The Virtual Physiological Human ToolKit – Evolution and Sustainability

Jonathan Cooper[1], John Fenner[2], Keith McCormack[1,2], David Gavaghan[1], Peter Coveney[3]
[1] Oxford University Computing Laboratory, Oxford, UK
[2] University of Sheffield, Sheffield, UK
[3] University College London, London, UK

Introduction

The Virtual Physiological Human (VPH) ToolKit is a technical and methodological framework to support and enable VPH research – the collaborative investigation of the human body as a single complex system. The aim is to achieve this goal through the creation, accumulation, and curation of VPH research-related 'capacities' – the integration of existing work, and its further development towards greater interoperability. The VPH Toolkit concept is evolving, as members of the VPH Network of Excellence (VPH-NoE) begin to appreciate both the scale of the task and the issues that must be addressed for a sustainable future.

The ToolKit is certainly not intended merely to be a collection of isolated tools used by VPH researchers and clinicians, nor can it be a single monolithic entity capable of fulfilling the needs of all users; the latter is impossible, and the former has little impact or utility.

In contrast, the ToolKit must evolve into a curated set of tools that are sufficiently usable, flexible, and interoperable that they can be configured and connected by researchers to provide a range of practical and user-friendly solutions for clinicians and biomedical researchers, instead of starting from scratch for each new use-case.

This challenging goal imposes requirements on ToolKit development, and requires the involvement of the wider VPH community, in particular all current and future projects funded under the VPH Initiative (VPH-I), since the VPH-NoE does not have the resources to achieve this vision by itself. These groups must work together to promote development practices that can achieve mutually beneficial goals and lead to long-term sustainability of the resources produced [2].

This paper describes the evolving approach to the ToolKit. The ways in which the approach to content provision is adapting to the needs of users are considered, taking into account the need for sustainability beyond the life of the VPH-NoE. To this end a process of standardisation is being introduced, to ensure high-quality ToolKit contributions and involving the development and publication of formalised guidelines for submissions, adherence to which will ensure that content can provide maximum utility to other users. Working Groups drawn from VPH-NoE partners are being formed to further this approach.

ToolKit Evolution

The first year of the VPH-NoE established the ToolKit concept and enabled it to be realised as a functioning repository of VPH tools, methods, and services, supported by a web portal[1] for interaction [1]. Subsequent months have established the principle of long-term sustainability as central to ToolKit development. Three principal strands of activity have emerged: interoperability, engagement and standards.

- Interoperable content: High-quality content for the ToolKit needs to be collected. Wherever possible, this is sought from existing developments external to the VPH-NoE, in order both to maximise engagement and to make best use of VPH-NoE resources. The focus is on making existing tools interoperable with other ToolKit content.
- Engagement: The Exemplar Projects within the VPH-NoE, and the wider VPH community, are natural sources for ToolKit content, as well as being our primary users. Support is needed (and is being requested) from the ToolKit team in order for these groups both to contribute to, and benefit from, the ToolKit. As the VPH-I projects make progress, it is essential that they work with the VPH-NoE in ensuring that the tools are being developed in a manner that will allow adaptation and incorporation into the Toolkit for re-use in the wider community. Engagement with these partners is therefore a high priority, to assist both in identifying useful outputs from these projects, and increasing their interoperability, in collaboration with content providers. Increasing the provision of training will support this work.
- Standards: The use and development of standards is of primary importance in achieving interoperability within the ToolKit [1], and again promoting this idea within the VPH-I, and further afield, is a key goal of the VPH-NoE. This activity has many facets: identifying crucial standards that already exist, improving tool support for such standards, identifying gaps in provision and working with interested parties to develop new standards, and providing training in the use of standards.

Sustainability Themes

Sustainability does not happen without careful consideration and planning. For software to be long-lasting, it must satisfy a range of criteria, most important amongst which is the need for a strong user and developer community to ensure its long-term support and relevance (which implies monetary investment also).

1 http://toolkit.vph-noe.eu/

Discussions at a recent VPH technical workshop drew out five key sustainability criteria for ToolKit content.

1. Standards – these are crucial to enable tools to interoperate, and for researchers to be able to share their data and models.
2. Ontologies – a sub-theme of standards, but sufficiently important to merit its own focus. Ontological annotation of models and data facilitates interconnection of ToolKit resources.
3. Certification – ToolKit content needs to be demonstrably of a high standard, well documented, and properly validated.
4. Interoperability and workflows – tools should not exist in isolation, but be usable in tandem to achieve scientific and clinical goals.
5. User friendliness and relevance – last in the list, but of fundamental importance!

These sustainability 'themes' are central to ToolKit survival, but it was agreed that more explicit guidance was required if content providers were realistically to meet the requirements of the ToolKit. Accordingly the VPH-NoE is working to agree and document those features that are considered to be essential elements of ToolKit content. These guidelines will cover such areas as tool, model and data characterisation, ontological annotation, provenance, licensing, ethico-legal issues, interoperability, and usability, with corresponding implications for development practices. They will be easily obtainable from the ToolKit portal as soon as early drafts are available.

In one area in particular some guidance is already available. A common issue for developers of scientific software is dealing with intellectual property considerations, in particular software licences. The requirements of the host organisation(s) involved in developing the software need to be taken into consideration, as well as the licences of any software libraries used in the final product. These topics need to be carefully considered when deciding how to release software, and under what licence. They are also worth considering when beginning a software project, since decisions made earlier in development may have a significant impact on any later decision to release.

In an effort to assist VPH projects in understanding these issues, and also assist users of VPH tools in understanding their licenses, the VPH ToolKit Portal now includes some overview information, along with links to relevant resources from third parties (see http://toolkit.vph-noe.eu/component/content/article/9). The pages include a list of recommended Open Source licences, setting forth the main features of each licence in a manner that is free from legal technicalities. Each licence is also categorised according to four criteria: whether or not it has been approved by the Open Source Initiative, whether it is business friendly, whether it is compatible with the GPL, and the legal jurisdiction specified in the licence, if any.

This information is designed to support the VPH ToolKit Portal since the latter includes a licence field for each entry. Where the licence (or one of the licences) used for a technology is one from our list, the entry's display will then link to our information page on that licence.

Discussion

Even at this embryonic stage of the VPH, it is clear that the community is nurturing a wealth of potentially powerful and relevant tools [3], with steady growth and development. These can be expected to be delivered over the next few years. Note, however, that a collection of isolated tools gains little advantage if the only influence of the VPH-NoE is to enable them to become a collection of isolated tools residing under the roof of the ToolKit portal. The metric of success must not be the number of tools hosted by the ToolKit, but instead must be one of sustainability. The role of the VPH-NoE must be to clarify direction and recommend strategies that promote interoperability and sustainability, but this is fundamentally predicated on a two way engagement between the VPH-NoE and the wider VPH-I projects.

Many project outputs are predominantly in the form of software tools, but if longer-term uptake is a genuine goal, then all should embrace a sustainability analysis that includes elements such as community, ethico-legal implications, certification, documentation, interoperability, training, user-friendliness, etc. Funding bodies will also need to support effort in these areas adequately. Unfortunately, adherence to the sustainability principles proposed above does not necessarily ensure long term sustainability. However, the process will encourage acceptance and use within the VPH community and thereby help to promote its continuing existence beyond the end of the project. The presence of end users and early adopters should create an enthusiastic user community willing to sustain the software and its concepts. This can also be achieved through affiliation with a ready-made community, relying on existing underpinning frameworks. The key message is thus one of community as an empowering force for sustainability.

An area fundamental to interoperability that has not been adequately addressed within the VPH-NoE thus far is that of security. Taking clinical requirements into account, any VPH system must support rigorous but flexible authentication and authorisation, based on a secure infrastructure for information and modelling exchange. This will be an important area for future work in collaboration with other projects.

References

[1] Cooper *et al.*, 2010. The Virtual Physiological Human ToolKit. Phil Trans R Soc A (in press) http://www.vph-noe.eu/vph-repository/doc_download/167-the-virtual-physiological-human-toolkit

[2] Hunter *et al.*, 2010. A vision and strategy for the virtual physiological human in 2010 and beyond. Phil Trans R Soc A 368:2595-2614; doi:10.1098/rsta.2010.0048

[3] VPH-NoE Consortium, 2010. Deliverable D3.6 VPH ToolKit Development. [Online] http://www.vph-noe.eu/deliverables-table