Several tools were installed and thoroughly tested in Botanicus, text-based websites, and PDFs, giving emphasis in those particularly promising in fulfilling the most user needs previously identified (Hypothes.is, Pundit and Pundit Pro, Recogito Annotorius). 	<ul style="list-style-type: none"> • It was evident from the analysis done that different tools had different (complementary) strengths and not one tool could provide for all the requirements enlisted.

<p>integration and effectiveness of the requirements compliance. By performing the actual installation of a prototype of one of the tools within a digital library platform, we will be able to corroborate our estimations and determine how to cope with any new issues and risks that have not been foreseen. Several annotations of each type of need identified in activity 1. will be input as a test of the prototype efficiency. The results and evaluations of such activities should feed the assessment following this task.</p>	<ul style="list-style-type: none"> • A proof-of-concept prototype was developed to address the basic characteristics that an annotation system must provide in a digital library platform (like Botanicus). • RERUM was used in the proof-of-concept prototype tool on how an existing annotation tool could support the different types of annotations that the botanical users may need to store. • The initial prototype functionality was developed further as a tool that could take images of pages and provide the basic characteristics that an annotation system must provide in a digital library platform as identified in the previous selection. • The prototype was tested with different types of annotations to determine key aspects of a tool development or adaptation of an existing one. • The recommendations on efficient ways to address the requirements were included in the Outcomes Assessment. 	<ul style="list-style-type: none"> • We invested the developers' time to explore how to inform this tools integration rather than concentrating in one single champion tool
<p>Assess outcomes from this project to identify requisites, best practices, needed tasks and further developments required, as well as the appropriate partners needed for a full-scale Project Plan. Particular consideration should be given to the the activities needed for the proper expansion and scaling of the prototype</p>	<p>An assessment of the outcomes was created, including</p> <ul style="list-style-type: none"> • A short summary of the characteristics for the annotations tools evaluated was compiled. • An estimation of the setup complexity that the different annotation tools could have was redacted in a table. • A comparison of the advantages and disadvantages of the annotation tools considered was included in a table. 	

	<ul style="list-style-type: none"> Some conclusions from our experience were redacted and future directions for the work ahead, deriving from this assessment, were indicated. 	
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18. Changes

Type of Change	Description	Date of Approval (if applicable)
1-year no-cost extension	The project was approved a 1-year no-cost extension to finalize the tasks executing a budget change (see Appendix 1. and 2.)	04 / 08 / 2019

19. Results

a. Agency-Level Goals

- Learning
 Community
 Content and Collections

For **Content and Collections** projects, proceed directly to Question 19b.

b. Program and Project-Level Results (for All Projects)

Intended Result(s)	Actual Result(s)	Explanation of Any Variance
Needs Analysis Report with a prioritized list of annotation needs for users of a botanical virtual library.	Needs Analysis Assessment done (see Appendix 3) and the list of prioritized annotation needs was created (see Appendix 4).	
Feasibility Study with the evaluation of four existing open-source annotation tools based on their potential to address the needs identified in the previous Analysis Report on how they could satisfy botanists' needs.	Seven existing annotation tools evaluated against the previous needs analysis to develop a feasibility study for how they could satisfy botanists' needs. (see Appendix 5. and Appendix 6.)	Initially, we chose four different existing annotations tools to assess how they satisfy the annotation needs of users in the Botanical community: 1) Hypothes.is, 2) Digilib, 3) Annotorious & 4) RERUM. While evaluating the tools we realized that only Hypothes.is and Annotorious were readily applicable and available interactive annotation tools while Digilib and RERUM are annotation

		<p>servers that support and facilitate annotations but are not readily available for the intended user. For this reason, some of the requirements could not be evaluated against these two former tools. We chose to add three other tools (i.e. Recogito, Pundit & VGG Image annotator) which were readily available via a WWW user interface or downloadable</p>
<p>Proof of concept prototype installed within a virtual library to demonstrate the functional capacity of one of the evaluated tools. Integrate RERUM within a digital library platform (Botanicus) as a proof-of-concept on how an existing annotation tool could support the different types of annotations needs that the botanical users may have.</p>	<p>As a proof-of-concept on how an annotation tool must support the basic needs that the botanical users may have from a digital library platform, a prototype with such functionality was developed, based on the way Botanicus works and integrated with RERUM as the central storage of annotations (see Appendix 7).</p> <ul style="list-style-type: none"> The code of the prototype was stored in a public Github repository: MBG-CBI/C2C: Consumers as Creators (IMLS LG-87-18-0057-18) 	<p>As a whole, much of the functionality needed to satisfy the annotation requirements identified is already included in different degrees in the existing tools analyzed. Therefore, instead of choosing and installing one single tool only, we tested several of them and concentrated our development efforts to illustrate how the tools' behaviour and integration should fit in the way current Digital Libraries work. This allowed us to extract lessons learned for any fully-developed tool to attend the minimum botanists' requirements identified.</p>
<p>Outcomes Assessment with next step recommendations to propose a full-scale project adopting an annotation tool as part of a virtual library.</p>	<p>An assessment of the outcomes is provided with a short summary for the annotations tools we evaluated, an estimation of the setup complexity of the different annotation tools, the pros and cons of those interactive annotation tools and our conclusions and future work deriving from this analysis (see Appendix 8.)</p>	

20. Lessons Learned

There have been different initiatives for the annotation of Digital Library contents and more in general of Web resources in the Humanities Sciences that have facilitated the researchers' workflow in their field since the advent of Web 2.0. When evaluating the original annotation needs of botanists with different annotation tools, we came up with additional annotation needs required by scholars in the humanities sciences and implemented in tools such as Pund.it and Recogito that were not suggested by the 15 interviewed users of digital Biodiversity libraries, but that could be adopted by our community.

There is no one single available annotation tool of the seven evaluated so far, that fulfills all the desired annotation functionalities of botanists. In theory, the tool that most closely appears to meet the annotation requirements of the botanical community, is Pund.it (<https://thepund.it/>). Pundit was initially targeted to scholars in the humanities Sciences but its newest version (i.e. Pundit Annotator Pro), with semantic annotation capabilities, has expanded to target professionals, journalists and other researchers. Pundit Annotator Pro allows annotations in the forms of comments, tagging, entities markup and linking, composition of rich semantic statements (Morbidoni & Piccioli, 2015). Unfortunately, this tool is not completely functional right now because the Pundit Web Annotator Chrome Extension is currently not working due to some updates to the Google Chrome Extensions policies. Therefore, we couldn't evaluate its full potential.

Many existing manual annotation software requires installation and setup. This requirement often results in a barrier for non-technical users who cannot deal with variability in software installation and setup procedures on different types of computing systems. One way to reduce the time and complexity for installation from end-users is to use pre-installed self-contained software packages like server containers. This guarantees compatibility against a myriad of potential combinations. Ideally, the tool used for annotation should be easily integrated into existing systems. In that sense, some tools allow you to choose the type of installation, either as a bookmarklet or a browser extension, or a javascript or other code that can be enabled in your own application. Alternatively, providing a fully functional encapsulated and pre-configured server to store the annotations ensures a hassle-free installation. This also allows an advanced starting point for a custom installation.

Although we wanted to evaluate annotations within a specific library (i.e. Botanicus), we have recognized that scholarly researchers should not be bound to a specific archive or corpus, but rather they should be able to annotate on top of the whole Web (if possible) or their annotations should reside in the same repository or at least in repositories that could be easily integrated. Tools, like Hypothes.is, are allowing annotations on top of the Web; however, this tool does not allow the annotation of images, which is the format in which a large percentage of the legacy information is conveyed. Also, the sites that can be annotated with this tool need to provide a clear URI for the place where the annotation is associated or it might get linked to the page or the site itself; in a Digital Library environment, this means that each page should have its own URL to allow annotations properly placed in them. Other tools like RERUM, a product of the Center for Digital Humanities at Saint Louis University and is both, an entity annotation ecosystem and repository for annotated corpora, enabling different tools to store their annotations and corpus in the same place.

Our recommended approach is instead to either expand or integrate the capabilities of those different independently developed platforms, each of which supports some of the requisite functionalities for botanists, but none of which provides the entire suite of required tools and resources.

21. Next Steps

The team has considered it important to share the results of the project, particularly the **annotation needs assessment**, directly with organizations involved in the development of different relevant tools. In this way, we expect to promote awareness of the botanical community annotation requirements and to influence the implementation of new annotation capabilities that satisfy the needs of the scientific research community at large.

In a similar way, our **assessment of the existing annotation tools** might serve as a guide for developers to identify new functionality recommended for their annotation tools. It could also allow developers to contrast the way other similar tools address the requirements of the scientific research community. It is our intent to share directly with our contacts from the existing initiatives to suggest steps forward in further updates and developments.

We hope that our recommendations also inform existing **Biodiversity Digital Libraries** of the possibilities of incorporating annotations into their platforms, as well as to make them aware of what needs are already addressed by the tools available. In that regard, we will share this report with several Digital Libraries initiatives and through the listservs and forums in which we participate, to promote ideas, discussions, and actions to foster the adoption of a more interactive environment.

From the analysis of our results we identified a request for existing and future annotation tools to be seamlessly **integrated** using common standards (such as the W3C Annotation Model), sharing the complementary functionality of each tool to address their comparative shortcomings.

Much of the Biodiversity Research legacy information content, fundamental for the Web-based delivery of books, journals, field notes, manuscripts, maps, and archival materials in Digital Libraries, are still contained only in digital images. The International Image Interoperability Framework (IIIF) is emerging as a standard for accessing and delivering these image-based resources. Recent advances of IIIF releasing new revisions of their APIs and defining novel best practices in associating information with IIIF materials, like the IIIF Maps Community Group, should be followed closely for future enrichment of the information served in Digital Libraries that would ultimately impact annotations and empower the Consumers as Creators of content.

22. Appendices

Appendix 1.

1-year no-cost extension request for project **IMLS Grant LG-87-18-0057-18**

Attention:

Ashley E. Sands, PhD
Senior Library Program Officer
Institute of Museum and Library Services

St. Louis, Missouri, March 29, 2019

Subject:

1-year no-cost extension of project **IMLS Grant LG-87-18-0057-18**

Dear Ashley:

I write to you to inform about the project advances and to kindly request a 1-year no-cost extension for the FY2018 National Leadership Grants for Libraries award for the project "Consumers as Creators: Understanding the annotation needs of the scientific community through the domain of botany." (**IMLS Grant LG-87-18-0057-18**).

Although a slight delay from the proposed date of start, we had been advancing our project according to our initial plan during the calendar year 2018 and had made substantial progress in three of our four main objectives, but we still need to dedicate more time into it to guarantee a successful outcome.

We have conducted personal interviews to 14 botanical community members to gather their real annotation needs and have compiled a prioritized draft list of annotation needs for users of a botanical virtual library. If we can get the project extension requested, we intend to validate further our current prioritization by widening our number of interviews with general input from the online community. But in order to conclude our analysis report, we will still need to verify this prioritization against the new input, evaluate the tools we proposed against the needs found and include the estimation of actual time and complexity required to set up each one of the tools to a working status that could satisfy the requirements indicated. We also need to conclude the development of our proof-of-concept prototype and outline our outcomes assessment in view of a fully development and implementation.

Unfortunately, a key member of our team, our colleague Trish Rose-Sandler, has left our institution and is no longer associated to the project, which has slowed down our progress. We would like to utilize the available staff funds to hire a member of the botanical community that could help us fulfill our project objectives by leading the tasks described above.

Additionally, we would like to fund our participation in the iAnnotate 2019 Conference on May 22–23 at the American Geophysical Union (AGU) headquarters in Washington DC, to present our preliminary results of the needs assessment and prioritization.

Please find attached to this message the revised budget for the remaining funds according to the new objectives.

Kind regards,

William Ulate
Center for Biodiversity Informatics, IT Division
Missouri Botanical Garden

Appendix 2.

IMLS 1 year no-cost extension approval for project **IMLS Grant LG-87-18-0057-18**

IMLS Award Period Change Notification - LG-87-18-0057-18

Ashley Sands

Mon 4/8/2019 2:11 PM

To: William Ulate <william.ulate@mobot.org>; Susan Winkler <Susan.Winkler@mobot.org>; Chuck Miller <Chuck.Miller@mobot.org>
Cc: grantsadmin@imls.gov <grantsadmin@imls.gov>

Thank you for your request for a no-cost extension on this IMLS award. Your request has been approved.

Please be advised that Award End date for the following award has changed.

Award Log Number: LG-87-18-0057-18.

Organization Name: Missouri Botanical Garden.

Original award dates: From: 05/01/2018; To: 04/30/2019.

Modified award dates: From: 05/01/2018; To: 04/30/2020.

Below is the revised reporting schedule:

Type	Due Date
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Final Financial	07/29/2020
Final Narrative	07/29/2020
Interim Narrative	07/30/2019
Interim Financial	07/30/2019