RISC Green Paper Recommendations

High Performance Computing Drivers and Needs in Latin America

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Executive Summary

The RISC Project's mission was to assess the ICT collaboration potential for Latin America and Europe in the areas of HPC and Computational Sciences. The mission has been achieved working closely with the partners in five LA countries (Argentina, Brazil, Chile, Colombia and Mexico) sharing information and contacts, with the support of a specific Delphi survey and the provision of questionnaires focused on ad hoc information and actions.

The group of the LA Partners contributed in define a clear picture of the HPC R&D and infrastructure situation in LA, leading to the production of this *Green Paper on High Performance Computing Drivers and Needs in Latin America*.

The Green Paper maps the Latin American HPC activities in each of the five LA countries involved in RISC, addressing also strategic goals priorities and plans for the next 3-5 years in HPC and Computational Science research. It also provides an overview of the HPC activities and actions implemented at European level, with a special focus on PRACE (the pan-European supercomputing infrastructure to enable high impact scientific discovery) and Horizon2020 the new Framework Programme launched by the European Commission for the 2014-2020 time frame.

The comparison of the activities in LA countries and Europe allowed to present a set of recommendations in the areas of HPC Infrastructures, Computational Science R&D, Industries, Training and Education that can represent opportunities for LA ICT actors to collaborate with EU and vice versa. The Green Paper, we believe, contribute to and is able to further facilitate the dialogue and share the vision between policy makers and other stakeholders from the European and Latin America HPC R&D communities and Industries.

The full Green Paper and the corresponding study can be found on the RISC project web site http://www.risc-project.eu/ and also on http://www.risc-project.eu/publication_type/green-papers/.

Green Paper Recommendations

The results of the surveys conducted with the support of the Latin American partners, were the basis to further discuss, meet and analyse the HPC landscape in the LA countries, considering their requirements, perspectives, evolution plans and possible synergies with the HPC actions at European level. As a consequence of this analysis, a set of recommendations have been proposed on different aspects of HPC drivers and needs in Latin America. These recommendations have been prioritised into immediate (one year), short-term (1 to 3 years) and mid-term (3 to 5 years) implementation.

HPC Infrastructures

1. The presence of HPC systems reveals a **huge gap between Latin America countries and the other geographical regions in the world**. The number of LA supercomputer sites in the Top500 list (November 2013) represents the 0.6 % of the total with only three systems, all of them in Brazil, the first of which at N. 156.
   Of course different supercomputers, less powerful, populate the different LA countries, mainly in academic institutions, as presented by the LARTop50 list of the 50 supercomputing systems with better computational performance of Latin America (http://lartop50.org).
   The HPC LA gap should be reduced. *Mid-term recommendation.*

2. All the countries involved in the RISC project have great interest in HPC as a driving mechanism to improve research and industrial effectiveness, so it is important to **consolidate and harmonise the HPC infrastructures in LA,** creating HPC infrastructures, at country level, providing services both for public and private research institutions in the different fields of computational sciences. A pyramidal structure with different level of HPC systems (Tier-0: national, Tier-1: regional and Tier-2: local) should be addressed.
   These facilities should have a national relevance as HPC infrastructure and should be disjoint from the single academic computer centres, to improve the access and the services to support research at national level and not just for a single Institution.
   The RedCLARA Latin American national research and education networks could act as a strong instrument to integrate the different HPC national facilities with high-speed networks and grid infrastructure services. *Mid-term recommendation.*

3. Advanced HPC resources are extremely expensive and require significant expertise to procure, deploy and utilise efficiently. The **Tier-0 resources should be reserved for the most exigent computational tasks of high potential value,** addressing other tasks to Tier 1 and Tier 2 HPC resources in order to maintain consistent and balanced at all levels the computational resources pyramid. LA must foster excellence and cooperation in order to gain the full benefits of these Infrastructures for science, engineering and industry. *Mid-term recommendation.*

4. The different national HPC centres in LA (Tier-0) should link together and cooperate in creating a **strong HPC Ecosystem in Latin America**, providing joint programmes in terms of support, research, cooperation and education. This ecosystem should cooperate and make synergies at European level. *Mid-term recommendation.*

5. Scientists and engineers must be provided with access to capability computers of leadership-class to **remain competitive internationally and to gain leadership**. The competitiveness of LA science and industry will be definitely jeopardised and isolated if sufficiently capable computers are not made available, together with the associated infrastructure and **skilled people necessary to maximise their exploitation**. This appears of great importance especially in this period, where the path toward multi-petaflops and exascale systems is approaching in US, Europe and Asia. *Short-term recommendation.*

6. Not adequately supporting HPC may face the risk that **scientists relocate to regions with better environments for HPC**, and Latin America science and industry becomes less competitive. It is recommended to avoid this risk, supporting adequately HPC adoption in LA. *Immediate recommendation.*

7. Deploy a production quality HPC infrastructure widely spread in Latin America, compared to similar initiatives in Europe, must face different main **economic and political aspects**, so a very well defined strategy and plan agreements are required and must be constantly monitored along the implementation period. These agreements should be **supported by national agencies through specific funds in a long-term vision**. *Short-term recommendation.*

Scientific Applications

1. As part of RISC activity a set of common scientific application domains, of interest of the different LA countries, have been identified and clustered:
   - *Bio - Life sciences, health and medicine*
   - *Natural resources exploration and sustainable energy*
   - *Natural disasters modelling*
   - *Environmental modelling, weather and climate research*

   HPC is an indispensable instrument to solve problems of the highest complexity in these areas, requiring extremely large and very efficient computational and storage capabilities to model natural phenomena (weather, climate change or epidemics), optimise energy resources, researching novel materials, etc.
   It is recommended to **establish Centres of Excellence for supporting scientific applications**, introducing new computational methods and techniques to enhance the research and innovation in these important application domains. *Short-term recommendation.*

2. The EU-CELAC action plan 2013-2015[1] integrated at the EU-CELAC Summit held in Santiago de Chile on 26-27 January 2013, identifies a number of initiatives in key areas of science, research, innovation and technology, sustainable development, environment, climate change, biodiversity, energy and many others. These scientific areas can be mapped with the common scientific domains identified by RISC so it is important to support the instruments and the initiatives presented by the EU-CELAC action plan and establish links to **reinforce the research collaboration in these scientific domains between European and LA scientists**. *Immediate recommendation.*

3. Since most of HPC's value comes from its application to real scientific, engineering and societal problems, effort must be dedicated to **support application users and developers**. Conditions for developing scalable, performing and competitive applications must be created through a pool of highly-trained specialists, new software tools and methodologies, effective dissemination and sharing of knowledge. *Short-term recommendation.*

4. **Development of new computational applications and numerical methods to advance science** cannot remain isolated as the action of single researchers. Coordination in scientific disciplines and development of new applications, computational

[1] Council of the European Union, *EU-CELAC Action Plan 2013-2015,* January 2013
http://www.eeas.europa.eu/la/summits/docs/2013_santiago_summit_eu-celac_action_plan_en.pdf

methods and tools must be effectively encouraged and supported in an integrated plan, pushing the international collaboration. *Short-term recommendation.*

5. Encourage the **development of Open Source solutions** to foster international collaborations and the emergence of international *de facto* standards, enabling commercial exploitation. *Short-term recommendation.*

Industry

1. In LA countries, industrial users are not well represented among the main HPC players. Only some major companies (mainly in oil & gas and banking) have HPC resources and these are mostly disengaged from the national efforts. This LA situation is quite similar to what happens in most European countries and worldwide. HPC plays a pivotal role in stimulating economic growth and innovation, so it is important to **push HPC adoption by Industries in order to enhance their innovation** capabilities and sustain competitiveness. *Short-term recommendation.*

2. Dynamic SMEs can drive innovation in manufacturing and services, but often face greater obstacles than bigger enterprises to adopt HPC solutions to innovate in products, processes and services and thus become more competitive.
   Many barriers hinder the access to HPC by SMEs, from the lack of expertise and/or knowledge on the possibilities of HPC and advanced simulation methods, to the scarcity of resources to facilitate the HPC adoption process, to the entry costs of implementing new technologies. It is recommended to **establish programmes to provide SMEs with the expertise necessary to eliminate the barriers to access HPC**, to take advantage of the innovation possibilities created by HPC, and thus increasing their competitiveness. *Immediate recommendation*.

Education and Training

1. The training activity in HPC is fundamental in two directions, from one side to form people in charge of managing and operate HPC infrastructures and, from the other, to train and educate the students and the researchers involved in computational activities. In both directions HPC training is a process articulated and in dynamic evolution that must be provided in a stable and structured way and not episodically. Special integrated programs for education and training must be developed to tackle the skills gap in LA.

Train the next generation of computational scientists and engineers, is fundamental for the progress and the growth of science and to attract and retain young scientists. *Immediate recommendation.*

2. Specialized **degrees in HPC at higher education level should be encouraged and organised in cooperation between LA and EU academic partners**, designing common curricula and activating joint degrees at MSc and PhD level. The LA students could spend part of their education activity in one of the associated European partner institution. The funds to organise the mobility of these students could be found via common EU-US programmes. PhD level training could involve research activities linked to specific computational projects in cooperation between LA and EU. *Immediate recommendation.*

3. Support to scientific users, that need to **access to the HPC infrastructures** must be a continuous actions exploited in a stable way from the technical people afferent to the Infrastructure themselves. *Immediate recommendation.*

4. RISC network should engage and facilitate and act as catalyst for **long term collaboration in HPC and computational** science using existing and future EC Research Program mechanisms. These should cover:
    - Exchange of students and academics
    - Focused Research Projects funding
    - HPC and Computational Science thematic Research Networks.

   Immediate recommendation.

5. **Collaboration with PRACE** at European level could be established for common HPC initiatives, establishing a partnership with PRACE so that LA researchers can access to the large European HPC infrastructure. Another element of cooperation is represented by the PATC Training centres, exploiting the consolidated HPC experience to organise common HPC training events in Latin American regions. *Immediate recommendation.*

6. RISC through the Green Paper and corresponding Roadmap should help to **foster long-term policies of research collaboration and cooperation** of EU and LA countries. *Immediate recommendation.*

7. Should be strategic to **create a strategic alliance between EU and LA** at high political to allow LA partners to access HPC infrastructure (hardware, software, humanware) in Europe at feasible costs. This alliance, from one side, could accelerate LA

development and growing in HPC technology and computational sciences and, from the other, produce an interesting business plan for EU, in cooperation, technology transfer and competency. This could represent the unique opportunity that EU has to look at LA as a source of richness, creating highly trained jobs at LA for EU researchers and become the HPC lab for LA. *Immediate recommendation.*