

# TECHNICAL REVIEW REPORT

## *Information and Communication Technologies ICT*

*Project acronym:* HOPSA-EU  
*Project title:* HOListic Performance System Analysis-EU  
*Grant agreement number:* 277463  
*Funding scheme:* Collaborative project  
*Project starting date:* 01/02/2011  
*Project duration:* 24 months  
*Coordinator:* Forschungszentrum Jülich GmbH  
*Project web site:* <http://www.hopsa-project.eu>

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*Period covered by the report:* Period No. 1, from 01/02/2011 to 31/01/2012  
*Place of review meeting:* Brussels, Belgium  
*Date of review meeting:* 13/03/2012

*Experts:* Andrea CLEMATIS  
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Individual report   
Consolidated report



**European Commission**  
Information Society and Media

## 1. OVERALL ASSESSMENT

### a. Executive summary

*Please give your overall assessment of the project, commenting on the following:*

- *main scientific/technological achievements of the project*
- *quality of the results*
- *attainment of the objectives and milestones for the period*
- *adherence to the workplan, any deviations (whether justified) and remedies (whether acceptable)*
- *take-up of the recommendations from the previous review (if applicable)*
- *contribution to the state of the art*
- *use of resources*
- *impact*

The first HOPSA-EU project review was held at EC premises in Brussels, BE, on March 13, 2012. The consortium led by Forschungszentrum Jülich (Juelich Supercomputing Centre) consists of five EU partners; its coordinated Russian counterpart, led by Moscow State University (contract no. 07.514.12.4001, referred to hereinafter as HOPSA-RU), consists of 4 Russian partners. All HOPSA-EU partners as well as two representatives of the counterpart HOPSA-RU attended the review meeting and contributed not only with project information and collateral documentation but, moreover, with specific insight into their ongoing activities.

All due deliverables were submitted in a timely manner and accompanied by presentation slides circulated at the review meeting. This report is based on the results of the review meeting and an assessment of the submitted project deliverables.

The main objective of the two coordinated projects is the integration of application tuning with overall system diagnosis and tuning to maximise the efficiency of HPC infrastructures, with the Russian partners focusing on system-level and the EU partners focusing on user-level application tuning. The project draws upon extensive experience of consortium partners with an established track record in the design and implementation of performance analysis tools for distinctive parallel computing environments. Within this setting, the consortium's collective research capacity offers the prospects of creating a significant added value through optimization and effective integration of diverse tools.

Specific objectives of the EU consortium include: (i) basic end-to-end performance analysis for all jobs running on a given system from their submission to their completion; (ii) identification of key performance issues and notification of the user and system performance database after job completion; and (iii) enhancement of individual performance measurement and tuning tools and their integration into a unified suite suitable for petaflop HPC infrastructures and breaking the barriers leading to exaflop speeds and beyond.

The project has been professionally and effectively managed, both from the administrative and technical standpoints. It has fairly successfully disseminated its results through diverse channels by way of publications as well as presentations and tutorials at various supercomputing conferences, workshops, and seminars.

Solid progress has been made in both key technical work packages (WP2 and WP3). The capabilities of the current set of tools are reasonably well understood as are most of the challenges that remain. Such challenges include but are not limited to improvements in granularity and synchronization; gathering, packaging and storing massive amounts of data;

filtering and reducing such data for further processing as well as creating subsets of pertinent information for future reference and comparative analysis; etc.

The reviewers would like to draw attention to complementarities and potential synergies with the sister project APOS and urge partners to proactively explore opportunities for closer cooperation at the planned joint meeting in Moscow in May, 2012.

In conclusion, the project is making tangible progress, successfully tackling the technical challenges and working toward achievement of its stated objectives. Moreover, it is successfully strengthening links between the Russian and EU teams, which was one of the major rationales behind a coordinated collaborative project.

b. Recommendations concerning the period under review

*Please give your recommendations on the acceptance or rejection of resources, work done and required corrective actions – e.g., resubmission of reports or deliverables, further justifications, etc.*

[1] While the project website documents the project and consortium as well as progress and results, it is somewhat drab and does not do the project justice. It has not been utilized in the most effective manner to document and more broadly disseminate new knowledge and ideas about performance analysis as well as system and application tuning in HPC environments; to point to materials prepared for training courses; and to attract more attention to from the broader HPC community. Given that the project generated plenty of compelling content and that most partners would benefit from recognition and publication of their achievements, there is an opportunity to rectify that through a facelift, some restructuring, better cross-linking and inclusion of additional as well as more effective presentation of the generated content.

c. Recommendations concerning future work

*Please give your recommendations – e.g., overall modifications, corrective actions at WP level, re-tuning of the objectives to optimise the impact or to keep up with the state of the art, better use of resources, re-focusing, etc. Where appropriate, indicate the timescale for implementation.*

Notwithstanding the progress and in order to enhance the potential for long-term impact the partners need to:

[2] Provide more details regarding dissemination and awareness raising activities within the scientific community in Russia, within the scope of the overall dissemination efforts.

[3] Explore the potential for publishing some papers aggregating and summarising the combined contributions of the EU and Russian partners.

[4] Link the project website to the Russian one, when rolled out, effectively linking the results of the coordinated efforts.

[5] Evaluate possibilities to participate in the HPC Advisory Council, a community effort support center for HPC end-users (<http://www.hpcadvisorycouncil.com/>), or other similar initiatives, to extend the breadth of dissemination efforts and consider establishing a special interest subgroup in the EU and Russia, focusing on performance analysis and combined application & system diagnosis and tuning.

[6] Explore complementarities and potential synergies with the sister project APOS and jointly consider concrete opportunities for closer cooperation in the run up to the planned joint technical meeting in Moscow in May, 2012. Such cooperation might entail but is not limited to provision for inclusion of tools developed within APOS project (e.g. HMPP) in the unified HOPSA suite as well as provision for usage and validation of early versions of HOPSA tools by APOS partners.

[7] In the context of the project's timelines, work plans during the forthcoming period should allow for sufficient time to conduct multiple rounds of testing and validation, feeding back into further development and integration of tools as well as refinements of the performance analysis workflow, bearing in mind the intended integration of application tuning with overall system diagnosis.

[8] Given the need to process and present large amounts of complex interrelated data, that can be easily quantified, analyzed, and processed by a human user, explore opportunities to use novel and innovative graphical techniques for visualization, over and above those available in individual tools.

[9] Given the capability of the EU and Russian partners, particularly the academic ones, attempt to establish a stronger theoretical [mathematical] basis for various elements of performance analysis. In addition, consider possibilities of adopting some formal techniques to study systems that evolve at different temporal scales.

[10] Consider introducing some business metric to maximise the efficiency of HPC infrastructures and facilitate related business decisions. Within that context, consider ways to incentivize stakeholders (users and system administrators) to optimize applications and infrastructures based on the results of the integrated, end-to-end performance analysis.

[11] Last but not least, explore opportunities to apply some of the results of the integrated performance analysis to more effective design and optimized architectures of the future exaflop HPC infrastructures.

d. Assessment

- Excellent progress (the project has fully achieved its objectives and technical goals for the period and has even exceeded expectations).
- Good progress (the project has achieved most of its objectives and technical goals for the period with relatively minor deviations).
- Acceptable progress (the project has achieved some of its objectives; however, corrective action will be required).
- Unsatisfactory progress (the project has failed to achieve key objectives and/or is not at all on schedule).

## 2. OBJECTIVES and WORKPLAN

### a. Progress towards project objectives

*Assess to what extent the objectives of the project for the period have been achieved. In particular, please indicate if the project as a whole has been making satisfactory progress in relation to the Description of Work (Annex I to the grant agreement) and comment on the interaction between the work packages and the level of integration demonstrated.*

The project has progressed well during the period under review by advancing the state-of-the-art in several key areas of performance optimization and tuning, in accordance with the DOW. The level of integration within the HOPSA-EU project is respectable. At the level of coordinated projects, between HOPSA-EU and HOPSA-RU it is steadily increasing and promising.

### b. Progress in individual work packages

*For each work package (WP), assess the progress in relation to the Description of Work (Annex I of the grant agreement). Please also report and comment on any delays, reasons for them and any remedial action taken. Specify the work packages concerned.*

#### **WP1 Project Management**

This work package entails administrative, financial and technical coordination as well as dissemination. The project has been effectively managed, both from the administrative and technical standpoints. It is commendable that the coordinator and partners managed to start planned activities and effectively coordinate them with HOPSA-RU before the execution of the grant agreement despite the staffing and budgetary constraints.

The interim results have been successfully disseminated through diverse channels although dissemination via the project website does not do the project justice. Further comments regarding dissemination activities are provided in Section 5 below.

#### **WP2 HPC application-level performance analysis**

This work package focuses on research and technical development involving solely the EU partners. Its objective is to enhance and extend the existing performance measurement and analysis tools, previously developed by the project partners, and to integrate them into a unified suite suitable for effective and consistent analysis and tuning of petaflop HPC infrastructures as well as beyond.

Within the scope of T2.1 and T2.2 several individual tools that will eventually be integrated into the HOPSA-EU performance analysis and tuning suite (e.g. Extrae, Paraver, Dimemas, Scalasca, CUBE, Score-P, Vampir, ThreadSpotter) have been considerably enhanced in terms of their functionality and scalability to enable analysis of parallel, real-world applications executed on platforms with tens to hundreds of thousands of processes and threads. Initial integration has been attempted (within the scope of T2.3) with a select subset of those tools although the bulk of the work is to be completed in the forthcoming period when T2.4 (Tool Validation) is scheduled to start.

Overall, solid progress has been made in this work package, for the most part according to plan and in line with the DOW.

### WP3 Integration of system and application performance analysis

The objective of this work package is to combine and integrate the work done for HPC system-level performance analysis by HOPSA-RU and for application-level performance analysis by resulting from WP2 into a coherent and holistic performance analysis environment.

Within the scope of T3.1 and T3.2, the interfaces between the system- and application-level components have been adequately defined and documented in D3.1; moreover, the overall architectural framework and performance analysis workflow has been largely agreed upon and delineated. Prototype of the “light-weight monitoring module” has been developed within T3.3 although further refinement, testing and validation remain to be done. Work on creation of a unified download, configuration, build and installation package (T3.4), based on a successful prototype of ParMA project, has started by adding support for Extrae and Paraver tools.

In general, work is well underway with progress evident in all tasks. There is, nevertheless, a clear need to improve the granularity of some measurements as well as for further refinements in their synchronization.

#### c. Milestones and deliverables

*Indicate whether the planned milestones and deliverables have been achieved for the reporting period (please give more detailed comments first and then fill in the summary table below).*

All planned milestones have been achieved. All due deliverables were submitted in a timely manner in advance of the review; all are of high professional standard, documenting the results in a comprehensive yet concise manner and hereby approved.

STATUS OF DELIVERABLES			
No.	Title	Status <i>(Approved/Rejected)</i>	Remarks
D1.1	Intermediate Progress Report	Approved	Referred to as “Intermediate Activity Report” in the DOW.
D2.1	Intermediate Tool Set	Approved	
D3.1	Requirements for the Interface between System-level and Application-level Performance Analysis	Approved	Referred to as “API Requirements Report” in the DOW

#### d. Relevance of objectives

*Indicate whether the objectives for the coming periods are (i) still relevant and (ii) still achievable within the time and resources available to the project. Assess also whether the approach and methodology continue to be relevant.*

The objectives for the coming period remain relevant and achievable. The approach and methodology continue to be relevant subject to implementing recommendations concerning future work and comments elsewhere in this report.

### 3. RESOURCES

#### a. Assessment of the use of resources

*Comment on the use of resources, i.e. personnel resources and other major cost items. In particular, indicate whether the resources have been utilised (i) to achieve the progress and (ii) in a manner consistent with the principle of economy, efficiency and effectiveness<sup>1</sup>. Note that both aspects (i) and (ii) have to be covered in your answer. The assessment should cover the deployment of resources overall and by each participant. Are the resources used appropriate and necessary for the work performed and commensurate with the results achieved? Are the major cost items appropriate? In your assessment, consider the person months, equipment, subcontracting, consumables and travel.*

Based on provisional figures for resources expended presented in an addendum (Progress/Finances) to the Intermediate Progress Report (D1.1), submitted separately shortly before the review meeting, as well as preliminary financial information provided at the review, the reviewers are satisfied that:

ad i) the resources used have been necessary for the implementation of the project and reflect the progress made; and that

ad ii) the costs were consistent with the principle of economy, efficiency and effectiveness.

While there was some under spending, largely attributed to lower than planned staffing costs and hiring delays, the deviations were adequately justified and their impact on progress limited.

Overall progress appears commensurate with resources expended and is consistent with the project achieving its goals within the planned timeframe and budget.

#### b. Deviations

*If applicable, please comment on major deviations with respect to the planned resources.*

N/A

<sup>1</sup> "The principle of economy, efficiency and effectiveness refers to the standard of "good housekeeping" in spending public money effectively. Economy can be understood as minimising the costs of resources used for an activity (input), having regard to the appropriate quality and can be linked to efficiency, which is the relationship between the outputs and the resources used to produce them. Effectiveness is concerned with measuring the extent to which the objectives have been achieved and the relationship between the intended impact and the actual impact of an activity. Cost effectiveness means the relationship between project costs and outcomes, expressed as costs per unit of outcome achieved." Guide to Financial Issues, Version 02/04/2009, p.33.

#### 4. MANAGEMENT, COLLABORATION AND BENEFICIARIES' ROLES

a. Technical, administrative and financial management of the project

*Assess the quality and effectiveness of the project management, including the management of individual work packages, the handling of any problems and the implementation of previous review recommendations. Comment also on the quality and completeness of information and documentation.*

The project was professionally and effectively managed (from the administrative and technical standpoints) throughout the period. Acting in good faith, the coordinator and partners notably managed to start planned activities and effectively coordinate them with HOPSA-RU before the execution of the grant agreement as well as related coordination and consortium agreements despite the staffing and budgetary constraints.

b. Collaboration and communication

*Comment on the quality and effectiveness of the collaboration and communication between the beneficiaries.*

The project is epitomized by close collaboration and effective communication among partners and among their evidently motivated researchers. Collaboration between the two coordinated HOPSA-EU and HOPSA-RU projects has been strong, opening prospects for durable cooperation between EU and Russia in HPC and related domains, extending beyond the formal project periods.

c. Beneficiaries' roles

*Give an assessment of the role and contribution of each individual beneficiary and indicate if there is any evidence of underperformance, lack of commitment or change of interest.*

The progress of the work packages demonstrates that the beneficiaries are performing as expected and remain committed to the project.



## 5. USE AND DISSEMINATION OF FOREGROUND

### a. Impact

*Is there evidence that the project has so far had, and is it likely to have, significant scientific, technical, commercial, social or environmental impact (where applicable)?*

The preliminary results are promising and the project is expected to have significant impact. In terms of long-lasting impact, the reviewers encourage the consortium to focus on integrating its work further.

The planned joint technical meeting with the sister project APOS offers an excellent opportunity to increase the impact of both projects by providing APOS with enhanced capabilities for application optimization while offering HOPSA another avenue for validation and increased usage.

### b. Use of results

*Comment on whether the plan for the use of foreground, including any updates, is still appropriate. Comment also on the plan for the exploitation and use of foreground for the consortium as a whole, or for individual beneficiaries or groups of beneficiaries, and its progress to date.*

Academic and scientific exploitation of results has been promising, resulting in a number of publications, tutorials and training materials. Tangible industrial/commercial exploitation is still outstanding although optimism is expressed by partners and several specific opportunities are currently being identified.

### c. Dissemination

*Assess whether the dissemination of project results and information (via the project website, publications, conferences, etc.) has been adequate and appropriate.*

The project has successfully disseminated its results through diverse channels. Scientific dissemination and exploitation was very good considering the quality and number of the publications as well as presentations at various supercomputing conferences, workshops and seminars. Notable additional activities included participation at numerous external training schools, sessions and workshops, related to performance analysis tools for HPC applications.

Dissemination via the project website on the other hand was suboptimal. While the website documents the project and consortium as well as progress and results, it is somewhat drab and does not do the project justice. Up to now, it has not been utilized in the most effective manner to document and more broadly disseminate new knowledge and ideas about performance analysis and application tuning in HPC environments; to point to materials prepared for training courses; and to attract more attention to from the broader HPC community.

d. Involvement of potential users and stakeholders

*Indicate whether potential users and other stakeholders (outside the consortium) are suitably involved (if applicable).*

The project suitably involved academic and industrial stakeholders in the broader, worldwide HPC community thanks to the active efforts of all its partners and through various dissemination activities.

e. Links with other projects and programmes

*Comment on the consortium's interaction with other related Framework Programme projects and other national/international R&D programmes and standardisation bodies (if relevant).*

In addition to links with APOS project referred to in several sections above, the project maintains strong links with PRACE (Partnership for Advanced Computing in Europe) and DEISA (Distributed European Infrastructure for Supercomputing Applications). It also interacts with relevant bodies and initiatives on a worldwide basis.

## 6. OTHER ISSUES

*If applicable, comment on whether other relevant issues (e.g. ethical issues, policy/regulatory issues, safety issues) have been handled appropriately.*

N/A

Name(s) of expert(s): Andrea CLEMATIS , Uros JANKO

Date: 28/03/2012

Signature(s):