How Clean is Your Software? The Role of Software Validation in Digital Preservation Research Projects

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ABSTRACT
The emphasis during the last three EC Framework Programs on Digital Preservation (DP) has enhanced our understanding of the boundaries of the problem, produced new methods, and supported the construction of preservation tools. In the case of methods and tools, measuring their suitability has emerged as a focus of research. What evidence does the DP community have that the digital preservation tools perform the functions they are supposed to and that they align with original specifications? This paper summarizes the efforts of the Sustaining Heritage Access through Multivalent ArchiviNg (SHAMAN) project to create and implement software validation as a means to gauge the fitness-for-purpose of software outputs. The paper concludes by demonstrating the applicability of the validation approach to preservation projects in general.

Categories and Subject Descriptors
D.2.4 [**Software Engineering**]: Software/Program Verification – *validation*

General Terms
Measurement, Performance, Reliability, Verification.

Keywords
digital preservation, software validation, evaluation, SHAMAN.

1. INTRODUCTION
In the last five years or so, the Digital Preservation (DP) domain has witnessed an unequivocal growth in investment, accompanied by an equally growing number of software applications that encapsulate the aims and objectives of DP research projects. Evidence on the existence, suitability, merit and functionality of these programmatic tools has been documented as part of the reports delivered under the banner of an array of DP projects funded by the European Commission.

Through this evidence, the role and significance of DP-specific software becomes clear to both funders and the community of users. Test implementations, demonstration versions and free open-source software outputs create a matrix of available options. Although the existence of these software tools in the public domain testifies the achievements of DP projects, there is an underlying layer, whose importance has – thus far – failed to emerge. What evidence does the DP community have that the digital preservation tools perform the functions they are supposed to, based on user requirements and the assertion of Descriptions of Work accompanying funded DP projects? How often is it that the alignment of software developed under these projects with original specifications are formally documented and made publicly available? This paper brings attention to the use of software validation [3, 6] as a means to significantly boost the trustworthiness of DP software developed under EC-funded projects. At present, there is a distinct lack in the DP domain of not only documentation of software validation, but of implementation of the very process itself. In a field which still strives to justify funding and investment, software validation can contribute to advocating the quality of software outputs from research projects for digital preservation, and support the claims for their suitability to actively aid in safeguarding the digital production of the 21st century. In recognition of this situation, this paper summarizes the efforts of the Sustaining Heritage Access through Multivalent ArchiviNg (SHAMAN) Integrated project to create and implement software validation for its software outputs.

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2. THE SHAMAN PROJECT
The SHAMAN Integrated project[1] has received funding from the 7th Framework Program for research and technological development of the European Commission to conduct research in the long-term preservation of digital heritage. SHAMAN centers on three distinct domains of focus, namely Memory Institutions, Industrial Design & Engineering and e-Science. Each domain has been commissioned to generate functional research prototypes, which "exhibit, test and validate the principles, functionality, viability and usefulness of the SHAMAN solutions" [5]. The combined results from the ISPs in all three domains of focus form the basis for achieving the SHAMAN high-level goal, that is to develop a next generation Digital Preservation (DP) Framework. The SHAMAN DP Framework is meant to provide a solution to

[1] http://www.shaman-ip.eu

the challenges posed by technological evolution and obsolescence through sustainable, scalable services for the preservation of complex objects and their relationships. SHAMAN has developed demonstrator applications[2] as exemplar cases that proclaim the operations and benefits of the prototypes and form the primary software outputs of the project.

3. SOFTWARE VALIDATION METHODOLOGY

The project partners in the Humanities Advanced Technology & Information Institute (HATII) at the University of Glasgow were appointed with the task to build and implement an instrument to assess software development. Guided by the specifications in the IEEE V&V Standard [3] the HATII team devised a validation methodology to complement the design and development of the SHAMAN demonstrators. The methodology was based on the IEEE Standard in order to generate a custom validation plan for the SHAMAN demonstrators. A set of validation instruments was selected that align with the specifications of the IEEE Standard. A comprehensive presentation and explication of these tools is included in the SHAMAN Report on Demonstration and Evaluation Activity in the Domain of Memory Institutions [2].

4. SOFTWARE VALIDATION RESULTS

The information collected through the metrics identified in the validation methodology provided valuable feedback and corroborated the alignment of project specifications to the development and implementation of demonstration software within the domain of memory institutions. At the conclusive stage of the demonstrators' development, the involved programmers and software developers were invited to validate the level of achievement with respect to the functional requirements identified through a software validation process. This was achieved through a dedicated online submission system, which collected feedback for a period of one month.

The aggregate results show that 87% of the total functional requirements across all ISP1-related Use cases have been completely or partially achieved. The requirements that were not achieved are straightforwardly implementable and are addressed in demonstrators for the subsequent ISPs. The level of overall achievement corroborates that the software developed at this phase of the project satisfies the original expectations and aligns with both the SHAMAN Description of Work and the needs to demonstrate the SHAMAN DP Framework to its community of users through exemplar software implementations. The results from the validation process show that the SHAMAN ISP1 Demonstrators have satisfied and justified the reasons for the development, covering at the same time fundamental project needs to showcase a real-life example of implementing the SHAMAN DP Framework.

5. CONCLUSIONS

Validating and assessing the achievement of DP projects in terms of developed software tools, in a structured and objective manner, is essential for both ensuring continuing investment in this field and for guaranteeing the good operation of these tools to target communities of users. For software validation to be successful the process must be included in the strategic plans of DP projects at an early stage and consistently continue to be applied until the end of the projects' life-cycle. In this manner, it is possible to exhibit verification and validation evidence that software development directions are not a tangent to user expectation. Software validation – although not a panacea for all software hardship a project might encounter – is a suitable evaluation and assessment method for measuring, quantifying and ascertaining the quality of software produced via research projects and its fitness-for-purpose. This paper concludes with the question it started from, addressed to anyone involved in development of research software for digital preservation: How clean (really) is your software?

[2] The Memory Institution Demonstrator is available via registration at https://shaman-ip.eu/shaman/Demonstrator%20for%20Memory%20Institutions

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