REPORT ON OpenDreamKit DELIVERABLE D1.3

Internal Progress Reports year 1, including risk management and quality assurance plan

NICOLAS M. THIÉRY, BENOÎT PILORGET, ET AL.

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Lead	Université Paris-Sud (UPSud)
Progress on and finalization of this deliverable has been tracked publicly at: `https://github.com/OpenDreamKit/OpenDreamKit/issues/19`	

DELIVERABLE DESCRIPTION, AS TAKEN FROM GITHUB ISSUE #19 ON 2016-09-15

- **WP1:** Project Management
- **Lead Institution:** Université Paris-Sud
- **Due:** 2016-08-31 (month 12)
- **Nature:** Report
- **Task:** T.1.3 (#16)
- **Proposal:** p.34
- **Final report**: in the making

This reports on the scientific progress accomplished during the first year of OpenDreamKit (September 2015 to September 2016):

- ✓ Evaluation of the progress of the project at the global level and the task level
- ✓ Evaluation of risks foreseen and how they are being handled by partners
- ✓ Quality assurance plan and report on Quality Review Board and end-user group's activities

CONTENTS

1. PROGRESS ON THE PROJECT

In this section, we give a general overview of the progress of the project. We start by recalling some context of OpenDreamKit's approach that is important to understand and evaluate the progress. Then we describe the general state, and in more detail the progress of the work packages.

1.1. Some context: OpenDreamKit's approach

OpenDreamKit's approach to delivering a Virtual Research Environment (VRE) for mathematics is not to build a monolithic one-size-fits-all VRE, but rather a toolkit from which it is easy to set up VRE's that are customised to specific needs by combining the appropriate components (collaborative workspaces, user interfaces, computational software, databases, ...) on top of available physical resources (from personal laptops to cloud infrastructure). This approach — chosen by design — allows to flexibly put together lean computational environments and tools for particular research challenges. These tools provide the required functionality but due to the component based approach carry no unnecessary bloat that would reduce effectiveness in terms of installation process, size, computation time, and reproducibility.

Most of the components preexist as an ecosystem of open source software, developed by well established communities of developers. For example, for interactive computing and data analysis, OpenDreamKit promotes Jupyter, a web-based general purpose flexible notebook interface[1] that targets all areas of science. A number of Virtual Research Environment already exist, e.g. powered by SageMathCloud or JupyterHub.

Hence most of the work in OpenDreamKit is to foster this ecosystem, improving the components themselves and their composability. The technical is distributed over the work packages:

- Component architecture (WP3):
  - ease of deployment: modularity, packaging, portability, distribution, for individual components and combinations thereof.
  - sustainability of the ecosystem: improving the development workflows.
- User Interfaces (WP4): enable Jupyter as uniform notebook interface, and further improve it; foster the collaboration between SageMathCloud and JupyterHub; generally speaking investigate collaborative, reproducible, and active documents.
- Performance (WP5): make the most of available hardware (multi-core, HPC, cloud), for individual computational components and combinations thereof.
- Data/Knowledge/Software (WP6): enable rich and robust interaction between computational components, data bases, knowledge bases, users through explicit common semantic spaces, a language to express them, and tools to leverage them.

These technical work packages are supported by the following two activities:

- Community building and dissemination (WP2): developer and training workshops, conferences, teaching material with focus on making the created value accessible to a wide, varied and growing user community.
- Studies of Social Aspects (WP7): analysis of user needs and research into collaborative and open software development in mathematics and science.

As a result of OpenDreamKit's approach, the work programme for OpenDreamKit consists of a large array of loosely coupled tasks, each being useful in its own right, and none being absolutely critical.

This first year confirmed that this is a strong feature of OpenDreamKit's approach. Indeed, as analysed in the proposal, this kind of project is subject to the following risks:

- Recruitment of qualified personnel;
- Different groups not forming effective team;

[1] a notebook is a document that contains live code, equations, visualizations and explanatory text

- Implementing infrastructure that does not match the needs of end-users;
- Lack of predictability for tasks that are pursued jointly with the community;
- Reliance on external software components.

Together with ambitious software challenges, this makes the accurate prediction of workload and precise timeline of work packages difficult, especially over a period of four years in a field of rapidly evolving technologies.

The loose coupling allows some flexibility, permitting to modify the tasks schedule and human resources allocation, with little influence on the general aims and objectives.

1.2. General progress

Intensive work has now started on almost all fronts of the project[2]. A few tasks (and the corresponding deliverables) have been postponed by a couple months due to recruitment delays. This concerns mostly the micro-magnetic VRE demonstrator (**T2.7**, **T2.8**, **T2.9**, **T3.8**, **T4.11**, **T4.13**, **T4.14**, **T7.4**), where recruitment at Southampton initially proceeded at expected speed but eventually experienced delays of several months outside our control due to unusually high demand on the UK Home Office which had to process work permit paperwork for the successful candidate (attributed to a high number of immigration applications in the run up to the Brexit referrendum). Some deliverables got delayed as well by a couple months due to unexpected technical difficulties or misplanning (e.g. D5.4, D5.1, D4.1). All these delays have been included in the amendment of the Grant Agreement, which was necessary to include UGent in the consortium. On the other hand, we are happy to report below on very strong recruitment (see Section 3.1), as well as unexpectedly rapid progress on portability and packaging aspects. Also WP6 (Data/Knowledge/Software) has witnessed a particularly strong and early uptake, with active involvement of many of the participants and promising outcomes.

All in all, OpenDreamKit is running according to its plan, and its first outcomes are already benefiting the mathematical community and beyond. September 2016 will see the start of Key Performance Indicators. These KPIs, which will be more precisely and realistically defined then, will give results for the 1st Reporting Period (RP1) at month 18. This way we will be able to see the evolution of the impact OpenDreamKit has had between the RP1 and RP2, at month 36.

1.3. Achievements and ongoing progress in workpackages

1.3.1. *WP1: Project management.* As planned in WP1, UPSud has been coordinating OpenDreamKit. Most of the management effort for year 1 has been made in **T1.1**: "Project and financial management" (see D1.1 and D1.2). A consortium agreement was signed between partners, stating precise rules about topics such as: responsibilities, governance, access to results and the background included. UGent has recently agreed to sign this Consortium Agreement without any modification to it.

Communication underpins a distributed network of researchers and software developers. The website for the project has been continuously updated with new content, and virtually all work in progress is openly accessible on the Internet to external experts and contributors (for example through open source software on Github). A modified, more outward facing version of the webpages is under development and will transition into a long-term dissemination and communication tool. The project has a number of mailing lists, which are currently reviewed to better support increasing dissemination and communication beyond the consortium.

During year 1, a kick-off meeting was organised in Orsay, followed by two progress meetings at which partners presented status reports, and the steering committee got together. The first progress meeting was organised in St Andrews (January 2016) and the second one was located in Bremen (June 2016). The latter coincided with the interim project review, planned at month

[2]status reports delivered at the St Andrews project meeting (January 2016) and at the Bremen's project meeting (June 2016) helped the Coordinator to track the progress

9, where deliverables due by then were presented to the Project Officer and Reviewers. The OpenDreamKit project was granted the grade 3 out of 4 for this interim review: "Good progress (the project has achieved most of its objectives and technical goals for the period with relatively minor deviations)".

Due to the length of the first reporting period (18 months), the UPSud administration decided to organise an internal and interim breakdown of costs. This exercise aimed at raising potential questions from partners early on and to make sure partners do follow the EC rules for the eligibility of costs.

More information on **T1.2**: "Quality assurance and risk management" can be found in Section 4 of this document: Quality assurance plan. Also, if some work has been done on **T1.3**: "Innovation management", a full report on the matter will be available at month 18.

1.3.2. *WP2: Community building and dissemination.* As planned in **T2.1**: "Dissemination and Communication activities" and **T2.5**: "Dissemination: reaching towards users and fostering diversity", 14 meetings, developer and training workshops have been organized and co-organized by OpenDreamKit during year 1, and complemented by many presentations and activities in external events. Many more are being prepared, including the first Women in Sage workshop in Europe and three major training conferences (tentatively at CIRM, Dagstuhl, and ICMS); OpenDreamKit and OpenDreamKit related work is regularly presented at conferences (see the report for D2.2).

Two additional workshops have been delivered for the micromagnetic user community in which the prototypes of the Jupyter and Python interface to the micromagnetic community's widely used OOMMF simulation code has been demonstrated, taught and feedback from the users sought (part of **T2.7**: "Open source dissemination of micromagnetic VRE")

OpenDreamKit is also working on its visibility and communication strategy. The D2.1: "Starting press release" was delivered and a page for the E-infrastructure booklet was written jointly by OpenDreamKit members. After one year, we have a clearer understanding of what is needed by the project. We are working on a new organization for the website where day to day activities would be more visible through our blog. Posts include reports on conferences, workshops, new features and emerging technologies (as part of D2.2).

1.3.3. *WP3: Component architecture.* The first task of this workpackage is to improve the portability of computational components **T3.1**: "Portability". A particular challenge is the portability of SAGE (and therefore all its dependencies) on Windows, which has remained elusive for a decade, despite many efforts of the community. We are happy to report that, in particular thanks to months of intensive and expert work by our recruit Erik Bray at UPSud, this challenge is about to be tackled, almost one year before the expected delivery time.

Task **T3.2** on interfaces between mathematical systems is progressing as expected. Experimental work on a semantic interface between GAP and SAGE (D3.9, due on month 36) has started during the joint GAP-Sage days, and a working prototype is already available. The current prototype uses *ad hoc* language mechanisms to transfer the semantics from one system to the other; these mechanisms will be replaced with a generic API once the MitM approach developed in WP6 will be mature enough. Meanwhile, a purely technical piece of the puzzle has been already achieved by D3.3, which brings support for the SCSCP protocol to the Python ecosystem (and thus to SAGE and its subsystems). This is instrumental for supporting the MitM approach.

The paragraph above is full of acronyms (MitM, API, SCSCP, GAP, SAGE) - should we spell some of the them out?

After D3.1: "Virtual images and containers" was delivered, a focused workshop in March (Sage Days 77) also triggered much work and progress on the packaging side (**T3.3**), both by OpenDreamKit participants and the community. There is now good hope to have proper packages

for SAGE (and its dependencies) on the Debian distribution in the coming months, a feature that has been desperately longed for for over a decade. The workshop was also the occasion to clarify the modularization, packaging, and distribution needs and challenges. Internal notes on the progress made have been taken in the SAGE wiki, and a mailing list specifically dedicated to packaging SAGE has been created.

Task **T3.8**: "Python interface for OOMMF micromagnetic simulation library" has been completed and is available online on github, and through the Python packaging index.

1.3.4. *WP4: User interfaces.* The first task for this workpackage is to enable the use of Jupyter as uniform notebook interface for the relevant computational components **T4.1**. This is well under way for most components. Progress was particularly fast for SAGE thanks to a very active involvement of the community; this will enable, in the coming months, a systematic transition from the legacy SAGE notebook system to JUPYTER; this is a particularly important achievement: beside all the benefits of a uniform and actively developed interface for the user, outsourcing the maintenance of the notebook interface will save the SAGE community much needed resources.

A new JUPYTER package, nbdime, was created for D4.6 enabling easier collaboration on notebooks via version control systems such as git. This project was presented at the major Scientific Python conferences SciPy US in July and EuroSciPy in August, and has been met with enthusiasm from the scientific Python community for its prospect of solving a longstanding difficulty in working with notebooks. Work has begun on a new package, nbval, for D4.9, which will integrate the above nbdime package for delivering testable, reproducible notebooks via traditional software development testing practices.

The JupyterHub package has received updates and further development, specifically a Services extension point, which enables shared workspaces for collaboration, a step on the path toward real-time collaboration for D4.15.

Active structured documents are a common need with many use cases, and as many potential solutions. Requirements and venues for collaborations were explored through discussions between participants, in particular at the occasion of Sage Days 77 workshop (see the notes), and June's ODK meeting in Bremen. The findings were reported in D4.2. Sage Days 77 was also the occasion to bootstrap the long term work of refactoring the Sage documentation build system (D4.13) in collaboration with a Sphinx developer.

One deliverable, D4.1, was delayed by a couple months due to unforeseen technical difficulties, but with no impact on the rest of the project.

1.3.5. *WP5: High Performance Mathematical Computing.* After D5.1 was delivered, **T5.7**: "Pythran" is making good progress towards the development of Pythran and its interaction with SAGE. More precisely, Pythran's typing system (D5.4) has already been improved yet it still requires additional effort, and the delivery date of D5.4 has been postponed from month 9 to month 12. It has no impact on related tasks or deliverables. The start of Deliverable D5.2 has been delayed from Month 12 to Month 18 due to the difficulty of hiring an engineer for the task. It is now making good progress.

Deliverable D5.5: "Extend the existing assembly superoptimiser for AVX and upcoming Intel processor extensions for the MPIR library." is making progress but has hit a major blocker: it requires to use a precise clock cycle counter, for which a kernel module has been proposed in this deliverable. However a bug in the Linux kernel seem to automatically disable these counters. It has been reported upstream but the long delay to have a patch incorporated into the kernel will impact the delivery of this deliverable. There is no dependency to this deliverable, and the problem is now well understood and its solution is underway (details).

As mentioned in the initial proposal, work on **T5.3** (LinBox) is just starting in September 2016, as the members of this group had already too many PM involved in other projects.

Is that (above) an early start? A late start? How do the many PM play into this? this could be clarified.

A first workshop on HPC will be organized in March 2017 in Grenoble, France. A smaller workshop may possibly be organized in December 2016, to gather participants involved in the development and Pythran.

1.3.6. *WP6: Data/Knowledge/Software-Bases.* In a series of workshops (September 2015 in Paris, January 2016 in St. Andrews, June 2016 in Bremen, and July 2016 in Białystok) the participants working on WP6 met and discussed the topic of integrating the OpenDreamKit systems into a mathematical VRE toolkit. Key results were

D1. the observation that *knowledge-aware interoperability of software and database-systems is the most critical objective* for WP6: Data/Knowledge/Software-Bases in the OpenDreamKit project.

D1. the consensus that this can be achieved by *aligning the mathematical knowledge underlying the various systems*.

the above two items are both labelled "D1" – this seems wrong?

This requires explicitly representing the three aspects of math VREs – Data (D), Knowledge (K), and Software (S) – and basing computational services and inter-system communication on a joint $\mathcal{DKS}$-base. These results are engrained in the "Math-in-the-Middle" (MitM) paradigm [CICM1616], which gives a representational basis for specification-based interoperability of mathematical software systems – so that they can be integrated in a VRE toolkit. In the MitM paradigm, the mathematical knowledge underlying the VREs (K) and the the interface of the for each system (S) are represented as modular theory graphs in the OMDoc/MMT format. For the data aspect (D) we have extended the concept of OMDoc/MMT theories to "virtual theories" that allow the practical management of possibly infinite theories, see [D6.216] for details.

A side effect of the **D1.** is that the verification aspects anticipated in the proposal are non-critical to the OpenDreamKit project. In particular the value of the exemplary verification of an LMFDB algorithm in **T6.8** and deliverable D6.8 seems highly questionable.

Correspondingly we have refined the notion of "triformal theories" coined in the proposal into the concept of "$\mathcal{DKS}$ theory graphs", which can be formalized and implemented without the extension of OMDoc/MMT for "biformal theories" anticipated in the proposal.

Through the concerted effort of the WP6 participants, we have been able to implement this design into prototypical $\mathcal{DKS}$ base patterned after the MitM paradigm with virtual theories, generating interface theory graphs for the GAP and SAGE systems and integrating the LMFDB system via the MitM codec architecture described in [D6.216]. Based on this, we were able to generically integrate GAP, SAGE, and LMFDB via the standardised SCSCP protocol [HR09] – essentially remote procedure calls with OpenMath Objects. This case study shows the feasibility of the initial design of $\mathcal{DKS}$-bases; further investigations and the integration of additional systems will determine the practicability.

1.3.7. *WP7: Social aspects.* Ursula Martin has stepped down in anticipation of her upcoming retirement, and Dmitrii Pasechnik has become the lead PI for this work package. This somewhat slowed down the takeoff of this work package, but the important deliverables are well on track, if not ahead of schedule.

As planned, the work was focused on bootstrapping **T7.1**: "Social Science Input to Design" and **T7.3**: "Mechanism Design for Free Software Development" whose early outcomes will nurture the design of OpenDreamKit's VREs in other work packages.

For **T7.1**, D7.1: "The flow of code and patches in open source projects" analysing in particular the state of affairs in our model system SAGE, is well on track to be delivered at Month 18, with Part I ready.

For **T7.3**: "Mechanism Design for Free Software Development", D7.2 is largely ready and is to be tested on the system SAGE; a paper [PE16] forming a part of D7.7 has been published.

Finally, early work was done for **T7.2** on connections of reproducibility, crowdsourcing, and a VRE as a mean to test and control the former: a paper [CP16] analysing a concrete well-established area of combinatorics in this respect, and describing the implementation of the corresponding meta-database in SAGE system has been published.

2. RISK MANAGEMENT

2.1. **Recruitment of highly qualified staff**

Recruitment of highly qualified staff was planned to be a high risk when the Proposal was written. And unfortunately it turned out we were right. In such a field as computer science and software development, potential candidates who are likely to be fairly young considering only temporary positions are offered, are very scarce. Furthermore they need to make a choice between public and private bodies which are very attractive, and the choice between pure development and research. Because of this difficulty to recruit in the past year, there have been slight changes in the workplan, which do not put the project results at risk.

The following people were hired in the past year:

NAME	GENDER	PARTNER	POSITION	HIRING DATE
Benoît PILORGET	M	UPSud	Project manager	17-09-2015
Jeroen DEMEYER	M	UPSud	Research engineer	01-03-2016
Erik BRAY	M	UPSud	Research engineer	01-01-2016
Christian MAEDER	M	JacobsUni	Senior researcher	01-01-2016
Tom WIESING	M	JacobsUni	Junior researcher	01-09-2015
Xu HE	M	JacobsUni	Junior Researcher	01-09-2015
Alexander BEST	M	UNIKL	Research engineer	01-02-2016
Anders JENSEN	M	UNIKL	Postdoc	01-11-2015
Alexander KRUPPA	M	UNIKL	Postdoc	01-08-2016
Jan AKSAMIT	M	USlaski	Technical staff	01-10-2015
Marijan BEG	M	Southampton	Research fellow	01-05-2016
B. RAGAN-KELLEY	M	Simula	Postdoc	01-09-2015
V.T. FAUSKE	M	Simula	Postdoc fellow	02-05-2016

OpenDreamKit partners had to face some Human resources issues in the past year:

- UPSud: Thanks to an early start in the recruitment process, and despite some difficulties in attracting experienced candidates for a part time position, the project manager position (24PM) was filled by Benoît Pilorget shortly after the start of the project.

  The recruitment of UPSud's first Research Engineer (48PM) was delayed by four months because the top ranked candidate for this position, Erik Bray, was originating from the US and needed time to arrange for his moving; there were also some administrative delays (visa, ...).

  The second Research Engineer position (36PM) was more problematic for internal administrative reasons. The top ranked candidate, Jeroen Demeyer, had the perfect profile; however for family reasons, he wished to work most of the time from Gent in Belgium. After eight months investigating an administrative solution to hire him at UPSud, and a temporary four month solution, it was decided with OpenDreamKit's Steering Committee and Project Officer to instead add Gent's university as new partner, hire Jeroen Demeyer there, with an adequate budget transfer and amendment to the Grant Agreement.

Those delays have induced late start on several tasks, and costed much management time. However the excellence of the recruitment, well confirmed by the results obtained so far, was worth it and will soon compensate for the late start.

In addition to this, a three year PhD position was open to work on WP6, starting from Month 12. By lack of suitable candidate, this position will be converted into a two year PostDoc position, presumably starting at Month 24. Active advertising has started and there are some tentative candidates. The relevant deliverables being due late in the project, no delay is to be expected from this change.

- CNRS: Because the research engineer offer (48PM) was still not filled in the Summer 2016, the CNRS decided to divide the position in two full positions of 24 PM each. As a result, a candidate was already selected for one of the two positions and should begin his work this Tall 2016. Thanks to the PM division, there should be no delay in any task or deliverable.

- JacobsUni: Michael Kohlase, lead PI for Jacobs University, has moved on 01/09/2016 to Friedrich-Alexander-Universität Erlangen-Nürnberg, and most of his team will follow him. Since he is a critical asset for OpenDreamKit, a Grant Agreement amendment will be submitted in Fall 2016 to update the consortium accordingly.

- UJF: The original tentative candidate for UJF's Research Engineer position (12PM, planned to start on Month 1), Pierrick Brunet, finally declined the position to accept an alternative permanent offer. The position will be filled by another candidate in Autumn 2016. This induced a delay of Deliverable D5.2 from Month 12 to Month 18, without impact on other tasks.

- UNIKL: UNIKL had to split the 12 PM planned for a software developer into 2 shorter positions (Anders Jensen and Alexander Kruppa) in order to deliver the planned work on time. Indeed the few qualified persons for this job were not able to accept this 12 months position during the timelapse planned within the project.

- USFD: The University of Sheffield has also been struggling in the the hiring process of a postdoc (36PM). The position should be filled this Autumn.

- Southampton: Southampton faced administrative difficulties in the recruitment of Marijan Beg (38PM) as a post-doc, due to the Croatian nationality of Mr Beg. His recruitment was delayed of four months, and therefore some tasks and deliverables, planned to be borne around the end of the project, were postponed of four months. However no serious delay nor implication on the main tasks of OpenDreamKit followed these difficulties.

- UVSQ: Nicolas Gama is currently on a long-term leave until September 2017. This will not affect the project in any way.

- UZH: The University of Zürich partner is only composed of one person, Paul-Olivier Dehaye, who does not enjoy a permanent position there. There have been worries that Mr Dehaye's contract with his university might end earlier than planned within OpenDreamKit. But thanks to the action of the OpenDreamKit steering committee, Mr Dehaye's position should be renewed for as long as the project needs.

- Simula: Everything is fine concerning temporary staff recruitment on the Simula side, however we have had to endure the hazards of human ressources with Hans-Peter Langtanger (the PI when the Grant was signed) being on a long-term sick leave, and with Martin Alnaes replacing him as PI currently on a paternity leave. However Benjamin Ragan-Kelley has stepped in to lead the Simula contribution in the meantime and all planned tasks are on time.

Altogether, this first year confirmed that the recruitment of highly qualified staff is indeed a risky endeavour, which induced delays on several deliverables. However the planned mitigation measures – taking into account the pool of potential candidates in the design of the positions, aggressive advertisement, weak coupling between tasks – worked adequately: with appropriate reshuffling of the work plan, we don't expect an impact on the overall progress of the project.

2.2. **Different groups not forming effective team**

As expected, this risk was tamed by the existence of many preexisting collaborations between the partners and of "joint itches to scratch together" (to use a common open source software metaphor). The organization of many joint workshops (for example the Sage-GAP workshop, the Atelier Pari attended by SageMath developers, the WP6 workshops) helped bootstrap joint activities through brainstorms and coding sprints. Upcoming workshops are planned on Year 2 to strengthen collaborations with the social aspects team in Oxford and the Singular team in Kaiserslautern.

2.3. **Implementing infrastructure that does not match the needs of end-users**

The consortium is keeping in their minds the end-user needs. Since OpenDreamKit is improving already existent software which have their own users, their needs are naturally met. However Key performance Indicators will evaluate the effects of OpenDreamKit on these software. KPIs, indicated in the Proposal, will be launched this Autumn with the help of the end-user group which was merged with the Advisory Board. Constant links between the accomplished work and the end-user needs should be made in WP2 deliverables and also in WP7 deliverables when relevant. Open tracking of KPIs evolution can be found on GitHub.

2.4. **Lack of predictability for tasks that are pursued jointly with the community**

As planned, we are regularly shifting manpower around to adapt for the variability of the involvement of the community in the different tasks. For example, the SageMath Jupyter kernel of D4.4 was mostly implemented by the community which allowed to focus on other tasks like the long term task like D3.7. On the other hand many other deliverables were implemented with very little help from the community.

2.5. **Reliance on external software components**

There is not much to report on this front yet: none of the external software component we rely on have failed us. Quite on the contrary, critical software like JUPYTER have continued to blossom. Besides the high modularity of the design means few components are critical to the overall success of the project.

3. QUALITY ASSURANCE PLAN

3.1. **Deliverables quality: Quality Review Board**

The Quality Review Board is the Consortium Body that fosters best possible quality in the deliverables. The body is chaired by Hans Fangohr, from the University of Southampton. He is supported in this task by Mike Croucher from the University of Sheffield, Alexander Konovalov from the University of St Andrews, and by Konrad Hinsen from the Centre de Biophysique Moléculaire.

All board members have a track record of caring about the quality in software for computational science, including Mike Croucher's outreach and blogs, Alexander Konovalov's engagement with the Software Sustainability Institute, Konrad Hinsen's founding and editorship of the ReScience Journal, and Hans Fangohr's creation and directorship of the UK's only centre for doctoral training in computational modelling.

The quality review board meets after each reporting period, the first one for OpenDreamKit ending at month 18 (February 2017), to review completed deliverables with focus on software quality. The board will choose and focus on selected deliverables and review these in greater detail rather than attempting a superficial inspection of all deliverables.

Seeking for continual improvement of the project's processes, the board will look for weaknesses, strengths and best-practice used in the creation of the deliverables, seeking further information from authors of the deliverables. The board will subsequently share their findings with the aim of increasing quality of future deliverables where possible. The quality review board embraces a no-blame culture to foster open exchanges and most-effective use and exploitation of their findings in achieving and sustaining high quality outcomes.

While the primary focus of the board is on the OpenDreamKit project and the software it develops, some of the lessons may be more widely applicable and be made publicly available.

3.2. **Infrastructure quality: End-user group**

It was decided by the Steering Committee during the kick-off meeting to slightly modify the management structure by having only one gender-friendly Advisory Board composed of 7 people (as agreed a few months later at the Bremen meeting), some of which to be end-users. The end user group was to be replaced by an informal community, modelled by a public and open mailing list.

Unfortunately, potential Advisory Board Members have not yet been selected. Names have already been raised and accepted by the consortium as potential members, and the Scientific Coordinator will personally take care of this in September 2016. Concerning the end-user group, open mailing lists have not succeeded in meeting their public, neither within OpenDreamKit nor outside the consortium. This issue should be soon cleared thanks to the new ODK website to be launched in Autumn 2016. This website will be designed to raise potential end-users awareness on the project. The different activities and results of OpenDreamKit will be made more visible thanks to blog posts, which could be sent out via a newsletter or via the already existing mailing lists.

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