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[1] C. J. Earl, S. Convay et al., "*A Strategic Agenda for European Leadership in Supercomputing: HPC 2020*", IDC Final Report of the HPC Study for the DG Information Society of the European Commission, July 2010.

[2] COM(2012) 45, "*High-Performance Computing: Europe's place in a Global Race*", Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Brussels, 15.2.2012.

[3] PRACE-1IP Deliverable D5.1.2 "*Requirements of Industrial Users*", December 2011.

[4] PRACE-1IP Deliverable D5.2.1 "*Business Models for Industrial Access to Infrastructures*", April 2011.

[5] PRACE-1IP Deliverable D5.2.2 "*PRACE Industrial Offer Assessment*", May 2012.

[6] PRACE-2IP Deliverable D9.1.1 "*Support for Industrial Applications -Year 1*", August 2012.

List of Acronyms and Abbreviations

AISBL	Association International Sans But Lucratif (legal form of the PRACE-RI)
AUD	Australian Dollar
BAdW	Bayerischen Akademie der Wissenschaften (Germany)
BIS	Business, Innovation and Skills
BSC	Barcelona Supercomputing Center (Spain)
CaSToRC	Computation-based Science and Technology Research Centre (Cyprus)
CEA	Commissariat à l'énergie atomique et aux énergies alternatives
CINECA	Consorzio Interuniversitario, the largest Italian computing centre (Italy)
CINES	Centre Informatique National de l'Enseignement Supérieur (represented in PRACE by GENCI, France)
CSC	Finnish IT Centre for Science (Finland)

CSCS	The Swiss National Supercomputing Centre (represented in PRACE by ETHZ, Switzerland)
CTLO	Clinical Trials Liaison Officer
DARPA	Defense Advanced Research Projects Agency
DEISA	Distributed European Infrastructure for Supercomputing Applications. EU project by leading national HPC centres.
EBI	European Bioinformatics Institute
EC	European Community
ECRIN	European Clinical Research Infrastructures Network
EDA	Economic Development Administration (USA)
EESI	European Exascale Software Initiative
EMBL	European Molecular Biology Laboratory
EoI	Expression of Interest
EPCC	Edinburg Parallel Computing Centre (represented in PRACE by EPSRC, United Kingdom)
EPSRC	The Engineering and Physical Sciences Research Council (United Kingdom)
ESFRI	European Strategy Forum on Research Infrastructures; created roadmap for pan-European Research Infrastructure.
ESRF	European Synchrotron Radiation Facility
ETHZ	Eidgenössische Technische Hochschule Zuerich, ETH Zurich (Switzerland)
EU	European Union
FESR	Fondo Europeo di Sviluppo Regionale
FIT	Fondo di Innovazione Tecnologica
FZJ	Forschungszentrum Jülich (Germany)
GENCI	Grand Equipement National de Calcul Intensif (France)
GRNET	Greek Research and Technology Network S.A. (Greece)
HET	High Performance Computing in Europe Taskforce. Taskforce by representatives from European HPC community to shape the European HPC Research Infrastructure. Produced the scientific case and valuable groundwork for the PRACE project.
HPC	High Performance Computing; Computing at a high performance level at any given time; often used synonym with Supercomputing
IAP	Integrated Access Programme
IB	InfiniBand
IBM	Formerly known as International Business Machines
ICHEC	Irish Centre for High-End Computing (Ireland)
ICRIN	Irish Clinical Research Infrastructure Network
ICT	Information and Communication Technology
IDA	State's Industrial Development Authority in Ireland
IDRIS	Institut du Développement et des Ressources en Informatique Scientifique (represented in PRACE by GENCI, France)IL
IPB	Institute of Physics Belgrade (Serbia)
ISC	International Supercomputing Conference; European equivalent to the US based SC0x conference. Held annually in Germany.
IT	Information Technology
IUCC	Inter University Computation Center (Israel)
JKU	Johannes Kepler University Linz (Austria)
JSC	Jülich Supercomputing Centre (FZJ, Germany)
KI	knowledge and innovation

KIT	Karlsruher Institut für Technologie
KTH	Kungliga Tekniska Högskolan (represented in PRACE by SNIC, Sweden)
LIMS	Laboratory Information Management System
LISA	Laboratory of Advanced Interdisciplinary Simulation
LLNL	Laurence Livermore National Laboratory, Livermore, California (USA)
MEDI	Ontario's Ministry of Economic Development and Innovation
MoU	Memorandum of Understanding.
NCF	Netherlands Computing Facilities (Netherlands)
NCMS	National Centre for Manufacturing Sciences
NCSA	National Centre for Supercomputing Applications (USA)
NCSA	National Centre for Supercomputing Applications (Bulgaria)
NDA	Non-Disclosure Agreement. Typically signed between vendors and customers working together on products prior to their general availability or announcement.
NDEMC	National Digital Engineering and Manufacturing Consortium
NIIF	Nemzeti Információs Infrastruktúra Fejlesztési Intézet (Hungary)
NIST	National Institute of Standards and Technology (USA)
NSW	New South Wales
NUI Galway	National University of Ireland Galway
OCE	Ontario Centres of Excellence
OEM	Original Equipment Manufacturer
OSC	Ohio Supercomputer Center
PIC	Predictive Innovation Centres
PII	Progetti di Innovazione Industriale
PM	Person Month
PON	Programma Operativo Nazionale Ricerca e Competitività
PRACE	Partnership for Advanced Computing in Europe; Project Acronym
PRACE-1IP	PRACE First Implementation Phase Project
PRACE-2IP	PRACE Second Implementation Phase Project
PRACE-3IP	PRACE Third Implementation Phase Project
PSNC	Poznan Supercomputing and Networking Centre (Poland)
PSRO	Public sector research organisations
RCSI	Royal College of Surgeons in Ireland
ROI	Return on Investment
R&D	Research and Development
SARA	Stichting Academisch Rekencentrum Amsterdam (Netherlands)
SBIR	Small Business Innovation Research
SE	Scottish Enterprise
SME	Small Medium Enterprises
SMM	Small and Medium sized Manufacturers
SNIC	Swedish National Infrastructure for Computing (Sweden)
SOSCIP	Southern Ontario Smart Computing Innovation Platform
STFC	Science and Technology Facilities Council (represented in PRACE by EPSRC, United Kingdom)
STRATOS	PRACE advisory group for STRAtegic TechnOlogieS
STTR	Small Business Technology Transfer Program
TCD	Trinity College Dublin
TCO	Total Cost of Ownership. Includes the costs (personnel, power, cooling, maintenance, ...) in addition to the purchase cost of a system.

Tier-0	Denotes the apex of a conceptual pyramid of HPC systems. In this context the Supercomputing Research Infrastructure would host the Tier-0 systems; national or topical HPC centres would constitute Tier-1
Tier-1	Denotes the national or topical HPC centres of the conceptual pyramid of HPC systems
UCC	University College Cork, Ireland
UCD	University College Dublin, Ireland
UC-LCA	University of Coimbra - Laboratório de Computação Avançada (Portugal)
UCPH	Københavns Universitet (Denmark)
UHeM	National Center for High Performance Computing of Turkey
ULFME	University of Ljubljana (Slovenia)
VSB-TUO	Vysoka Skola Banska – Technicka Univerzita Ostrava (Czech Republic)
WP	Work Package

Executive Summary

In PRACE-3IP, WP5 "*Services for industrial users and SMEs*" has the objective to design and pilot an effective and integrated set of high-level, coherent and complementary services to industrial users and in particular to Small Medium Enterprises (SMEs) which may be interested in advanced HPC resources to enhance their innovation and competitiveness through high performance simulation. These services will be gathered in an Integrated Access Programme (IAP) for Industries and SMEs and will be proposed to the PRACE AISBL for the inclusion in its services offer.

The objective of this deliverable is to identify and analyse the models and the practices to define an effective IAP.

The industry support models currently operating in eight HPC infrastructures in Europe and three in USA and Canada have been investigated. The analysis has been done leveraging on the work of earlier studies and activating specific contacts with these main infrastructures.

A sub-set of the initiatives provided from these infrastructures specifically targeted the SME. In these examples the support programmes were mainly enabler actions with the goal to use the HPC infrastructures to demonstrate to the SMEs the benefit of adopting advanced simulation methods.

To complete the analysis, the investigation has been extended to support models offered by eleven non HPC research infrastructures in order to evaluate the offer in different areas respect to the HPC services (Synchrotrons, Molecular Biology and Genomics, Technological Innovation, Micro and Nano Technologies, Semiconductors research, Clinical trials, etc.).

The results of all these investigations of HPC and non HPC Infrastructure, integrated with the requirements of industrial users analysed in PRACE-1IP WP5 have permitted to identify a set of the main current needs of industrial users towards HPC. These needs span from raising awareness to coaching, from training and information to trying out HPC solutions to open research and development access to HPC infrastructure.

All these elements should contribute to an effective Integrated Access Programme provision for Industry and SMEs offered by PRACE.

1 Introduction

High Performance Computing (HPC) has been widely recognized as a crucial asset for the EU's innovation capacity. It represent not only a fundamental instrument to advance science and technology and to maintain scientific excellence at world class level, addressing societal and scientific grand challenges more effectively, but it is also vital for engineering and industry for supporting EU's competitiveness and innovation.

From a study from IDC it appears that 97% of the industrial companies that employ HPC consider it indispensable for their ability to innovate, compete, and survive [1].

Recently, in February 2012 the European Commission, in its communication to the European Parliament "*High-Performance Computing: Europe's place in a Global Race*", underlined the necessity to provide a world-class European HPC infrastructure, benefitting a broad range of academic and industry users, and especially SMEs, including a workforce well trained in HPC [2].

Since the beginning PRACE has been committed to push HPC toward industries, when during the PRACE Preparatory Phase launched the successful series of *PRACE Industrial Seminars* to enhance contacts with the industries to identify better their HPC needs and expectations.

The continues attention of PRACE toward Industries is drawn in Figure 1. In PRACE-1IP a Work Package was dedicated to the relationship between PRACE and the industrial end users: WP5 "*Industrial User Relations*" had the objectives to establish continuous relations with industrial users of HPC and develop a proposal for a PRACE offer for industry.

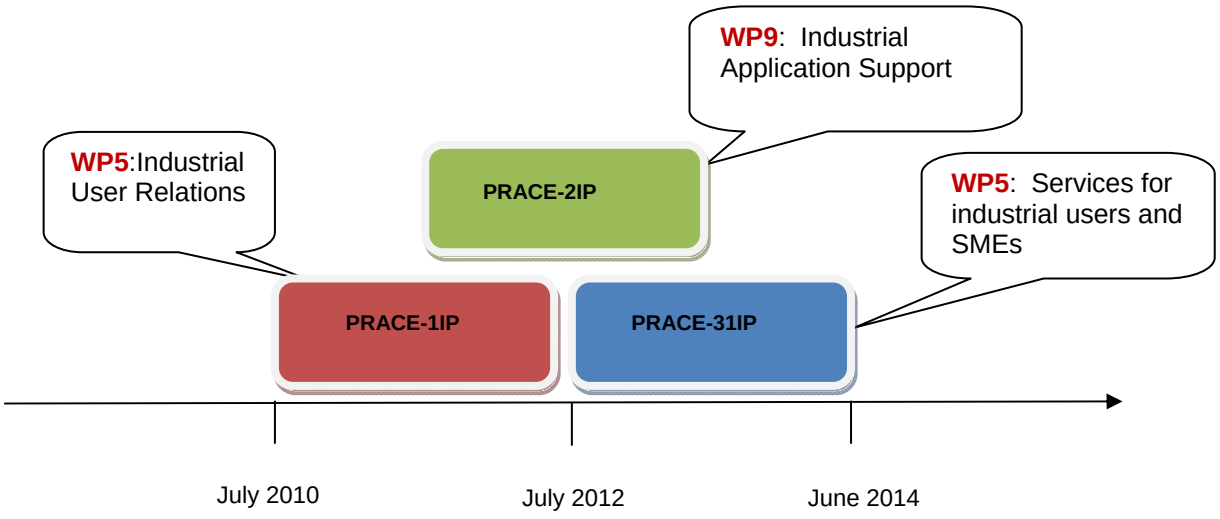

Figure 1: PRACE and Industries

WP5 provided first and in depth analysis of the HPC needs and expectations of users from European industry companies [3], then proceeded to the analysis of the existing business models used by infrastructures and organisations (both at European and world-wide level) regarding access of users from industry [4]. Finally, WP5 developed a proposal for the PRACE industrial offer for the infrastructure and services, based on the information gathered from different industrial users and from the analysis of the business models for industrial access to other infrastructures in Europe and world-wide [5]. This work led to the adoption by

the PRACE AISBL of the Open R&D business model, which is applied to PRACE calls for proposals since January 2012.

In PRACE-2IP the attention toward industrial users continued with an action more focused on industrial applications. WP9 "*Industrial Application Support*" has the objective from one side to continue to strengthen the relations with industrial users and ISVs and from the other to work on application codes of interest for industrial users [6]. This second objective has been declined in two important actions: The first one focusing on petascaling open source codes of interest for the industrial communities, the second one devoted to enable emerging industry relevant open source codes for HPC systems. Many open source codes used by industries are unable today to exploit massive parallelism; furthermore, other open source applications with an high potential impact on industrial research and innovation are not ready for industrial production on powerful HPC Systems. So, it is important to enable and petascale these codes, allowing industrial users to access petascale resources and to be competitive through high end simulation.

In PRACE-3IP the aspects related to industrial users are dealt in WP5 "*Services for industrial users and SMEs*". This Work Package has the objective to design and pilot the Integrated Access Programme (IAP) an effective and integrated set of high-level services aimed to the specific needs of industrial users and SMEs in particular. Here the focus on SMEs is important as they represent the most robust and dynamic part of the European Industry but often lack expertise to know and apply new technologies for innovation.

This IAP activity will deliver an integrated programme to facilitate the industrial HPC usage and expand the PRACE visibility and presence among industrial HPC users.

The Task 5.1 of WP5 has the objective to analyse the models and the best practices for access programmes for industrial users. The results of this task will represent the main input to build the effective design of the IAC for the industrial users and SMEs elaborated by Task 5.2.

This deliverable describes the activity undertaken in Task 5.1, and is structured as follows:

- Section 2, after a brief overview of the different business models for industrial users analysed in PRACE-1IP WP5, deepens the analysis of the pre-competitive R&D model to evaluate if it can be applied to the PRACE context;
- Section 3 presents an analysis of the different industry support models offered by HPC infrastructures in Europe and other regions;
- Section 4 presents some examples of other industry support models offered by non-HPC research infrastructures, both at European level and worldwide;
- Section 5 identifies the current needs of industry in terms of HPC access programme;
- Finally some conclusions follow.

The intended audience of this deliverable if primarily the PRACE-3IP Project, in particular the Work Packages directly involved in collaborating to the success of the IAP implementation: WP2, WP3, WP4, WP5, WP6 and WP7. Furthermore, the deliverable is intended to support the PRACE AISBL for the realisation of IAP and to the industrial users and industry stakeholders that can find in PRACE HPC access an important instrument to enhance their innovation, productivity and competitiveness.

2 Industrial Users: their HPC needs and possible business models

PRACE-1IP Project, WP5 "*Industrial User Relations*" investigated the potential industrial target groups which could benefit of a PRACE industrial offer [4]. The map reported in Figure 2 synthesizes the target groups identified as potential consumers for a PRACE industrial offer.

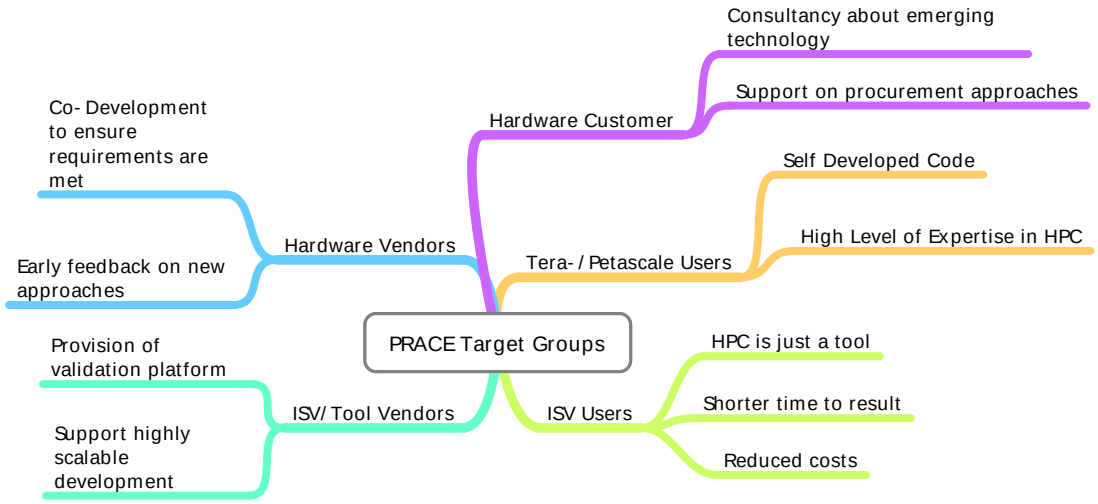

Figure 2: Map of Industrial target groups.

When focusing on the group of the industrial users potentially interested in using the HPC PRACE resources, three possible categories have been identified:

- **Desktop-level SMEs** – companies of less than 250 employees that have not yet adopted HPC;
- **SME-level HPC users** – companies of less than 250 employees that are using HPC (and intend to extend its usage);
- **Users from large organisations** – companies of more than 250 employees.

The needs for these categories have been widely identified and analysed in [3]. The following points summarise the main needs for these potential users:

- Evangelisation, information and training – access to expertise on the possibilities of HPC as well its implementation and maintenance requirements;
- On-demand access to HPC resources which provides the opportunity to '*try-out*' HPC solutions (without committing extensive resources);
- Expertise in scientific software by supporting and recommending ISV code options as well as creating a pool of Open Source Codes - in order to allow smaller users to adopt HPC;
- Code Enabling – the scaling of codes up to the Tier-0 level;
- Co-design of industrial applications – cooperation with PRACE in order to develop new software solutions for industry;

- An Open R&D Programme in order to perform R&D and develop solutions that can be shared with other members of community;
- Pre-Competitive R&D - R&D activity or code development where the disclosure of results may be postponed or which might require a payment;
- Partnership with HPC research centres in order to develop solutions and participate in PRACE prototyping activities;
- Technology Transfer and other high-value knowledge services – access to knowledge on HPC hardware and software technology options;
- Commercial Activities – access to resources on a commercial basis.

In PRACE-1IP WP5, Deliverable D5.2.1 "*Business models for industrial access to infrastructures*", [4], analysed the assessment of the existing business models for access the HPC resources. Three of these business models have been further investigated to identify if they could fit the needs of the potential industrial users [5]. The activity was done in collaboration with PRACE-1IP WP2 "*Evolution of the Research Infrastructure"* in order to better investigate the legal and financial aspects regarding the current statuses of the PRACE AISBL and its four Hosting Members (France, Germany, Italy and Spain). The business models analysed were:

1. **Open R&D**
   The industrial users may only use the facilities and services provided by the infrastructure for basic research and development purposes. The condition associated with this free access is for the industrial user to publish all results obtained at the end of the grant period. Industrial users may apply as principal investigator on their own or in some cases may be paired with an academic partner in order to foster technology transfer between academia and industry.
2. **Pre-competitive R&D**
   The industrial users can access the facility and the services of the HPC infrastructure for performing software/product development in a pre-competitive stage and in a less restrictive way. Compared to Open R&D the condition to publish the results immediately is weakened with the intent to give to the industrial user the time to ship the product and to take the benefits of its innovation.
3. **Production, consultancy and commercial activities**
   In this business model the industrial user use the infrastructure in production mode for commercial activities. The service needs to be charged at the market rate.

The outcome of the business model analysis supported the PRACE Council in January 24th 2012 when it established to open the PRACE calls for proposals to the industries, on the basis of Open R&D projects. See [5].

PRACE-3IP WP5 "*Services for Industrial Users and SMEs*" with the support of PRACE-3IP WP2 "*Policies and Procedures*" is investigating furthermore the Pre-competitive R&D business model to see if this model could be implemented in PRACE to allow the industries (with a particular attention to SMEs) to access HPC services in a wider scenario.

Extending the model for including pre-competitive activities has to take into account a number of considerations and the (likely) impact on the legal and taxation status of the PRACE AISBL Association.

The legal, fiscal and implementation aspects have been considered and a specific consultancy action on these aspects has been asked to the law firm Bird&Bird[1].

The answer from Bird&Bird has been produced focusing on the following aspects: competition law, the legal status and the taxation aspects of the PRACE AISBL.

The problems are complex and need time to be investigated in a clear and safe way. Just to give an example, of the complexity, appears that PRACE in principle is not subject to the competition law because it offers scientific services. Extending services to industry for free might raise the issue of PRACE being accused of "*abuse of a dominant position in the form of predatory pricing*". To minimize (not exclude) that risk PRACE must ensure that its activity is purely scientific and not economic.

As a result, appears that the full implementation of the Pre-competitive R&D seems quite complex and important legal issues have to be further investigated in order to finalize the extension of the model to the pre-competitive R&D.

The work is still in progress and the final analysis and evaluation will be presented as part of the next activity of PRACE-3IP-WP5 and WP2.

[1] Bird&Bird, http://www.twobirds.com

3 Analysis of currently operating industry support models offered by HPC Infrastructures

In this section, we analyse the currently existing national support models for industry, in Europe and outside. These national programs are very often carried by HPC infrastructures, where the expertise and the resources are. Knowing what services they provide and how, these initiatives will help to design a support model at the European level.

3.1 UK initiatives

3.1.1 *Daresbury*

Established in 2010, Sci-Tech Daresbury is a public-private joint venture which is dedicated to SMEs and large corporates, helping them growing and innovating through a direct on-site access to scientific facilities, academic expertise and funding. It brings together businesses (based on the Enterprise Zone), academics and scientists. These actors currently work in a variety of scientific fields including high performance computing, accelerator science, sensors or detectors.

The joint-venture was established in 2010 between the Science and Technology Facilities Council (STFC), Halton Borough Council and the Langtree company. As part of UK Research Councils, the STFC supports national science and technology through an access to scientific facilities and expertise. Halton Borough Council, the local authority, has to take Daresbury to the next level by funding and facilitating private sector investment. As a property developer and investor, Langtree mandate is to provide access to high quality offices, laboratories and technical spaces. The Universities of Lancaster, Liverpool and Manchester are also active on the site.

Sponsored by government through UK's Ministry of Research funding and the HM Treasury, Sci-Tech is a specific collaboration of government-sponsored science, university-sponsored science and private sector. The program facilitates the route to market, staff, technology and funding (by the UK's Department for Business, Innovation and Skills, BIS) for SMEs based on the campus. Thanks to the collaboration between academia and businesses and an open innovation model, SMEs can get access to a wide range of services including supercomputing resources, expertise or training, access to demonstration and learning centres dedicated to marketing events and technical courses, laboratories and offices.

Approximately 50 SMEs are leading research activities on Sci-Tech Daresbury, coming from a variety of sectors, including advanced engineering and materials, biomedical, digital ICT, mobile and energy and environmental technology. In over 7 years of operation of the site only 10 companies have failed. Of these 10 companies, one was acquired by another campus companies and 7 have phoenixed.

3.1.2 *HPC Wales*

HPC Wales was established in July 2010 by Cardiff, Swansea, Aberystwth, Bangor, Glamorgan Universities, Wales Alliance Universities and Technium business innovation centres around Wales.

The program aims to provide a pan-Wales distributed network of computer clusters, with expert advice and support and to facilitate strategic partnerships between the academic and private sectors. Three structures have been deployed in order to answer companies' needs: an

HPC capacity with a distributed network of computer clusters, an HPC Institute that aims to develop strategic partnerships between the academic and private sectors and an HPC Skills Academy which delivers technical courses and workshops. An access to an interactive portal is also providing with knowledge base, thematic collaboration areas, discussion groups and blogs.

Targeted organisations are coming from start-ups to small and medium businesses. Blue chips companies can also participate.

£40M were injected into the programme in 2010 for the 2010-2015 period, including: £19M from the Welsh European Funding Office, £10M from the Department for Business, Innovation and Skills (BIS), £4M from collaborating academic institutions, £5M from the Welsh Assembly Government, £2M from private sector and research income. This investment covers infrastructure development, equipment, software research, management and operational costs over the first five years to 2015 by which time HPC Wales expects to become self-supporting.

Concerning the management of the programme, 25 people are involving into HPC Wales, including 6 people for the management team, 6 people for the technical one, 8 for the Training & Outreach team and 5 in the Head Office.

3.1.3 *CORE*

CORE is an on-demand High Performance Computing (HPC) and data management e-Infrastructure available to both industry and academia, launched in mid-2012 by Imperial College London and the University of Cambridge. It delivers ready solutions on a world-class HPC and data analysis capability, to allow organisations to accelerate research and build real competitive advantage.

Targeted organisations are SMEs as well as large companies in every sector. Though, companies starting “from scratch” might not be able to use the resources at its most. Partners include Rolls-Royce, Caterham F1 Team, and SMEs as Audio Analytic.

Two separate services are provided by CORE: Cloud HPC and consultancy services. The Cloud HPC service consists in per-pay-use on-demand access to HPC resources along with some support. CORE also offers consultancy in the design, deployment, management and utilisation of HPC and large-scale data analytics. As a commercial programme with a pay-per-use on-demand access, companies pay to have access to the resources and the expertise as long as they want.

Apart from the advertised easy utilisation of the “business-ready” solutions, the only lowered entry barrier is a “free starter package” of 10,000 core hours and one day of free support for companies engaging in CORE for the first time. It is more a discount than a full support programme. That is the reason why the programme targets companies that already have a tested project and a vision instead of SMEs needed to be evangelized and cannot afford to pay for the demonstration of HPC benefits.

3.1.4 *Supercomputing Scotland*

Supercomputing Scotland is a programme running by EPCC (Edinburgh Parallel Computing Centre), the Scotland National HPC provider which delivers unique facility in Scotland and Scottish Enterprise (SE) a Scotland’s economic development agency mandated by the Scottish Government with supporting company growth. One avenue of providing such support is encouraging the uptake of new technologies such as HPC.

Supercomputing Scotland is dedicated to both SMEs and large companies and is initially a three-year initiative. Three target sectors have been identified (Energy, Life Sciences and Financial Services) but the programme is opened to all sectors provided a clear need for HPCexists. Each HPC Adopter Project has a duration of between 3 and 6 months.

The aim of Supercomputing Scotland is to give companies the knowledge to help them to decide if using HPC makes sense for them. More specifically, it has to allow companies to assess the usefulness of HPC to their business by lowering the initial costs of adoption. Four kinds of support services are delivered: knowledge on the HPC ecosystem and its possible benefits, a support for the feasibility study, an access to supercomputing resources and a support for the use of the resources.

The key objective is to improve the company's competitiveness through the use of HPC to deliver new and improved products and services. The return on investment of the three pilot companies have been evaluated by external consultants, who found that it generates approximately £10 net Gross Value Added for every pound of public spend with a five year projection of £25. The required outcome is the solution of a specific company problem through the HPC adopter Project or simply the Feasibility Study which may identify that the use of HPC is not cost effective for the company at this time.

The programme is in two parts: First, a detailed feasibility study of the company's project is done by EPCC. This is free to the company and paid for jointly by EPCC and SE. Then, the company and EPCC engage in an HPC Adopter Project supported by SE and which comprises access to HPC resources and modelling and simulation expertise. The cost of the programme is shared between EPCC (in-kind), SE (cash) and the company, which contributes both in-kind and in cash. A company can only generally take part in one HPC Adopter Project. However, in exceptional circumstances a second project could be funded.

Concerning the management and the review process of the programme, a well defined three stage process is followed for each Feasibility Study. At the end of each stage, progression to the next is agreed between EPCC and SE. Following a successful Feasibility Study and application for funding is made to SE which is then reviewed and agreed provided a sufficiently strong case is made. The resulting HPC Adopter Project is then managed in the normal way by EPCC and reviewed throughout by SE.

3.2 Ireland initiative: ICHEC

The Irish Centre for High-End Computing (ICHEC) provides a high performance computing orientated consultancy services to sectors of the economy outside of academia. It is not a support programme per se and much more a commercial service but the engagement of companies can be funded by state agencies like Enterprise Ireland and the State's Industrial Development Authority in Ireland (IDA) provided that this is in full compliance with the terms of that funding.

The goals of these consultancy services are largely client driven and rarely involve the sale or use of HPC hardware resources, e.g. the National service systems Stokes or Stoney, aside from proof of concept demonstrations. Rather, the desire is normally to access the expertise that exists within the centres mix of technologists and scientists.

Typical goals involve improving existing business processes to speed-up workflows or performance critical parts of same. Typical requests include:

- Programming for compute accelerators;
- Training in HPC-like techniques;
- Mathematical and algorithmic expertise;

- Workflow optimisation;
- Profiling and benchmarking, particularly in a parallel context.

ICHEC is obliged to not undercut the private sector as such it provides services to the state at slightly greater than full economic cost. Services to the private sector are provided at full economic cost plus a commercially level margin.

Engagements are typically of the order of a few months from commencement to completion. An exception to this would be ICHEC's engagement with the National Weather service, where ICHEC provides an operational HPC service. This situation has pertained since 2006.

There are no formal requirements as outcome aside from payment in the normal commercial sense and a customer testimonial may be requested but not required, particularly in a new business area.

Operationally each engagement has a project manager, a technical team and a technical reviewer. Headline figures for the overall number of engagements and the generated income are reported to ICHEC's funding agencies.

3.3 FRANCE initiative: HPC-PME

"Initiative HPC-PME" is a joint initiative established at the end of 2010 by three French public partners: GENCI, a civil society created in 2010, in charge of the coordination of the major French civil equipment in high performance computing; INRIA, a French public science and technology institution dedicated to computational sciences and OSEO, a French public bank for developing innovation in industry and especially SMEs. This programme is also supported by the 5 French biggest technological clusters: Aerospace Valley (aeronautics and aerospace), Axelera (chemicals and materials), Minalogic (micro electronics), System@TIC (embedded systems) and Cap Digital (digital media).

Targeted organisations are French SMEs coming from various domains: automotive and aeronautics, oil & gas, offshore and sailing industry, finance, digital media and healthcare, microelectronics, etc.

The aim of such a program is to allow French SMEs to assess and demonstrate the potential of using HPC in their innovation process. This initiative is based on an integrated offer providing high value services like information, training/best practices, expertise from public research (in various scientific domains as well as in HPC), access to HPC systems (the ones from GENCI as well as regional centres) and funding facilities.

SMEs can apply online through a web portal to the initiative using a permanent call for proposals and submitted proposals are reviewed monthly by representatives from GENCI, INRIA and OSEO. The pre-selection phase is dedicated to the SME project qualification and aims to determine SME needs. Then a second phase is engaged where the co-design of the SME industrial project is supporting with a customized assistance using the combined skills of all the partners. Most of the necessary assistance consists in providing understanding and support for implementing new work methodologies using HPC. In that way, one of the most important added-value of HPC-PME is to foster technological transfer between expertise from public research and SMEs from industry. The HPC-PME support ends when the SME has demonstrated the feasibility of its industrial project, has acquired HPC expertise and skills, could be integrated into existing funding tools for innovation and HPC ecosystem and finally could develop and deploy its industrial project by its own with a clear view of its associated ROI.

3.4 Germany initiative: SICOS GmbH

SICOS GmbH in Stuttgart is not a Support Programme, it is a company (GmbH; corporation with limited liability) owned by KIT (Karlsruhe Institute of Technology) and Stuttgart University and it is fully funded by its owners respectively the Ministry of Science, Research & Art of Baden-Württemberg. SICOS stands for SImulation, COmputing and Storage.

SICOS' mission is to support industry in its take-up of simulation and HPC technology, focussing on Small and Medium-sized Enterprises (SME) with the goal to help them improve their competitiveness. SICOS presents the advantages of simulation and HPC technology at conferences, trade shows, workshops, etc. and informs interested companies, especially SMEs, about the opportunities which are offered by current HPC, Grid-/Cloud-Computing and Data Analysis systems.

For those companies that would like to know more about the possibilities of HPC, SICOS offers in a second stage consulting to identify the specific problems of the interested companies and answer detailed questions they might have.

In a third phase, SICOS connects these potential HPC users with the appropriate experts and specialized service providers to solve their specific problems. This includes the local competencies at the computing centres (Steinbuch Center for Computing at KIT and HLRS at the University of Stuttgart), but also selected partners from research as well as industrial simulation and HPC experts (e.g. engineering simulation providers and ISVs).

SICOS is not profit oriented and offers its expertise and service free to potential users. The HPC resources that these users need will be mainly provided by the shareholders and their computing centres.

For more information see http://www.sicos-bw.de/.

3.5 Nederland initiative: SARA Innovating Infrastructure with impact

SARA has a history of allowing part of the academic infrastructure for open R&D and precompetitive activities. In the Netherlands a programme is currently running 2011-2013 to further promote and enable HPC usage for SME's and industry in the Netherlands. The Netherlands Ministry of Economic Affairs uses a Top-sector approach. The ICT infrastructure, including HPC resources will align with these frameworks. As these sectors are organized through their respective platforms it is enabling fast reach-out to these sectors.

This Top-sector approach identified the following sectors:

- Water;
- agriculture & food;
- life sciences & health;
- chemistry;
- high tech;
- energy;
- logistics;
- creative industry.

Within this Top-sector frameworks it is possible to create a KI (knowledge and innovation) contract. This is a form of public private partnership involving research institutes, universities, business and or government. All partners make a financial contribution, the ministry adds 25%.

A promotional campaign will start in 2013 aiming to promote and advocate HPC usage for SME's and Industry. A support and development programme is under development and will consist of:

- Market reach out:
  - sector focused market research and showcasing;
  - inspiration workshops and training.
- Assessment:
  - business case development with young academics;
  - benchmarking;
  - poc / demo activities.
- Fostering of a value network
  - passepartout R&D contracts;
  - access & support pay per use;
  - optimisation and benchmarking;
  - scale-out services.

We find that the following aspects are of mayor importance. Related to a tightly connected why, what, and how. Why would companies use these services? What is thus your offering and how are you organised to offer these.

The abovementioned programme aims at all these issues. There is a challenge in translating to and integration with existing business. This means talking in terms of business value, understanding the sector language and making a significant implementation effort. How services are being offered is of extreme importance: time to solution, availability of systems, but also compliancy with internal policies, security and privacy are aspects that have to be properly addressed.

The notion of high performance computing seems to have different meanings in different contexts. Enable SME's through 'PRACE' HPC is very ambitious and challenging. Advocating HPC's opportunity could very well mean that lower computing tiers (Tier-1 or Tier-2) are found to be more suitable for enterprises. Scaling up / scaling out from 4 to 32 processor cores is already of great added value for many businesses. Arguments such as not having to maintain own systems and becoming part of a valuable knowledge network are well received benefits.

Technology transfer contracts with commercial service providers and or consultancy business and memoranda of understandings are used to foster a long term relationship with SME, Industry and knowledge institutes based on a common objective. A Technology transfer with a market focused provider has been signed end of 2012 to enable transfer and translation to professional business services.

3.6 USA initiatives

3.6.1 *NCMS Digital Manufacturing Initiative*

The NCMS (National Center for Manufacturing Sciences) objective is to drive the global competitiveness of North American Manufacturers through collaboration, innovation, and advanced technologies. Though NCMS's founding mission is to provide project management for collaborative R&D, the organization has evolved with manufacturers and now provides products, services, and initiatives designed to further the overall goal of improving competitiveness in the global market. The NCMS is a driving force in several US high-tech initiatives, one of them being "Digital Manufacturing and High Performance Computing".

NCMS proposes the development of knowledge infrastructure which leverages the wealth of talent, ideas and facilities within universities, national labs and industrial research centres to bring Small and Medium sized Manufacturers (SMMs) access to this desperately needed technology.

Focusing on product design, development and advanced manufacturing, this network intends to consist of numerous public-private sector collaborations called Predictive Innovation Centres (PIC).

Access through a secure web-based portal will allow manufacturers of all sizes to experiment with HPC tools and optimize their own innovation processes – eliminating the heretofore-insurmountable cost-upfront barrier that has kept so many SMMs from adopting HPC.

NCMS works closely with federal agencies, leading OEM's (original equipment manufacturer), entrepreneurial technology companies, and SME's in all industrial sectors. Both industry and government agencies reach out to NCMS and our cross-industry network of members to ensure that their new technology efforts are focused on real-world applications with inherent and immediate viability. The NCMS serves as a "trusted third party" for these groups in order to accomplish their research and development goals.

As a neutral, technology-agnostic third party, NCMS is set up to protect individual and corporate Intellectual Property, manage communication, ensure that projects remain on task, and drive any activity toward its outcome. With over 350 successfully completed R&D projects under its belt and a standardized, definitive approach to project and program management, the NCMS is a well-positioned in team organization and project oversight.

The programme is financed by the membership fee of all its members, according to a sliding scale so that bigger companies pay a higher fee than SMEs.

NCMS provides full lifecycle project collaboration services on a contract basis, such as expertise in R&D proposal development, feasibility studies, project administration, legal agreements, accounting, purchasing, contracting and knowledge capture functions.

These services are tailored to meet the specific needs of its clients who desire to conduct R&D via private collaborations facilitated by a neutral third party.

3.6.2 *National Digital Engineering and Manufacturing Consortium (NDEMC)*

NDEMC is a public-private partnership to support and enhance the use of modelling and simulation among America's small and medium manufacturers.

The project is initially focused in the Midwestern United States, where an extensive manufacturing base exists and a chance for major economic impact was identified.

This partnership has included the U.S. government and selected manufacturers willing to collaborate with their Midwest manufacturing supply chain members in a pilot program.

Partners and co-applicants include:

- The National Centre for Manufacturing Sciences (NCMS)
- The Ohio Supercomputer Center (OSC)
- The National Centre for Supercomputing Applications (NCSA) at the University of Illinois
- Purdue University

Government agencies associated with the Memorandum of Understanding include:

- Department of Commerce (EDA, NIST)
- NASA
- Department of Energy
- National Science Foundation

Private sector partners include:

- Lockheed-Martin
- John Deere
- Procter & Gamble
- General Electric Energy

NDEMC started with 18 months of public funds from the Department of Commerce Economic Development Administration (EDA) totalling $2.02M. This investment is matched with $3M in additional funds from private and state sources.

The federal government has provided funding support and in-kind contributions - such as computational assets, expertise, professional education, etc. - as their contribution to the pilot program.

The selected manufacturers have provided in-kind contribution such as expertise, coaching, etc. The federal government and the selected manufacturers are designated as shareholders. Furthermore, the selected manufacturers will identify and recruit members of their supply chain (Midwest locations) to participate in the pilot program. Some SMEs not affiliated with the manufacturers may be considered for participation.

Through its activities the NDEMC seeks to improve supply chain integration, shorten time-to-market, and increase SME bottom line through the use of software and High Performance Computing assets.

NDEMC is a resource of expertise, hardware and software in support of improving manufacturing productivity through modelling and simulation, and will be responsive to assisting participating SMEs with education, training, and implementation.

This is accomplished through group and individualized training at the company location and improved access to shared resources (hardware and software) supported by the solution partners. SMEs have to put into it the effort commensurate with the potential benefits they will receive.

A field trainer will be provided to them at no-cost for a period of time lasting at least several months and perhaps as long as a year. This direct engagement could go on for as long as the SME is demonstrating that knowledge transfer is having a positive impact on transitioning their internal workflows.

3.7 CANADA initiative: Ontario Centres of Excellence (OCE) HPC Initiative or Southern Ontario Smart Computing Innovation Platform (SOSCIP)

SOSCIP Consortium Agreement is a partnership engaging IBM, the Government of Ontario, the Government of Canada, Ontario Centres of Excellence (OCE), and academic institutions: University of Toronto (U of T), Western University, University of Waterloo, McMaster University, University of Ontario Institute of Technology, Queen's University and the University of Ottawa.

Inside this partnership, OCE's specific mandate is to identify high-potential companies such as SMEs that could make considerable gains using HPC and to help them increase their competitiveness and productivity through access to HPC infrastructure and services. SMEs in Ontario are specifically targeted by the programme.

As per the SOSCIP Consortium Agreement, the Call for Proposals is aimed at generating creative collaborations among Consortium member universities, SMEs, and IBM as well as creating new products and/or services that can be commercialized in Ontario and applied both domestically and around the globe. Areas of focus for the research collaboration include problem facing cities, healthcare challenges, water conservation, efficient energy conservation and software innovation in high performance computing platforms.

The initiative will launch calls as for the first call resources will be offered through the SOSCIP Consortium until March 31, 2014. Proposals extending beyond this date will only be considered based on the continued availability of resources. The availability of resources will also be contingent on meeting agreed-upon deliverables which will be reviewed at six-month intervals.

OCE HPC Initiative is $210 million dollar research and development endeavour. The Federal Economic Development Agency for Southern Ontario (FedDev Ontario) is contributing $20 million to allow the seven universities and IBM to install two high-performance IBM Blue Gene/Q supercomputers and develop a cloud computing and agile computing platform to underpin the initiative's research collaboration. Ontario's Ministry of Economic Development and Innovation (MEDI) provides $15 M while the IBM Canada Research and Development Centre is contributing for IBM's $175-million investment to upgrade or create new facilities, in-kind contributions etc.

In its first Call for Proposal the SOSCIP Consortium invites interested to submit proposals for the development of collaborative research projects. Proposals must include SME collaboration or identify potential SME candidates. The Ontario Centres of Excellence has dedicated resources to assist engagement with SMEs.

3.8 Analysis of the initiatives

As we can see from the examples above, there are several national initiatives aimed at supporting the industry in its use of numerical simulation and HPC. A synthesis of the industry support models offered by these HPC Research Infrastructures is reported in Table 1.

A subset of these initiatives is that which specifically targets SMEs. In this case, all these support programmes have in common to try to lower the entry barriers for SMEs. Going from working with desktop applications to using HPC resources needs a very significant investment, in money and time that SMEs cannot usually afford when they don't have a clear view of what added value it will bring to their businesses. Their lack of HPC expertise and references not only prevent SMEs to adopt compute-intensive simulations but also prevent them to realize its benefits.

That is why most support programmes are enablers. The goal is to use the knowledge of HPC infrastructures to demonstrate to SMEs the advantages of adopting simulation. The first step (feasibility study, proof of concept), the highest one for SMEs, is, in most of the cases, free or at a very attractive price, thanks to funding from national agencies.

If the programme is targeting bigger industries or at least those mature enough to be willing to engage into HPC on their own, the goal of lowering the entry barrier is not the main focus. Rather, it aims more at providing the full range of needed services in the same place. Services provided are typically based on consultancy, training and access to HPC resources.

Once the benefits have been demonstrated to the company, regardless of its size, the programmes have different desired outcomes: the company can stay in the programme, benefiting from the same services, but at a commercial cost (this is mostly the case in UK), or can be linked with service providers in the market (HPC-PME and SICOS).

The legal structures which are delivering the support programmes vary from country to country. It could be the supercomputing centre itself (Daresbury, ICHEC, etc) helped with national agencies funding, a public-private partnership (NDEMC), or a private company (SICOS).

Country	Name of the programme	Legal structure	Target		Services				Support/Commercial
				Proof of concept / Feasibility Study	Access to computing resources	Expertise	Training	Others	
UK	**Daresbury**	Public-private joint-venture	SMEs and large companies	?	YES	YES	YES		Mostly commercial
	HPC Wales	Support programme (mainly public, but with some private funds)	SMEs		YES	YES	YES	Access to an interactive portal	Mostly commercial
	CORE	Universities program, designed as a private company	SMEs and large companies	YES	YES	YES	YES	On-demand Cloud HPC and data management	Purely commercial : per-pay-use.
	Supercomputing Scotland	HPC center & development agency	SMEs and large companies	YES	YES	YES	YES		Free support for the feasibility study, then semi-commercial programme.
Ireland	**ICHEC**	HPC center	SMEs and large companies	YES	YES (but usually only for the Proof of concept)	YES	YES		Purely commercial, but companies can be helped by state agencies
France	**HPC-PME**	Public iniative: state agency, research centers, and public SMEs bank	SMEs	YES	YES (but usually only for the Proof of concept)	YES	YES	Elaboration of a sustained financial solution at the end of the programme (once the concept has been proved)	Free support only from the standpoint of the initiative, but direct contracts between the companies and experts and/or computing centers are possible
Germany	**SICOS**	Private company, owned by KIT and Stuttgart University	SMEs			YES		Information about the oportunities and connection with experts and services providers	Free support for now
Netherlands	**SARA**	Public support and development program (will start in 2013)	SMEs and Industry	YES	YES	YES	YES	Business case development with young academics, R&D contracts	Pay-per-use access to resources and support is planned, but it is in an early stage

USA	**NCMS**	Private initiative	Small and Medium Manufacturers	YES	YES	YES		Fostering of public-private collaboration, and trusted third-party for R&D projects management	Support for the public-private collaborations by providing access to web-based portal which allows manufacturers of all sizes to experiment with HPC tools
	NDEMC	Public-private partnership	Manufacturers supply chain members		YES	YES	YES	On-location group training. This should be accomplished through group and individualized training at the company location and improved access to shared resources (hardware and software) supported by the solution partners.	Free support, but the company has to put as much effort into it as others are putting.
Canada	**SOSCIP**	Public-private consortium agreement	By industry side - SMEs		YES	YES	YES	Calls for collaborative research projects between consortium member universities and SMEs	Creating new products and/or services that can be commercialized in Ontario and applied both domestically and around the globe

Table 1: Synthesis of industry support models offered by HPC Research Infrastructures.

4 Analysis of other industry support models offered by non HPC research infrastructures

In this section an analysis of other industry support models related to non HPC research infrastructures is provided, including how large public research infrastructures approach services towards industry, especially SMEs, and how national or local governments approach innovation processes and support access of industries to research infrastructures.

The purpose of this analysis is to come to a design of an integrated access programme for SME's to HPC infrastructures. In order to further inform this programme design we will inspect the non-HPC research infrastructures in Europe and other areas for their industry support offerings and approaches. This will be based on the ESFRI related European projects and information obtained by direct contacts within PRACE, other competence networks, existing reports and website information.

4.1 European Synchrotron Radiation Facility (ESRF)

ESRF is an X-ray light source for Europe located in Grenoble, France, supported and shared by 19 countries.

The ESRF is the most powerful synchrotron radiation source in Europe. Each year several thousand researchers travel to Grenoble, where they work in a first-class scientific environment to conduct exciting experiments at the cutting edge of modern science.

ESRF has two types of access for industrial users. The first one is Open R&D, similar to what is already implemented in PRACE: industrial users can apply along with academics, and are granted free access to the beam-line resources on sole scientific excellence, under the condition to publish results afterwards.

The second type of access is through a commercial service. The access is faster, strict confidentiality is ensured, and there is no need to publish any result. To handle this commercial work, ESRF has had a dedicated structure in place since 1995, currently called Business Development Office. Being a Société Civile in France, ESRF has a legal limitation included in its statutes: commercial actions cannot represent more than 10% of the annual budget. As an estimate, in 2010, all commercial activities represented around 1.7% of the 98 million Euro budget.

When some beam-lines face sufficient demand from the regular calls, some slots are left in the schedules for proprietary access. According to the rules, up to 10% overall of beam time can be assigned to paid-for access, and up to 30% on any one beam-line.

ESRF also has long-term partnerships with some companies. The conditions vary from a Best Client system for structural biology clients, to sliding scale charges for clients purchasing a large amount of access. They perform contract research and have partnerships with industry for (co)-funded PhD and Post-docs for example.

As of today ESRF does not differentiate in costs for access between large and small companies. In this respect care must be taken that all companies from all of our 19 member states have the same access charges to avoid any one country obtaining a privileged access. Another limitation is that the analysis of data produced on the beam-lines usually requires expert input that industry does not have. This has been identified as a major bottleneck preventing deeper engagement of industry in ESRF. However, Mr. Mitchell, head of the Business Development Office, estimates that some 25% of the peer review experiments done have some level of direct industrial participation - although this is rarely indicated in the beam

time application forms at the moment - for example via industry sponsored students or funding in academia for R&D.

Further information on ESRF can be found at: http://www.esrf.eu/.

4.2 EMBL-EBI European Bioinformatics Institute

The European Bioinformatics Institute (EBI) is an academic research institute located on the Welcome Trust Genome Campus in Hinxton near Cambridge (UK), part of the European Molecular Biology Laboratory (EMBL). The European Molecular Biology Laboratory is a non-profit organisation and a basic research institute funded by public research money from 20 member states and one associate member. Research at EMBL is conducted by approximately 85 independent groups covering the spectrum of molecular biology.

EMBL-EBI Industry Programme is active since 1996, consisting in:

- kick-starting research of importance to industry
- providing expert training in specialist workshops targeted to the needs of its members
- developing standards - for example in sequence analysis and genomic maps - that protect partners from becoming locked into proprietary solutions
- improving resources and services in line with the needs of the partners
- providing opportunities for members to work on-site in close collaboration with EMBL-EBI staff
- hosting strategy forums and networking opportunities on neutral ground.

The programme is funded its members, through an annual fee. The Industry Programme comprises many of the world's leading pharmaceutical, agri-food and diagnostics companies.

SMEs have access to EMBL-EBI training, services and support. In addition, EMBL-EBI has established an annual series of information workshops designed to allow SMEs to effectively use the freely available data resources, tools and services provided by EMBL-EBI and its collaborators (including the European Patent Office). The workshop provides the opportunity to introduce the tools and data resources that are available and the opportunities for SMEs to use and integrate these resources in order to derive business benefit from the existing and developing infrastructure.

The topics of the workshop are specifically selected on the basis of previous interactions with SMEs and regard new technologies in scientific computing, and patent services providing by EMBL-EBI and the European Patent Office.

Further information on EMBL-EBI can be found at: http://www.ebi.ac.uk/.

4.3 Initiatives in Italy

4.3.1 *Industria 2015*

The Italian national strategic lines for supporting technological innovation in industries are included in the plan “Industria 2015” approved in 2006 for the 2007-2015 period.

It is based on three instruments:

- Progetti di Innovazione Industriale (PII). Grants to fund R&D projects involving collaboration among industries, universities, research centres, local entities. The themes are limited to specific areas defined as strategic, like energetic efficiency or sustainable mobility.

- Reti di impresa. A new kind of association among industries having strategic objectives and common activities aimed to increase competitiveness and innovation.
- Finanza innovativa. New funds to provide subsidized loans to industries acting to increase competiveness and technological development, like the so-called Fondo di Innovazione Tecnologica (FIT). FIT is a fund designed to support programs related to experimental development activities, which may include non-preeminent industrial research. It is meant for funding design and construction of pilot and demonstration projects and prototypes aimed at new products, processes or services or to make substantial changes to products and processes provided that they result in significant improvements of existing technologies, with a 20% reimbursement of admissible expenses, plus a 50% as subsidized loan

In 2012 the Italian government introduced also plans to create and support the so called Cluster Tecnologici Nazionali (National Technological Clusters), aggregation of industries, universities, research centres, regional technological districts and other entities, in a limited numbers of areas considered strategic, like smart communities technologies or aerospace.

For underdeveloped Italian regions (Calabria, Campania, Puglia and Sicilia) a specific action has been created, called Programma Operativo Nazionale Ricerca e Competitività 2007-2013 (PON). It is meant to promote initiatives and fund projects (with national and EU FESR fundings) for scientific research, competiveness and industrial innovation.

Further information on Industria 2015 Programme can be found at: http://www.sviluppoeconomico.gov.it/.

4.3.2 *Regione Lombardia*

The regional governments, especially in regions with larger industrial vocation, like Lombardia or Emilia Romagna, have specific programs to foster technological innovation especially in SMEs.

The actions include different support instruments, either direct or indirect.

In 2012, in analogy with the national initiatives, the so-called “meta-distretti” were fostered and funded through specific calls. They are temporary aggregations of industries, SMEs and large companies, and research centres. Each typology of entity has a determined maximum representation percentage in funded projects. Seven economically strategic areas like fashion or design have been chosen.

Lombardia has specific calls to provide funds (“Voucher ricerca e innovazione”) to support SMEs in their innovation projects, including obtaining new patents, introducing new highly technological skilled personnel, obtaining consultancies from universities and research centres, including HPC facilities.

An indirect form of support is the LISA (Laboratory of Advanced Interdisciplinary Simulation) initiative, where the CINECA Milan site has been funded to provide support and training to researchers belonging to regional universities and research centres in research projects of industrial relevance. The aim is to provide specialized training in advanced simulation techniques for graduate students in order to bring these competences later on in regional industries and to provide advancements in specific R&D projects in specific areas considered strategic for the regional development. The initiative was recently renewed up to 2014.

Some of these initiatives are co-funded with other national or local organizations. The Lombardy Chamber of Commerce, for example, provide part of the fundings for the

innovation vouchers given by the Regional Government, and provides specific grants to foster new digital technologies and IT processes in SMEs.

Further information on Regione Lombardia initiatives can be found at: http://www.regione.lombardia.it/.

4.4 Sweden: Myfab

Myfab is the Swedish national research infrastructure for micro and nano fabrication. It provides academic and industrial researchers clean-room facilities and more than 500 instruments for fabrication and characterization, along with highly qualified staff for support and training.

The Myfab network was established by Chalmers, KTH (Kungliga Tekniska högskolan) and Uppsala University in 2004 in order to achieve networking benefits for researchers and companies on a national and international level. The motivation for Myfab was to avoid duplication of expensive equipment, to provide local and open access to the whole network, to apply harmonized user fees, instrument classes as well as back-up standard processes enabling cross-disciplinary synergies. Myfab is recognized today as a national research infrastructure by the Scientific Council (VR), and as such, also mentioned as important for the strategic efforts launched by the Swedish government in the fields of Material Science, Nanoscience and Information and Communication Technology (ICT).

More than 130 companies used the network during the past years. The resources within the network are assessed through its own Laboratory Information Management System (LIMS) where more than 500 tools are made available.

Support to SMEs is provided through subsidized fees (including access fees, equipment fees and staff support fees). Micro-companies in their first two years pay rates 30% lower than other companies.

In 2012 a new program was introduced offering free access to the laboratory facilities for SMEs not having any previous experience of micro-nanofabrication at Myfab.

Access is granted depending on the evaluation of the SME proposal, including both equipment usage for fabrication and analysis, as well as training services from site staff, and scientific support. The user's travel expenses and accommodation costs associated with visits are also covered. Inexperienced users are trained in clean-room work, clean-room safety and clean-room technologies, to operate both basic and advanced equipment for fabrication and analysis. To facilitate proposals submission, the handling of the project proposal is maintained simple, easy and fast. The proposals are evaluated by the Myfab Access Selection Panel, always within 4 weeks. It is required that the outcome of the proposed work should be scientifically motivated or expected to have a significant value for non-academic users.

Further information on Myfab can be found at: http://www.myfab.se/.

4.5 Initiatives in Ireland

4.5.1 *The Tyndall National Institute*

The Tyndall National Institute, University College Cork, located in the south west of Ireland is a leading national research centre which specializes in semiconductor research. Having approximately 420 personnel comprising of staff, students and visiting industrial researchers it is perhaps Ireland's largest topic specific research centre.

Tyndall is focused on research with applications in ICT. In addition to supporting related academic activity at a national level it also supports industrial activity at all levels from MNC to SME.

The objective of the programme is the creation of new IP which may reside with the institute or the industrial partner depending on the terms of individual contracts.

It should be noted that the production of graduate students with highly relevant training is also a significant support, in particular, to the fabrication industry in Ireland where both Intel and Analog Devices operate large-scale fabrication facilities. Furthermore multi-national corporations which are considering establishing an Irish or European operation can work with together with Tyndall and the IDA, the state's industrial development authority, to identify research partners and programmes that are suited to Ireland and then avail of administrative and technical support.

The programme is administered by the Tyndall Institute itself. The centre's mandated to run the programme comes from the state in that it receives on-going funding from national funding agencies to support aspects of its activities primarily concerned with academia. The state is also represented on the governing board.

Its unique nature is also a de-facto mandate as the provision of the research infrastructure concerned is extremely costly ((€150M invested to end of 2011 in infrastructure and equipment), as such it is the only such facility of its scale in Ireland outside of the private sector.

Services are provided by Tyndall staff on a contract basis and are charged at commercial rates. In Contract Research engagements, whereby researchers are contracted to work on industry problems, resulting IP is normally exclusively licensed to the given commercial partner. Industry is also supported through the delivery of licensed IP, which has been developed in-house, on a commercial basis. It is noted that this requires careful management to ensure technology ownership is protected and licensing is straightforward for industry clients. Typical 4 technology licenses are issued per year.

Tyndall's academic research is financed in the normal academic fashion through state funding agencies and external programmes e.g. FP7 projects.

Projects may typically last several months to 1-2 years.

In the programme there are no specific outcomes aside from those which might be set out as part of the terms of contracts governing the engagement e.g. payment, IP ownership etc. As previously mentioned the production of trained students is also an important outcome.

Tyndall has over 200 industry partnerships and customers worldwide and income for 2010 was in excess of €33M.

Tyndall provides a wide range of services to industry and in particular to the SME sector which may not otherwise have access to costly equipment.

While the exact services provided vary by client requirements by and large they are in the following areas:

- Design Technology Evaluation
- Modelling
- IC Design
- Wafer Fabrication
- Packaging And Assembly Technologies.
- Environmental Reliability Testing
- Analysis & Reverse Engineering of Electronic Assemblies.

- Test and Measurement
- FIB Re-Engineering & Failure Analysis
- IP Investigation

Tyndall provides support to start-ups through access to facilities and personnel whether this is a 'spin-in' or 'spin-out' scenario. 5 start-ups have been formed based on Tyndall technology. Furthermore industrial staff who is suitably trained can work directly with equipment at Tyndall. In 2011 15 industry researchers were based in Tyndall.

Tyndall operates under a governing board comprised of 6 members drawn from industry, 2 from government departments and 3 from academy in addition to its chairman. The operation of the overall programme is overseen by this board.

There is no prescribed limit on companies using the services of Tyndall repeatedly.

Further information on the Tyndall National Institute can be found at: https://www.tyndall.ie/

4.5.2 *ICRIN*

The Irish Clinical Research Infrastructure Network (ICRIN) is the national coordinating body bringing together the clinical expertise and capacity to facilitate the conduct of multi-centre clinical research and clinical trials across a wide range of diseases. In Ireland, ICRIN's mission is primarily to support investigator-led trials but it also facilitates industry-led trials, particularly those involving SMEs and start-up companies.

ICRIN is the national source of expertise and training in the clinical and translational research environment and it ensures fit for purpose, processes and training. ICRIN also supports the existing and emerging Clinical Research Centres in Dublin, Cork and Galway that form regional hubs of clinical support within the universities and affiliated hospitals. ICRINs industry-facing role includes advice and consultation on navigating the research processes and effective engagement with the Irish research system. ICRIN is Ireland's representative in the European Clinical Research Infrastructures Network (ECRIN) and maintains up to date knowledge of European and other international research requirements for Irish researchers who wish to perform activities internationally.

ICRIN was established in 2006 by five academic partners (NUI Galway, RCSI, TCD, UCC, UCD) and its preparation phase is funded by the Health Research Board and the Health Service Executive. It operates as a business unit of Molecular Medicine Ireland.

Its role include promoting Ireland as a location for clinical trials for multinational pharmaceutical, biotech, medical device companies offering a one stop shop for Clinical research in Ireland. Furthermore, ICRIN provides clinical research training activities targeted to personnel of SMEs and Pharmaceutical Industries. The seminars and training events provided in 2011 are reported below:

- Seminars on hospital approval process for clinical trials (70 attendees)
- Insurance and indemnity provisions for medical device clinical investigations (50 attendees).
- Clinical research (60 attendees).
- Ireland as a location for medical device clinical investigations (80 attendees).

ICRIN has a successful "Good Clinical Practice" training programme with over 350 researchers trained up to the end of 2011.

Since 2009, Enterprise Ireland (state SME funding agency) has funded a Clinical Trials Liaison Officer (CTLO) in addition to ICRIN's services. The CTLO facilitates the

development of processes, knowledge and awareness of clinical research and resources among indigenous and multi-national pharmaceutical, medical device and diagnostic companies to enable them to bring their products to market. To the end of 2011, the CTLO engaged with over 250 companies, researchers and service providers broken down as follows:

- 52 research projects
- 38 high potential start-up companies
- 26 pre-start-up companies
- 45 established companies
- 15 multinational companies
- 72 clinical service providers.

The CTLO also provides support to companies considering establishing in Ireland.

Further information on ICRIN can be found at http://www.molecularmedicineireland.ie/icrin.

4.6 Singapore: SPRING

SPRING Singapore is an agency under the Ministry of Trade and Industry responsible for helping Singapore enterprises grow and building trust in Singapore products and services. As the enterprise development agency, SPRING works with partners to help enterprises in financing, capability and management development, technology and innovation, and access to markets. As the national standards and accreditation body, SPRING develops and promotes an internationally-recognised standards and quality assurance infrastructure. SPRING also oversees the safety of general consumer goods in Singapore.

To support SMEs' R&D and technological innovation process, a special programme named Technology for Enterprise Capability Upgrading (T-Up) was started in 2002. It allows SMEs to access the Singapore Agency for Science, Technology and Research (A*Star) infrastructures and expertise. Spring helps defray the cost of engaging the A*Star researchers and experts by paying 70 per cent of their salaries for up to two years. The SME also gets to retain the technology that is jointly developed with the experts, and provide continuous feedback to SPRING.
The published results show a rapid increase in the number of SMEs willing to access the Programme along the years, going from 41 in 2009 to 56 in 2010, with a target of 500 in the 2011-2016 period. According to the reports, 90 per cent of the companies were able to commercialise their inventions after the project.

Further information on SPRING can be found at http://www.spring.gov.sg.

4.7 Australia: New South Wales

The Innovation and Productivity Council is the peak body that advises the New South Wales (NSW) Government on policies and strategies related to R&D. In 2011-12 the NSW Government has made available AUD 10 million (around € 8M) to support NSW research organisations and assist them to attract funding from other sources. Over the course of the Science Leveraging Fund, it has assisted in growing the State's expertise in fields as diverse as quantum computing, capital markets, robotics, bio-technology and environmental science.

The TechVouchers Programme was established by the NSW Government to drive the culture of research collaboration between NSW small and medium enterprises (SMEs) and public sector research organisations (PSROs).

TechVouchers provides two funding streams to support business and research collaboration in NSW. They consist of:

- **TechVouchers** which provides up to AUD 15,000 (around € 12,000) for SMEs to access technical research infrastructure and expertise for building more clever, innovative and efficient practices;
- **TechVoucher Connectors** which provides financial support for PSRO's to employ 'Connectors' to better meet the research requirements of industry.

The Council also supports attendance at trade exhibitions and conferences. It also conducts significant activities to increase stakeholder engagement which includes co-ordinating advisory panels and boards, and runs a Science communications and outreach program which seeks to enhance competition and productivity in NSW by encouraging a skilled and educated workforce, with particular focus on encouraging students into mathematics, science and engineering.

Further information on NEW south Wales initiatives can be found at: http://ww3.business.nsw.gov.au/TechVouchers/home.aspx.

4.8 USA: SBIR and STTR

The United States government supports the access of SMEs to research infrastructures through two specific Programs, the Small Business Innovation Research (SBIR) and Small Business Technology Transfer Program (STTR).

The SBIR program is coordinated by the Small Business Administration, in which 2.5% of the total extramural research budgets of all federal agencies with extramural research budgets in excess of $100 million (around € 75M) are reserved for contracts or grants to small businesses. In 2010, that represented over $1Billion (around € 750M) in research funds.

The program has three main objectives

- to spur technological innovation in the small business sector;
- to meet the research and development needs of the federal government;
- to commercialize federally funded investments.

For the purposes of the SBIR program, the term "small business" is defined as a for-profit business with fewer than 500 employees, owned by one or more individuals who are citizens of, or permanent resident aliens in, the United States of America.

The SBIR program agencies award monetary grants in phases I and II of a three-phase program:http://en.wikipedia.org/wiki/Small_Business_Innovation_Research - cite_note-sba20100916-5

- Phase I, the start-up phase, makes awards of up to $150,000 (around € 110.000) for approximately 6 months support for exploration of the technical merit or feasibility of an idea or technology.
- Phase II awards grants of up to $1 million (around € 750.000) , for as many as 2 years, in order to facilitate expansion of Phase I results. Research and development work is performed and the developer evaluates the potential for commercialization. Phase II grants are awarded exclusively to Phase I award winners.
- Phase III is intended to be the time when innovation moves from the laboratory into the marketplace. No additional SBIR funds are awarded for Phase III. The small business must find funding in the private sector or other non-SBIR funding.

In 2010, the SBIR program across 11 federal agencies provided over $2 Billion (around € 1.5 Billion) in grants and contracts to small U.S. businesses for research in innovation leading to commercialization. The company owns the intellectual property and all commercialization rights. Companies such as Symantec, Qualcomm, DaVinci and iRobot were started with R&D funding from this program.

The STTR program uses a similar approach to expand public/private sector partnerships between small businesses and non-profit U.S. research institutions, and is funded at present at .3% of the relevant agencies' extramural research budgets. In 2010 that amounted to over $100 Million (around € 75M). The key difference between the two programs is in the structure of the effort, whereas in SBIR research institution partners are encouraged, in STTR a small business must partner (via a subcontract) to a university or non-profit research institution in order to acquire federal funding.

Further information on the SBIR and STTR Programmes can be found at: http://www.sbir.gov/

4.9 Analysis of the initiatives

As we can see from the examples above, national or local governments worldwide are widely supporting innovation processes of industries, in a variety of ways and approaches, often funding directly the access of industries to large research infrastructures. A synthesis of the different offers is reported in Table 2.

Country	Entity or initiative	Grants	Subsidized loans or fees	Training	Academic know-how transfer	Notes
EU	ESRF	YES (open R&D only)			YES (cofunded PhD)	
	EMBL-EBI			YES (tailored for SMEs)		services in collaboration with EPO
Italy	Industria 2015	YES	YES		YES (sponsorship of public-academic clusters)	
	Regione Lombardia	YES		YES	YES (financing specialized training)	
Sweden	Myfab	YES	YES	YES (together with grants)		
Ireland	Tyndall National Institute			YES	YES	
	ICRIN			YES	YES	
Singapore	SPRING		YES		YES	
Australia	New South Wales	YES			YES	
USA	SBIR and STTR	YES			YES	

Table 2: Synthesis of industry support models offered by non HPC Research Infrastructures.

A subset of these initiatives has the aim to try to lower the entry barriers for SMEs like the access to research infrastructures, the lack of investment funds and the lack of expertise to fully benefit from the access are tackled in a number of ways.

Fees are subsidized either directly, providing grants to the industries for their R&D projects, or indirectly, financing research infrastructures which in turn offer special rates for SMEs or start-ups. The Italian government is also trying to lower the barrier supporting partnerships among SMEs or between SMEs and large industries to create teams having sufficient “critical mass” to fully benefit from accessing research infrastructures.

Advanced training and raising technological awareness is a step considered as fundamental in practically each of the analysed programmes. It is usually accomplished with courses or workshops, in some cases directly targeting SMEs. Of particular interest is the EMBL-EBI example, where the SMEs workshops are developed in joint collaboration with the European Patent Office, an example that may be worthwhile to export to HPC. In other case, notably in Singapore, researchers are temporarily detached from Universities or Research Centers to work inside the industries with salaries subsidized by the funding entity. The result is two-fold: expertise in R&D is introduced in the industry, with training-on-the-job to SME employees, and at the same time a better understanding of industrial needs is introduced in the academia, helping to shape university courses and lectures.

5 Analysis of the current needs of industry

From the experience gathered so far, it becomes clear that the requirements of the European industries and SMEs, in the process of adopting HPC access and services, are very diverse and are related not only to the size of the companies (i.e. large companies vs. SMEs) but also to the expertise existing within the companies themselves.

In the following we try to synthesize and clusterise in main points the HPC needs from the industries, with a specific focus on SMEs,

This material is based on D5.2.1 'Requirements of Industrial Users' published in December 2011, [4], with the addition of further research carried out by the work package team during contacts with industrial users and integrated with the synthesis of the information gathered from the initiatives presented in the previous sections.

The needs of European industrial SMEs in the process of adopting HPC fall into the following categories:

- **Raising Awareness**, i.e. Most of the time, SMEs are not aware about the potential of HPC for increasing their competitiveness, companies are more focused on short term business milestones and do not have internal skills. In this case SMEs require information about the HPC ecosystem (including technology watch) and access to training and consulting services on the general possibilities provided by HPC.
- **Coaching and expertise**, i.e. Assistance in understanding how a HPC solution can be implemented in an SME's business environment and provide a tangible return on investment. Such expertise could be provided by domain science experts or HPC and numerical simulation experts, able to co-elaborate with the company an industrial project to be demonstrated for providing to the SME a clear view on the expected ROI by using HPC.
- **Trying-out**, i.e. The possibility of 'trying out' a HPC solution without committing to extensive investment in order to lower the entry cost to such technologies. Proof-of-concept on an HPC centre can be useful to assess the possible ROI in using HPC.
- **Open Research and Development Access** to HPC resources: SMEs are lacking skills in science domain, numerical simulation and HPC. Such efforts could be leveraged by fostering technological transfer between academia and industry and using public funded research infrastructures (like PRACE) through Open R&D business models.
- **Commercial on-demand Access** to HPC resources: after having demonstrated through a concrete industrial project a clear vision of the ROI of using HPC in their daily business, companies will either invest in their own HPC facilities or access to remote HPC Cloud Services for their commercial activity.

All these categories are recommended to PRACE to be included in an effective implementation of the Integrated Access Programme for Industry and SMEs.

6 Conclusions

The importance of computational methods and simulation through HPC are well understood as being crucial instruments to push technological innovation, enhance the products, reduce time to market and increase the competitiveness of the industries at worldwide level.

Some industries (mainly big companies) have aggressive HPC infrastructures and adopt HPC methodologies in the production cycle experimenting to achieve a rapid return of investment (ROI). In other cases, especially for the SMEs, this process runs more slowly, and in many cases it is missing at all advantages and the potential benefits are totally unknown.

Since the beginning, PRACE had an important role to push HPC toward industries: The successful series of the PRACE industrial seminars, the Open R&D industrial pilots launched in PRACE-1IP [5], the adoption of specific actions to petascale codes of industrial interest and to support emerging opportunities for industry in PRACE-2IP [6] are just some examples of the PRACE activity toward European Industries.

In PRACE-3IP a new important activity toward such industries has been issued with the objective to design and pilot an IAP, an effective and integrated set of high-level services aiming at addressing the specific HPC needs of industrial users and SMEs in particular.

This Deliverable reports the results of the analysis of the models and the best practices for access programmes for industrial users and will serve as a basis for the effective design of the IAP, and for the implementation of a IAP pilot, planned for the mid half of 2013.

So far the only business models for industrial users, admitted by PRACE, is the Open R&D HPC resources access. An analysis of the constraints and the problems (legal and financial) has been addressed to evaluate if PRACE can provide also a Pre-competitive R&D offer. This offer should be of great interest for European industries and especially for SMEs users, to enable large scale simulations without specific investments, enabling the commercialisation of the products and reducing the time to market.

An analysis of the different industry support models offered by HPC infrastructures and by non HPC research infrastructures, in Europe and other areas has been accomplished. In many case local governments world-wide are supporting the innovation processes of industries, for the HPC access and for other innovation instruments. The supports occurs in a variety of ways and approaches, but it is worth noting in particular the effort to lower the entry barriers for SMEs, to reach HPC infrastructures, mainly due to lack of investment funds and lack of expertise and knowledge to fully benefit from the access.

Another aspect of fundamental importance highlighted from the analysis of the industrial support models is the importance of training programs, specific for the industrial users, and instruments to raise the technological awareness of HPC methodologies.

The analysis of the different industry support models, together with the previous experience gained in PRACE-1IP, the contacts with the industrial users at the industrial seminars and through surveys issued by HPC centres, has permitted to identify the main needs of industry in terms of HPC access programme. These needs span from raising awareness to coaching, from training and information to trying out HPC solutions to open research and development access to HPC infrastructure. These needs are the main ingredients to set up an effective IAP for HPC Access for Industry and SMEs users.