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EXDCI

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Final methodology and monitoring tool-set

Final

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Authorship	**Edited by:**	Guy Lonsdale, SCAPOS
	Contributors:	Jean-Philippe Nominé, ETP4HPC Maike Gilliot, ETP4HPC Valeria Bartsch, Fraunhofer/ITWM Kai Kruger, Fraunhofer/ITWM Franz-Josef Pfreundt, Fraunhofer/ITWM Guy Lonsdale, SCAPOS
	Reviewed by:	Inigo Yenes, PRACE aisbl Oriol Pineda, BSC
	Approved by:	MB/TB

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References and Applicable Documents

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[14] EXDCI WP7 deliverable D7.2 "First release of the HPC Ecosystem Balanced Scorecard", June 2017

List of Acronyms and Abbreviations

BSC	Balanced Scorecard
CoE	Centres of Excellence (for Computing Applications)
CSA	Coordination and Support Action
cPPP	contractual Public Private Partnership
DX.Y	Deliverable Number X.Y (Number Y of Work Package X)
EC	European Commission
EU	European Union
EXDCI	European eXtreme Data and Computing Initiative
FET	Future and Emerging Technologies
FET-HPC	HPC component of FET programme in H2020
FP7	Framework Programme 7
H2020	Horizon 2020 – The EC Research and Innovation Programme in Europe following FP7
HPC	High Performance Computing
ISV	Independent Software Vendor
KPI	Key Performance Indicator
R&D	Research and Development
R&I	Research and Innovation
SRA	Strategic Research Agenda
WP	Work Package

Executive Summary

This report comprises the EXDCI Project Month 25 deliverable D7.3 "Final methodology and monitoring tool-set". EXDCI WP7 addresses impact monitoring of the H2020 R&I activities linked to the HPC contractual Public Private Partnership strategy: focusing on the development on monitoring methodology and corresponding tools, it also operates the HPC Ecosystem Balanced Scorecard – a central component of the developed methodology that underpins the design of the monitoring tools developed in WP7 - in order to gather and issue data for the monitoring requirements of the HPC contractual Public Private Partnership.

Deliverable D7.1 reported on the motivation for the initial methodology and tool-set and on its realisation. This deliverable explains how lessons learned with execution of the balanced scorecard in WP7 Task 7.2 were used to optimise the tool-set, the core methodology being maintained. A reiteration of the background and balanced scorecard approach and the alignment with the pre-existing progress monitoring guidelines of the HPC contractual Public Private Partnership is performed. The tools used to gather the data for the 2016 HPC contractual Public Private Partnership report and to be used in the final project period, which should contribute to the future contractual Public Private Partnership reports, are commented.

1   Introduction

The purpose of EXDCI WP7 is to generate and gather data and create the necessary analysis tools to support informed decision-making in relation to the development of the European HPC Ecosystem and the impact of the R&I activities linked to the HPC cPPP (contractual Public Private Partnership) strategy [1]. The work package comprises two tasks, which are aligned with the two central objectives of WP7: providing a set of methodologies and processes to be used in the measurement of Ecosystem development and progress; perform the periodic monitoring of the implementation of the HPC cPPP strategy. The two tasks are:

- Task 7.1: Methodology and establishing data capture procedures and tools
- Task 7.2: Data capture and analysis

This report comprises the final deliverable from Task 7.1 and addresses the methodology and tool-set for data gathering. A key component of the approach taken in EXDCI WP7 is the use of the balanced scorecard concept (which will be summarised/re-iterated in Section 2.1). Task 7.1 delivers the guidelines for the operation of an HPC Ecosystem Balanced Scorecard, which is operated in Task 7.2 to monitor the development of the European HPC ecosystem and the impact of the actions relating to the HPC cPPP. The output of that monitoring flows into the regular cPPP meetings, the annual cPPP reports and into the mid-term assessment of the HPC cPPP in 2017.
The close interaction between EXDCI WP7 and the reporting and monitoring activities within the HPC cPPP ensures on the one hand that the WP7 outputs will have a clear impact. On the other hand, it also means that WP7 cannot operate in isolation and without boundary conditions. Thus, we will see that the development of the HPC Ecosystem Balanced Scorecard has been guided by the pre-existing cPPP KPIs that were defined during the process of establishing the HPC cPPP.

Section 2 of this report summarises the balanced scorecard concept and the alignment of its key perspectives with the pre-existing cPPP KPIs (Key Performance Indicators, detailed in Annex 1 to this report). Section 3 reports on the final tool-set arising from the selected methodology, covering surveys developed (included in Annexes 2 and 3) and data sources selected and employed. These tools were used for the Task 7.2 activities that led to the WP7 deliverable D7.2 [14], which covers the HPC Ecosystem Balanced Scorecard operation,
It also provides feedback on the initial operation, linked to data provision for the 2016 HPC cPPP report. Section 4 provides concluding remarks.

2 Methodology Background

This Section provides an overview of the methodology used within EXDCI WP7 and repeats in summarised form, and for the convenience of the reader (making the report as self-contained as possible), information contained in WP7 deliverable D7.1 [13] and in the introduction of deliverable D7.2 [14], regarding the initial methodology setup and its first deployment.

The central methodology of using the HPC Ecosystem Balanced Scorecard to generate perspectives associated with key performance indicators **has not been changed** in the second project period. Maintaining the methodology, we have used the experience in the initial operation (execution of surveys and analysis of the results) to adapt and extend the tools to be used, which will be described in Section 3.

2.1 Balanced scorecard concept

The balanced scorecard (BSC) [2] is a widely-used strategic planning and management system that provides decision makers (in business: executives and managers) a performance measurement framework with a balanced view of organisational performance. That balance is achieved by going beyond pure financial metrics to include strategic, non-financial performance measures. Within the BSC process, perspectives are identified and goals are assigned to each of those perspectives to ensure that the overall organisational strategy can be monitored and assessed – via the continuous use of the BSC. In the EXDCI context, that continuous use is the operation of the BSC within Task 7.2. Prior studies [3] have also highlighted the need for adaptation of perspectives when using the BSC concept for monitoring and analysis tasks for non-profit organisations, and indeed the specific needs of the European HPC ecosystem have been taken into account as discussed below.

2.2 The HPC Ecosystem BSC

The adoption of the BSC concept was realised through an alignment of the perspectives, and subsequently goals and KPIs per perspective, with the purposes of EXDCI and its input for the HPC cPPP. The European HPC Ecosystem BSC thus created should support informed decision-making in relation to the development of the European HPC Ecosystem and the impact of the R&I activities on the HPC cPPP strategy.

Important driving factors are the activities of the projects funded under the H2020 HPC Program [4] – the FET-HPC Projects and Centres of Excellence – and the visions and strategies developed in the ETP4HPC Strategic Research Agenda [5], which links to the multi-annual roadmap of the HPC cPPP. The perspectives selected are Industrial Competitiveness & Socio-Economy Impact, Operational Aspects of the Programme and Management Aspect of the Programme, which aligns with the categorisation of the set of KPIs (included in the Annex to the report, Section 5.1) contained in the HPC cPPP performance and impact monitoring guidelines, defined during its establishment.

The goals per BSC perspective presented in Table 1, the KPIs (and sub-KPIs) in Table 2.

Perspective	Goal
Industrial Competitiveness and Socio-Economy Impact	• Increase market share • Create innovation environment in HPC (exploited patents and standards) • Increase employment • Support growth of SMEs
Operational aspects of the programme	• Effective research programme and coverage • Develop performance of HPC technologies • Provide education, training, skills development • Increase use of HPC • Develop a HPC software ecosystem • Generate patent, inventions and contributions to standards
Management aspects of the programme	• Dissemination and Awareness • Effective execution

Table 1: Perspectives and Goals of the BSC

	Perspective	Key Performance Indicator (KPI)
1	Industrial Competitiveness and Socio-Economy Impact	Global market share of European HPC
2	Industrial Competitiveness and Socio-Economy Impact	HPC additional investments
3	Industrial Competitiveness and Socio-Economy Impact	Jobs
4	Industrial Competitiveness and Socio-Economy Impact	Innovation Environment in HPC - European HPC start-ups - Number of new SME start-up companies created out of HPC research programmes in the PPP - Unsuccessful HPC start-ups - Growth of existing European HPC start-ups
5	Operational aspects of the programme	Research programme effectiveness and coverage - Coverage of the R&I roadmap by calls topics - Number of co-ordinated calls launched - Number of responses to calls - Number of active research projects - Geographical coverage of project participation - Additional leverage and Impact in other related programmes (e.g. areas such as nano-electronics, photonics, microelectronics, software, storage in other parts of Horizon2020
6	Operational aspects of the programme	Performance of HPC technologies developed - Cost per petaflop/s - Cost of ownership (power, space, operation-manpower) - Percentage of HPC systems with at least 30% of European engineered componentry inside (in Europe and worldwide) - Number of European systems in Top500 and Green 500 - Range of architectures available in Europe - Number of new prototypes made available per year via the PPP

7	Operational aspects of the programme	People, education, training and skills development • Statistics on number of days of training delivered, range of nationalities and countries of work of course attendees, gender balance of training participants • Origin of training participants: SME, large company, academia (graduate, post-graduate, engineers, developers) • New curricula and trainings created • Quality and pertinence of the trainings through feedback on evaluation forms • Number of infrastructure operators jobs in relation to the Programme • Increase of the graduate/postgraduate, PhD and post-doctoral positions related to HPC subjects, including, but not limited to, those directly related to the PPP stakeholders projects
8	Operational aspects of the programme	HPC use • Growth in investment in HPC systems; • Growth in the use of external HPC services by SMEs; • Growth in the availability of application software on HPC systems • Publications crediting the use of the HPC resources (number, citation indicators, ranking of journals, etc.) • European research communities using HPC (at Tier-2, Tier-1 and Tier-0 levels) • Organisation and participation in multi-disciplinary or cross-disciplinary activities (e.g. number of workshops organised and number of participants) • Size and number of structured communities in HPC applications engaging with the PPP (disciplinary and multidisciplinary) Co-design initiatives
9	Operational aspects of the programme	HPC Software ecosystem • Development of next-generation software codes, libraries and algorithms. • Number of application software adapted to work with the next generation of machines • Usage of European developed codes, algorithms and libraries • Number of European codes benefiting from PPP results: open source applications, system software, ISV codes, etc. • Increase in user base of European codes New tools of world-class interest for the research and industry communities (e.g. measured by increase in market share of tools of European origin)

10	Operational aspects of the programme	Patent, inventions and contributions to standards in HPC by H2020 funded project
11	Management aspects of the programme	Efficiency, openness and transparency of the PPP Consultation Process • number of participants contributing to the strategy and implementation workshops • Analysis of ETP4HPC members Monitoring of the decision making process during the consultation
12	Management aspects of the programme	Dissemination and Awareness

Table 2: Key Performance Indicators for the HPC Ecosystem BSC

3   Methodology elements and tools

With the BSC defined as discussed above, data sources, data capture tools and subsequent analysis approaches (to map from raw data to appropriate ecosystem estimates or indicators) are required to address the specific KPIs − which remain the same.

In the second project period, WP7 has adapted and extended the tool-set reported on in deliverable D7.1 [13] with a particular focus on:

- Improvements to the survey amongst ETP4HPC members (reacting to feedback received during the previous survey execution); this survey is performed annually.

- The organisation of an investigation by the external commercial analysts Hyperion Research (formerly IDC); this was a pilot study which brought promising insight and extra precision on some socio-economic aspects; how to make this approach sustainable is an open question.

These were supplemented by existing surveys (for example, the EXDCI survey issued in 2016 to the H2020 projects falling under the umbrella of the HPC cPPP, namely the FETHPC projects, the Centres of Excellence and in addition, the FP7 Exa-scale technology projects) and data sources. An overview of the data sources and their use for each specific KPI is given in Table 3. Figure 1 provides an overview of the surveys performed.

			KPI data sources					
	KPI	**Key Performance Indicator (KPI)**	EXDCI survey	ETPHPC Surveys and activity report	PRACE KPIs	EC H2020 stats	Analysts' study	Public sources Web etc.
Industrial Competitiveness and Socio-Economy Impact	**1**	Global market share of European HPC					***	*
	2	HPC additional investments		**			**	
	3	Jobs		**			**	
	4	Innovation Environment in HPC: start-ups…	**	**			**	*
Operational aspects of the programme	**5**	Research programme effectiveness and coverage: H2020 calls….				***		
	6	Performance of HPC technologies developed	*	*				**
	7	People, education, training and skills development			**			
	8	HPC use	*		**			
	9	HPC Software ecosystem	**		**			*
	10	Patent, inventions and contributions to standards in HPC by H2020 funded project	*	**			**	
Management aspects of the programme	**11**	Efficiency, openness and transparency of the PPP Consultation Process				***		
	12	Dissemination and Awareness	**	**	**			

	Not a data source
*	Complementary source
**	Important source
***	Main source

Table 3: Key Performance Indicators data sources
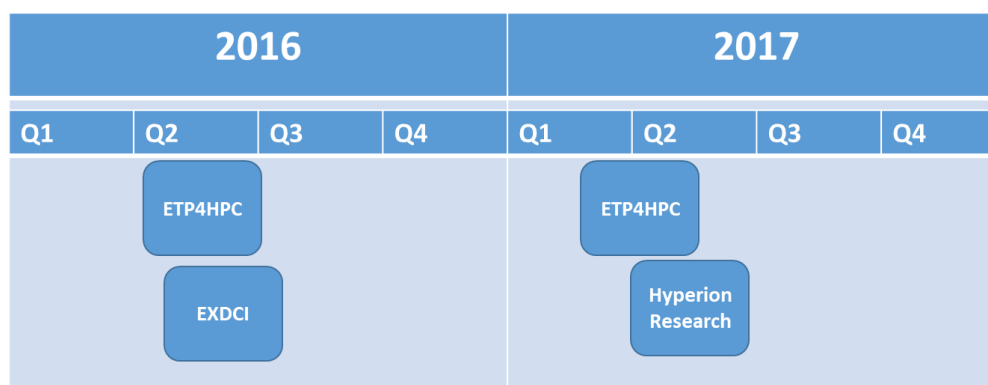
Figure 1: The schedule of WP7 surveys performed to date

The following external data sources were used for the results summarised in D7.2 [14] and developed in the 2016 HPC cPPP annual progress report:

- European Commission/DG CONNECT H2020 data and statistics relating to the prior open calls and projects selected [4, 7, 8] – updated with information relating to the results of completed calls for each cPPP annual report;
- the IDC report on HPC in the EU [6];
- PRACE documents relating to its KPIs [9, 10] – updated annually;
- other publicly available reports or web-sources, such as, but not limited to, the Top500 and Green500 lists – updated twice a year.

In addition, certain KPIs are addressed, or also addressed, by specific collaboration between the European Commission and ETP4HPC in the context of the operation of the HPC cPPP, through Partnership Board discussions or in the joint preparation of the HPC cPPP annual report.

More details on the surveys and investigations are provided in the subsequent subsections along with an explanation of the contributions to each of the HPC Ecosystem BSC perspectives.

3.1   Survey for ETP4HPC Membership

This section summarises the format used for the recurring annual survey amongst ETP4HPC members, and explains improvements made as a result of the lessons learned from the execution of the survey. The complete survey can be found in the Annex contained in Section 5.2.

As in the initial tool-set, the survey amongst the ETP4HPC membership plays a key role in addressing, in particular, KPIs linked to economic impact. The membership covers a good selection of strategic players in the European HPC Ecosystem (at the time of writing, the ETP4HPC membership includes 82 organisations in total).

The output from the survey is a collection of data covering:

- The number of patents held.
- Involvement in standard bodies.
- Number of jobs created and head count.
- Numbers on research funding (plus percentage of budget from nationally funded and EC-funded projects).
- Acquisition of SMEs / creation of spin-offs.

The tool and approach were maintained (a web-based approach, the survey being built with the survey tool LimeSurvey [11]).

The coverage and contents of the survey thus remained basically the same, but the formulation of questions and "user flow" improved based on feedback received from ETP4HPC members who participated in the 2015 & 2016 surveys. The most recent operation was in Q1 2017, leading to the results included in WP7 deliverable D7.2 [14].

Data for the years 2015 and 2016 were generated by surveys performed in Spring 2016 and Spring 2017, respectively. For the second survey, measures to increase the level of participation were introduced as a result of an analysis of the responses (including partial responses) received through the first survey. In addition, direct contact was made to a number of member representatives. The key aspects and changes were as follows.

- The issue of sensitivity of business-relevant information that is requested by the survey remains a critical issue. Participants were again re-assured that only anonymised, collated data would be disclosed in any subsequent reports (the annual cPPP report and EXDCI deliverables, such as WP7 deliverable D7.2 [14]). In addition, the provision of the organisation name was no longer necessary.

- A number of steps were taken to simplify the process of completing the questionnaire: the information on the organisation type (SME, industry, academic) was pre-filled; several questions were dropped for which the information could be found from an internet-search or had been provided in the first survey (e.g. participation in standards bodies); instead of a list of patents, only the number of patents files was requested (which data is sufficient for the survey needs).

- Based on a hypothesis (which will be tested when the data from the 2018 survey is available) that the replacement of temporary research staff generated a skew in the data (stable head-count despite reported appointments), the question on job creation was modified to ask participants to report on newly created jobs.

Despite the improvements leading to a sound and easy-to-use survey tool, return rates from the ETP4HPC membership were sub-optimal and this was one of the reasons to enhance the tool-set through the use of external analysts, discussed in Section 3.3. In this context it should be noted that the individual ETP4HPC member organisations are as members of the association (indirect) stakeholders in the HPC cPPP. The ETP4HPC association is the contractual partner of the cPPP.

3.2   EXDCI Survey for FET-HPC Projects and CoEs

The EXDCI survey (covering issues from both work packages 4 & 7) was issued to the active FET-HPC projects and e-Infrastructure HPC Centres of Excellence (CoEs) in 1H 2016 (and supplemented by interviews with project representatives in some cases). So far it has not been re-conducted: it captured some early snapshot of the first important round of FETHPC and CoE projects. For the time being only a small number of new FETHPC projects have been added to the H2020 portfolio. The questions related to such a survey are:

- Whether and how a complementary survey could and should be performed amongst the same projects at a later or final stage of their development?

- Whether and how such a new survey could and should be performed amongst new and future projects (after FETHPC 2017 and CoE 2018 projects have been selected?)

The output from the survey comprised:

- Compilation of information on the projects/CoEs training activities and plans.
- KPIs that the projects/CoEs selected to measure their impact.
- Compilation of information on technologies from the projects/CoEs with potential for technology transfer or exploitation (licensing, patent filing, creation of start-ups).
- Compilation of information on middleware / application software, next-generation software, libraries, algorithms and their status, use of HPC resources.

Given that the projects were at their half-way point (and many engaged in project review processes) during the operation of the BSC for the 2016 cPPP report it was considered inappropriate to request that projects engage in a further survey. The projects could be contacted again in the final period of EXDCI or by a follow-up Coordination and Support Action - CSA (noting that the first tranche of projects completes in September 2018, 5 months after the completion of the EXDCI project). The relevance of the survey content, as presented in WP7 deliverable D7.1 [13], for the European HPC Ecosystem BSC remains (including the identification of innovation via effective or anticipated outcomes of projects, like software development, potential patents filing, SME creation). It should be pointed out that the survey targets projects as opposed to individual organisations and does not include the types of commercially sensitive questions included in the ETP4HPC survey, discussed above.

3.3   External analysts

An external study was outsourced to Hyperion Research (the former IDC HPC Team) with the dual objectives of: obtaining direct access to global and EU-wide market data; leveraging the potential of an independent, commercial organisation – not involved in HPC cPPP-related activities or with direct HPC ecosystem business interests – to interact directly with key players in the European HPC domain. The product of the external study was a report covering:

1. Historical and forecast data based on Hyperion Research's close tracking of European spending on HPC servers, storage, software and services—and how much of this spending goes to indigenous European HPC suppliers.
2. Quantitative data and qualitative information (quotations) derived from Hyperion Research's interviews with H2020 HPC Work Program participants.
3. Quantitative data on returns associated with European investments in HPC, from a separate, ongoing worldwide study Hyperion Research is conducting for the U.S. Department of Energy.

For the second item, WP7 provided suggestions and contact details for potential interviewees (including SMEs) and interacted with Hyperion on the definition of questionnaires issued to potential participants. The questionnaires are included in the Annex contained in Section 5.3. For the contribution to the 2016 cPPP report (covered in deliverable D7.2 [14]), 9 companies were interviewed, with involvement in 12 FET-HPC (technology) projects, accounting for 26 M€ of H2020 funding and including 4 SMEs. This represents almost all the industrial funding which was granted to the private sector in FET-HPC projects in 2015.

3.4   Industrial Competitiveness and Socio-Economy impact

The primary tools used to address the perspective "Industrial Competitiveness and Socio-Economy Impact" were the ETP4HPC survey and the contract to the external analysts, Hyperion Research. That was supplemented by use of the previously existing external, public

data source (the IDC report, [6]) for KPI 1 (concerning the global market share) and also in part the feedback on innovation received via the EXDCI survey. Table 4 summarises the targeted sample and data acquisition methods.

As explained in deliverable D7.1 [13], sample sizes from the survey preclude the use of formal statistical analysis techniques to relate the survey responses to statistics on the European HPC market; KPIs 2 to 4 target concrete (single number) statistics. However, the identification of trends is possible by comparison of results from the ETP4HPC surveys addressing data from 2014 to 2016, as presented in deliverable D7.2 [14]. In addition, the Hyperion report provides qualitative feedback on the benefits of the FET-HPC programme for industrial participants.

KPI	Targeted sample	Method
1	Global & EU market data	Analysts' study, open data sources
2	H2020 Participants	ETP4HPC survey, Analysts' study
3	EU HPC eco-system	ETP4HPC survey, Analysts' study
4	European HPC communities & Eco-system	ETP4HPC & EXDCI surveys

Table 4: KPIs 1-4: Targeted samples and data capture methods

3.5   Operational Aspects of the Programme

The next 6 KPIs are connected to the BSC perspective "Operational aspects of the programme". Table 5 presents for each of the KPIs the targeted sample and data acquisition method. For this BSC perspective, we have methods covering the complete sample to be measured. The tools deployed were both EXDCI and ETP4HC surveys, use of open data sources (European Commission sources: participant portal [7] and the CORDIS database [8]; Top500 & Green500 online data), collaboration with PRACE for data exchange.

In contrast to the Industrial Competitiveness and Socio-Economy impact perspective, the responses on the operational aspects of the programme are not sensitive.

KPI	Targeted sample	Method *[A]vailability – Applicability / relevance* *[R]eliability*
5	FET-HPC projects and CoEs	Use European Commission data sources *[A] The EC operates the H2020 projects and has all data* *[R] Complete EC database*
6	European HPC systems	Use open data sources like the TOP500 and GREEN500 lists; exchanging data with PRACE *[A] Public and bi-annual xxxx500 data; important network of tier0/tier1 PRACE systems with known contacts* *[R] xxxx500 considered covering almost all research oriented systems and significant fraction of industry owned systems*
7	Training providers on HPC	Exchanging data with PRACE *[A] Since 2010 PRACE has been the main catalyser of new pan-European HPC training* *[R] PRACE has been carefully monitoring activities since 2010*
8 & 9	European HPC communities: FET-HPC projects and CoEs	Web-based survey (EXDCI survey – c.f. Section 3.2) ; exchanging data with PRACE *[A] Known group of consortia/stakeholders, FETHPC & CoEs span a significant and representative fraction of the ecosystem* *[R] Depends on answer rate and completeness of answers to surveys (direct interviews can be done to improve this but can become a huge effort)*
10	HPC organisations	Web-based survey (ETP4HPC survey – c.f. Section 3.1 & Annex 5.2) *[A] Known group of ETP4HPC members (85), a still growing very representative sample of industrials, SMEs, research organisation* *[R] Depends on answer rate of surveys*

Table 5: KPIs 5-10: Targeted samples and data capture methods

3.6   Management Aspects of the programme

The perspective on "Management aspects of the programme" includes 2 KPIs which relate to the internal management of the HPC cPPP (involving the European Commission and ETP4HPC), KPI 11, and to the dissemination activities of projects executed within the programme linked to the HPC cPPP, KPI 12. No specific tools or data acquisition methods are required of EXDCI. The HPC cPPP partners, and ETP4HPC in particular, are responsible directly for KPI 11. For KPI 12, EXDCI collaborates with the FETHPC projects and FP7 exascale projects, CoEs, as well as the EC, and PRACE, and indeed provides common information dissemination opportunities, such as the ISC exhibits and SC Birds-of-a-Feather sessions.

KPI	Targeted sample	Method
11 & 12	H2020 Participants, EU HPC ecosystems & European HPC communities: FET-HPC projects and CoEs	EC H2020 statistics; Direct information from ETP4HPC & EXDCI

Table 6: KPIs 11-12: Targeted samples and data capture methods

4   Concluding Remarks

The monitoring methodology for the HPC Ecosystems Balance Scorecard has been realised through a set of tools (two separate surveys, outsourced study to external analysts, various data sources) and the operation of the BSC has been used to provide input to the HPC cPPP annual reports for 2015 and 2016. The experiences with the operation of the BSC and feedback from survey participants has been used to drive refinements to the methodology components.

Great importance was placed on the timely and high quality reporting for the 2016 report, which inputs to the mid-term review of the HPC cPPP as a whole. At the time of writing, no feedback is available concerning that review.

In the conclusions for deliverable D7.1 [13] a number of directions for further development were identified and key aspects have been addressed in the creation of the final methodology and tool-set reported on herein:

- improvements of recurring ETP4HPC surveys based on the participants feedback;
- the use of Hyperion Research to address quantitative socio-economic KPIs and improve and complement the aforementioned ETP4HPC surveys;
- performance of a trend analysis from the HPC BSC and previously available cPPP report data.

The activities in Task 7.2 in the final project period will employ the methodology and tools described herein for the operation of HPC Ecosystems Balance Scorecard, with results reported on in the final WP7 deliverable, D7.4.

Open questions for the future are the possible deployment of new surveys addressing the FETHPC and CoE projects, at early stages of new projects development and/or at later stages of projects already interviewed in their early stages. This refers more generally to the possible strategic assessment and steering of R&D projects outcomes and their possible synergies.

For the analysis of the KPIs, it has been identified that there is a need to provide more comparative data to make sure that the context of the KPI is properly taken into account. One example of this is KPI 1 dealing with the global market share of European HPC (the contextual issue being to consider the consumption and provision of resources in Europe). This is an activity relating to the operation of the HPC Ecosystems Balance Scorecard and is planned to be covered in the final WP7 deliverable, D7.4.

5 Annexes

5.1 HPC cPPP current KPIs

Based on the Multi-Annual Roadmap of the HPC cPPP and Partnership Board discussions, the following detailed definition of HPC cPPP KPIs was validated during the cPPP Partnership Board of November 2014.

Key Performance Indicators (KPIs) for the HPC PPP

Reference:
These performance indicators are based in the section "Expected Impact" of the HPC PPP proposal (annex to the HPC PPP contractual agreement). The data strategy will use different sources of information to establish a solid basis for measurement, to validate the initial values and to stabilize the influencing factors for the measurements in the coming years. Projects selected in Horizon2020 Calls will be asked by the European Commission (EC) to provide specific additional information to the EC (units in charge of the projects) or the ETP4HPC in order to monitor specific indicators and metrics. The ETP4HPC will provide guidelines and suggest ideas on the specific information to be requested to projects. Additional data will be gathered in collaboration with PRACE, with the HPC Centres of Excellence, and other relevant initiatives (e.g. ECSEL, Photonics, etc).

The Partnership Board of the HPC PPP will be the main mechanism for dialogue to monitor the objectives of the PPP. The ETP4HPC will establish a specific working group for monitoring the KPIs ("KPI-wg"). The KPI-wg will investigate mechanisms for anonymous data collection, which is believed to be extremely important if KPI monitoring via data collection is to be effective. It has to be noted that there are issues related to the delivery of data from HPC technology organisations in general but also within the ETP4HPC membership, as many aspects can be considered to be addressing business-sensitive data. While many of the KPIs can be addressed through surveys, the success of these is related to the willingness of individual organisations to provide data and the need for anonymisation of information.

The results of the KPIs monitoring exercise need to be available for the mid-term review (June 2017) and the final review of the HPC PPP (2021) respectively. Regarding HPC market, data will be acquired amongst other sources through the study on HPC Return On Investment (ROI) carried out by the EC, (available in mid-2015). In addition, the ETP4HPC will explore different possibilities to execute some of the data collection and analysis, including two studies performed by independent 3rd parties for the mid-term and final review of the HPC PPP.

A. Indicators for Industrial Competitiveness and Socio-Economy Impact

• **KPI 1: Global market share of European HPC**
Metrics: HPC systems, components and tools based on technologies developed and built in Europe, volume (in generated income) of HPC technology exported from Europe (European HPC technology developers) to the rest of the world.
Baseline: In 2011, the global market share of Europe was 5%
Targets: Reach a global market share of at least 7.5% by 2017, and 12.5% in 2020
Data strategy: Data to be acquired from studies (EC in 2015, and two studies from ETP4HPC for the mid-term and final review in 2017 and 2021)

• **KPI 2: HPC additional investments**
Metrics: The level of high-tech investment generated by the PPP, and the additional investments leveraged in the HPC value chain; relation to the investments made into European HPC companies by private investors and venture capital funds.
Baseline: No baseline
Target: In direct R&I activities, matching the Community funding in the PPP (~700 million€ by 2020). In leveraged investments, four-fold effect in industrial effort per pubic Euro in the PPP.
Data Strategy: Data to be acquired by the ETP4HPC from the studies and companies/organisations participating in HPC research programmes and other organisations in HPC in Europe

• **KPI 3: Jobs**
Metrics: Direct, sustainable jobs out of HPC research programmes recommended by the PPP, and indirect jobs in technology companies further downstream and in end-user organisations of HPC technologies and applications
Baseline: No baseline
Target: direct jobs: 400 by 2017, and 1000 by 2020. Indirect jobs, 10000 in technology companies and 100000 in HPC end-users organisations by 2020
Data Strategy: Data to be acquired by the ETP4HPC from the studies and PPP partners and companies/organisations participating in HPC research programmes and other organisations in HPC in Europe

• **KPI 4: Innovation Environment in HPC**
Metrics:
- European HPC start-ups (not just those arising from H2020 projects)
- Number of new SME start-up companies created out of HPC research programmes in the PPP (only successful SMEs with a sustainable business)
- Unsuccessful HPC start-ups
- Growth of existing European HPC start-ups
Baseline: No baseline
Target: 4 successful new SMEs in the PPP by 2017, and 10 by 2020
Data Strategy: Data to be obtained from HPC PPP Projects funded under H2020, project final reports, participating HPC vendors, etc. The ETP4HPC will put in place a dedicated workgroup supporting and monitoring the creation of SMEs in the European HPC business.

B. Indicators for the operational aspects of the programme

• **KPI 5: Research programme effectiveness and coverage**
Metrics: quality of the research programmes launched
- Coverage of the R&I roadmap by calls topics
- Number of co-ordinated calls launched
- Number of responses to calls
- Number of active research projects
- Geographical coverage of project participation
- Additional leverage and Impact in other related programmes (e.g. areas such as nano-electronics, photonics, microelectronics, software, storage in other parts of Horizon2020
Data strategy: Data from proposals and projects to be provided by the European Commission Units in charge of the corresponding Horizon2020 Calls, and with ETP4HPC and other EC units regarding the impact in other programmes.

• **KPI 6: Performance of HPC technologies developed**
Metrics: Technological contribution of the initiative to the next generation of HPC in terms of the affordability and usability of the technologies developed in the PPP:
- Cost per petaflop/s
- Cost of ownership (power, space, operation-manpower)
- Percentage of HPC systems with at least 30% of European engineered componentry inside (in Europe and worldwide)
- Number of European systems in Top500 and Green 500
- Range of architectures available in Europe
- Number of new prototypes made available per year via the PPP
Data Strategy: Specific ETP4HPC working group.

• **KPI 7: People, education, training and skills development**
Metrics: Showing the on the European HPC knowledge base providing High-skilled HPC profiles and curricula developed in the PPP:
- Statistics on number of days of training delivered, range of nationalities and countries of work of course attendees, gender balance of training participants
- Origin of training participants: SME, large company, academia (graduate, post-graduate, engineers, developers)
- New curricula and trainings created
- Quality and pertinence of the trainings through feedback on evaluation forms
- Number of infrastructure operators jobs in relation to the Programme
- Increase of the graduate/postgraduate, PhD and post-doctoral positions related to HPC subjects, including, but not limited to, those directly related to the PPP stakeholders projects
Data Strategy: The ETP4HPC will put in place a dedicated workgroup monitoring this KPI.

• **KPI 8: HPC use**
Metrics: Use of the HPC technologies developed in academia and industry (in particular SMEs):
- Growth in investment in HPC systems;
- Growth in the use of external HPC services by SMEs;
- Growth in the availability of application software on HPC systems
- Publications crediting the use of the HPC resources (number, citation indicators, ranking of journals, etc.)
- European research communities using HPC (at Tier-2, Tier-1 and Tier-0 levels)
- Organisation and participation in multi-disciplinary or cross-disciplinary activities (e.g. number of workshops organised and number of participants)

- Size and number of structured communities in HPC applications engaging with the PPP (disciplinary and multidisciplinary)
- Co-design initiatives

Data strategy: Data to be obtained from the studies and the HPC cPPP Projects funded under H2020, PRACE and HPC Centres of Excellence.

• **KPI 9: HPC Software ecosystem**

Metrics: Impact on software ecosystem (number of applications, number of users, etc). Large scale scientific and industrial applications adapted to the next computing generation addressing key economic areas and societal challenges
- Development of next-generation software codes, libraries and algorithms.
- Number of application software adapted to work with the next generation of machines
- Usage of European developed codes, algorithms and libraries
- Number of European codes benefiting from PPP results: open source applications, system software, ISV codes, etc.
- Increase in user base of European codes
- New tools of world-class interest for the research and industry communities (e.g. measured by increase in market share of tools of European origin)

Data strategy: Data to be obtained from the HPC PPP Projects funded under H2020, PRACE and HPC Centres of Excellence.

• **KPI 10: Patent, inventions and contributions to standards in HPC by H2020 funded projects**

Metrics: Patent, direct contributions and activities leading to standardisation, and invention-submissions out of HPC research programmes recommended by the PPP
Target: 40 per year by 2017, 80 per year by 2020
Data Strategy: Data to be obtained from the HPC cPPP Projects funded under H2020

C. Indicators for management aspects of the programme

• **KPI 11: Efficiency, openness and transparency of the PPP Consultation Process**
Metrics:
- Monitoring the number of participants contributing to the strategy and implementation workshops
- Analysis of ETP4HPC members to provide evidence for representation of the HPC community
- Monitoring of the decision making process during the consultation

Data Strategy: ETP4HPC will collect and deliver this data on a bi-annual basis.

• **KPI 12: Dissemination and Awareness**
Metrics: Make HPC visible to the general public in Europe and to a broad range of stakeholders. Wide dissemination of information and tangible examples about how HPC solutions contribute to the day to day live of European citizens by using various communication channels like social media, print, video, etc. awareness and information actions held for promoting the PPP activities to a broad range of stakeholders (within and beyond the ones included in ETP4HPC) – this includes events, targeted Newsletters, social media, etc.
Data Strategy: Data to be obtained from the HPC Projects funded under H2020 and from the HPC PPP actors and other stakeholders (ETP4HPC, Centres of Excellence, PRACE, etc.), and to be collected by the European Commission units and the ETP4HPC. The ETP4HPC will be responsible for the dissemination of the information.

5.2   ETP4HPC cPPP Annual Survey 2016

The following pages provide screen-shots of the execution of the web-based survey by a research organisation. This is followed by a complete list of questions asked for all organisation types.

Introduction

General HPC R&D impact

HPC PPP KPIs (funding of R&D and jobs)

| ETP4HPC | | Resume later | Exit and clear survey | Question index ▾ |
| cPPP 2017 d | | | | |

Other HPC R&D	
Non HPC R&D with impact on HPC	
Of the entire organisation/suborganisation	

15 How many new jobs were created in your organisation/suborganisation in 2016 related to (either for or as a result of) HPC R&D activities in 2016 (New employees minus leaving employees)

ℹ Only numbers may be entered in these fields.

HPC R&D activities

entire organistion (suborganisation)

16
How many new jobs were related to H2020 HPC funding?

ℹ Only numbers may be entered in this field.

Previous   Next

ETP4HPC
cPPP 2017 d

Resume later   Exit and clear survey   Question index ▾

❓ Don't be too exact (+- 5% is enough)

19 What was the percentage budget contribution from EC funded projects (FP7 or H2020) for (please enter a number without the % sign)

ℹ Only numbers may be entered in these fields.

HPC Technology R&D

Other HPC R&D

Non HPC R&D with impact on HPC

Of the entire organisation/suborganisation

❓ Don't be too exact (+- 5% is enough)

20 What was the percentage budget contribution from nationally funded projects for (please enter a number without the %-sign)

ℹ Only numbers may be entered in these fields.

HPC Technology R&D

Other HPC R&D

Innovation focus

ETP4HPC
cPPP 2017 d

Resume later   Exit and clear survey   Question index ▾

22 Please give some details:

23
You are a research organisation:
did you (or researchers from your organisation) create any spin-off company in 2016 in the area of HPC?

○ Yes
○ No

25
You are a research organisation:
Are you (or researchers from your organisation) in the process of creating a spin-off company in the area of HPC ?

○ Yes
○ No

28
Would you be willing to take part in a more detailed interview?

○ Yes
○ No

Previous   Submit

Overview of All Questions

ETP4HPC cPPP 2017

ETP4HPC cPPP Annual Survey

HPC Public Private Partnership Performance Monitoring 2016

ETP4HPC will use the information collected through this survey as part of a report on the progress of the Contractual Public Private Partnership (PPP) for High_Performance Computing as requested by the European Commission (each PPP is expected to produce a report of this kind and we are using a template defined by the EC).

This impact assessment effort is supported by EXDCI Coordination and Support Action and we will combine outcomes of this questionnaire with other data collected within the EXDCI activities. Besides using global data, stemming from the aforementioned sources, for the cPPP Annual report and related EXDCI reports, EXDCI and ETP4HPC will provide feedback to the respondents and stakeholders.

This is a high priority request and the quality of the information included in the Report will affect the future development of the European HPC Community. While we expect all ETP4HPC members to provide accurate information, **only anonymised, collated data and statistics will be disclosed in any subsequent report** (Annual cPPP report and some EXDCI deliverables).

Do not hesitate to contact us if you have any further question regarding this questionnaire – main contact: jean–philippe@office.etp4hpc.eu

Definitions in this document:

- HPC Technolody R&D: R&D for technologies covered by the technical research priorities of the ETP4HPC SRA or related and comparable technologies.
- Other HPC R&D: R&D activities relating to the use of HPC, e.g. for modelling and simulation or data analytics applications.
- Non HPC R&D with an impact on HPC: Other R&D activities in areas other than HPC that have an impact on HPC and/oro the results of which might be used in HPC (e.g. microprocessor development that could also impact HPC systems).

We are looking for data relating to activities carried out IN EUROPE only.

This survey is an update of the one we sent last year to ETP4HPC members, regarding the 2015 period, and answers should therefore refer only to 2016 only.

By clicking **Next** you agree with this terms of conditions.

There are 18 questions in this survey

General HPC R&D impact

1 []Did you hold any patent in 2016? *

Please choose **only one** of the following:

○ Yes

○ No

2 []Please give the number patents (related to both HPC Technology R&D and Other HPC R&D) in 2016

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '1 [q11a]' (Did you hold any patent in 2016?)

Please write your answer here:

3 []How many patents were linked to the H2020 HPC funding?

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '1 [q11a]' (Did you hold any patent in 2016?)

 Only numbers may be entered in this field.

Please write your answer here:

Jobs

Job creation
4 []What was your organisation's (suborganisation's) total R&D headcount for the year 2016 for :

	total
HPC Technology R&D	
Other HPC R&D	
Non HPC R&D with impact on HPC	
Of the entire organisation/suborganisation	

5 []How many new jobs were created in your organisation/suborganisation in 2016 related to (either for or as a result of) HPC R&D activities in 2016 (New employees minus leaving employees)

Please write your answer(s) here:

HPC R&D activities

entire organistion (suborganisation)

6 []

How many new jobs were related to H2020 HPC funding?

Only numbers may be entered in this field.

Please write your answer here:

HPC PPP KPIs

Funding of R&D
7 []

What was your organisation's (suborganisation's) total R&D budget in K€ (kilo euros) for the year 2016 for :

	total
HPC Technology R&D	
Other HPC R&D	
Non HPC R&D with an impact on HPC	
Of the entire organisation/suborganisation	

Don't be too exact (+- 5% is enough)

8 []What was the percentage budget contribution from EC funded projects (FP7 or H2020) for (please enter a number without the % sign)

Please write your answer(s) here:

HPC Technology R&D

Other HPC R&D

Non HPC R&D with impact on HPC

Of the entire organisation/suborganisation

Don't be too exact (+- 5% is enough)

9 []What was the percentage budget contribution from nationally funded projects for (please enter a number without the %-sign)

Please write your answer(s) here:

HPC Technology R&D

Other HPC R&D

Non HPC R&D with an impact on HPC

Of the entire organisation/suborganisation

Don't be too exact (+- 5% is enough)

Innovation focus

10 []

You are an industrial company:

Only answer this question if the following conditions are met:
TOKEN:ATTRIBUTE_2 == "I"

Please choose **only one** of the following:

○ Did you conclude the acquisition of external technologies in 2016 (e.g. acquiring SMEs) to strengthen your HPC

offer portfolio or R&D potential ?

○ Or conversely did you cease activities in certain technology areas ?

○ No Answer

11 []Please give some details:

Only answer this question if the following conditions are met:
Your Type is and Answer was NOT 'No Answer' at question '10 [q21]' (You are an industrial company:)

Please write your answer here:

12 []

You are a research organisation:

did you (or researchers from your organisation) create any spin–off company in 2016 in the area of HPC?

Only answer this question if the following conditions are met:
TOKEN:ATTRIBUTE_2 == "R"

Please choose **only one** of the following:

○ Yes

○ No

13 []please give some more details

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '12 [q23]' (You are a research organisation: did you (or researchers from your organisation) create any spin-off company in 2016 in the area of HPC?)

Please write your answer here:

14 []

You are a research organisation:

Are you (or researchers from your organisation) in the process of creating a spin-off company in the area of HPC ?

Only answer this question if the following conditions are met:
TOKEN:ATTRIBUTE_2 == "R"

Please choose **only one** of the following:

○ Yes

○ No

15 []Please give some details:

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '14 [q25]' (P { margin-bottom: 0,21cm; direction: ltr; widows: 2; orphans: 2; }ou are a research organisation: Are you (or researchers from your organisation) in the process of creating a spin-off company in the area of HPC ? You are a research organisation: P { margin-bottom: 0,21cm; direction: ltr; widows: 2; orphans: 2; } Are you (or researchers from your organisation) in the process of creating a spin-off company in the area of HPC ?)

Please write your answer here:

16 []

You are a recently founded SME / startup (less than 3 years):

Please provide information about the date of creation and recent growth (in terms of annual turnover)

Only answer this question if the following conditions are met:
Answer was 'Yes' at question ' [q6]' (Are you a recently founded SME / startup (less than 3 years)?)

Please write your answer here:

17 []

Would you be willing to take part in a more detailed interview?

Please choose **only one** of the following:

○ Yes

○ No

18 []Please provides some contact information.

Only answer this question if the following conditions are met:
Answer was 'Yes' at question '17 [q28]' (Would you be willing to take part in a more detailed interview?)

Please write your answer here:

When the survey is finished ETP4HPC will analyse the data and prepare a report to the EC in a anonymised way, 03-31-2017 — 00:00

Submit your survey.
Thank you for completing this survey.

5.3   Hyperion Questionnaire

HYPERION RESEARCH	**The Former IDC High Performance Computing (HPC)**

APPROVED - USE

QUESTIONNAIRE FOR EXDCI ON IMPACT OF H2020 HPC PROGRAM

- This study will contribute to the HPC cPPP Annual Progress Report to the European Commission
- <u>All individual responses to questions will be kept confidentia</u>l. Only summaries/averages will be reported.

Background. An ETP4HPC & EXDCI partners team is preparing the 2017 report and asked Hyperion Research, LLC (previously IDC's HPC team) to gather information *on a confidential basis* that will be crucial for the quality and completeness of the report. With this important goal in mind, Hyperion Research was asked to contact you and some other private organizations that belong to FETHPC consortia — ETP4HPC members as well as non-members.
This action is supported by the EXDCI project funded by the European Commission under H2020.

We would greatly appreciate your cooperation in responding to these survey questions as fully as you can. As the questionnaire indicates, the EC and HPP cPPP are especially interested in any leveraging of HPC R&D funding received under Horizon Work Program 2014-2015 by participants who also provided additional R&D funding from their own resources.

The names of the Hyperion Research HPC team are Earl Joseph, Steve Conway, Bob Sorensen and Kevin Monroe. If you have questions, please contact Jean-Philippe Nominé (jean-philippe.nomine@cea.fr) or Maike Gilliot (maike.gilliot@teratec.fr).
Hyperion's main contact person for this study is Steve Conway (sconway@hyperionres.com).

Date: _____

Name: _____

Title: _____

Your Organization: _____

Phone: _____

Email: _____

General Survey Questions

Q1. Please describe the R&D project for which you received funding under the Horizon Work Program 2014-2015?

_____

_____

_____

_____

_____

_____

Q2. Which of these statements best describes the nature of the project?
- a. A new R&D direction we have never tried before
- b. An advancement of an existing R&D initiative
- c. Other (please specify):_____

If you received Horizon Work Program funding for more than one project, please answer the same question for each project.

Q3. Project 2: Which of these statements best describes the nature of the project?
- d. A new R&D direction we have never tried before
- e. An advancement of an existing R&D initiative
- f. Other (please specify): _____

Q4. Project 3: Which of these statements best describes the nature of the project?
- g. A new R&D direction we have never tried before
- h. An advancement of an existing R&D initiative
- i. Other (please specify): _____

Q5. Project 4: Which of these statements best describes the nature of the project?
- j. A new R&D direction we have never tried before
- k. An advancement of an existing R&D initiative
- l. Other (please specify): _____

Q6. How important for your research was this R&D funding? (Choose only one)
- a. Extremely important for our future
- b. Somewhat important for our future
- c. Not very important for our future

Please explain:

_____

_____

_____

_____

Q7. What was the amount of funding your company received (in euros)? €_____

Q8. What specifically did this funding help you to attempt or achieve, targeting which TRL level?

_____

_____

_____

_____

Q9. If you had not received this funding, what would you have done? (Choose only one)
- a. We would not have been pursued this R&D initiative
- b. We would have pursued this R&D initiative on a more limited basis
- c. We would have fully pursued this R&D initiative with our own funds
- d. Not sure

Q10.   What is the status of the first project for which you received Horizon Work Program funding?
   a.   Completed
   b.   Expected to be completed within 6 months
   c.   Expected to be competed in 7-12 months
   d.   Expected to be completed in 13-24 months
   e.   Ended before completion, but with important knowledge gained
   f.   Ended before completion, with little knowledge gained
   g.   Not sure/don't know

Q11.   Did your organization leverage this funding by providing additional funding from your own resources to help ensure post-project ROI after productization ? If yes, how much (in euros)?
   €_____
   _____
   _____
   _____

Q12.   In your opinion, how important is it for Government HPC R&D funding to remain available in the future under an initiative like the Horizon 2020 Work Program?
   a.   Very important
   b.   Somewhat important
   c.   Somewhat unimportant
   d.   Very unimportant
   e.   Not sure

Q13.   Do the Horizon Work Program funding help your organization to secure any patents?
   a.   Yes
   b.   No

Q14.   If yes, how many patents did the Horizon Work Program funding help your organization to secure?
   a.   One
   b.   Two
   c.   Three
   d.   More than three

Q15.   Do you have any other comments before we move on to the ROI portion of the survey?
   _____
   _____
   _____
   _____

ROI Survey Questions: For Current Projects

- Please complete this portion of the survey for one (1) ROI / Innovation success story achieved with the help of Horizon Work Program funding.
- Examples of success for a single HPC project: one research result that was published, a new discovery in your field, the creation or rendering of a single movie, the discovery of a new scientific phenomenon, the design of a new car engine, the invention of a new process, or the discovery of a method, etc.

Q1. What is the name (or title) of this project, accomplishment, or innovation?
_____

Q2. Briefly describe the project/accomplishment/innovation (including why it's important):
_____
_____
_____
_____

Q3. Which industry or sector best fits your organization?
a) Energy, Petroleum Oil and Gas
b) Chemical
   Movies
c) Pharmaceutical, & Bio
d) Financial or Economic Modeling and BI
e) Manufacturing
f) IT, Electronics and Telecommunications
g) Transportation and Logistics
h) Entertainment, Animation,
i) Government
j) Academia / University
k) Other (specify): _____

Q4. Overall, what was the primary innovation/ROI area that this project provided to your organization (please select only one):
a. ___ Helped Us Make Better Products
b. ___ Major Scientific Breakthrough
c. ___ Cost Savings
d. ___ Created A New Approach
e. ___ Discovered Something New
f. ___ Helped Society
g. ___ Supported Research Programs

Q5. Did this accomplishment generate a financial ROI or a non-financial Innovation or both?
a. ___ Financial ROI (Please complete all questions)
b. ___ Innovation only (Please skip to QUESTION 9)
c. ___ Both (Please complete all questions)

FOR PROJECTS THAT CREATE A FINANCIAL ROI AFTER THE PROJECT IS COMPLETED – Note that not all projects generate a financial ROI:

Q6. What are (or is expected to be) THE TOTAL REVENUES/SALES from this project/program/discovery after the project is/was completed? In other words what is the estimated sales revenue for the product during the entire lifetime of the product?
a. ___ €1 to €100,000
b. ___ €100,000 to €250,000
c. ___ €250,000 to €500,000
d. ___ €500,000 to €750,000
e. ___ €750,000 to €1 million
f. ___ €1 to €2.5 million
g. ___ €2.5 to €5 million
h. ___ €5 to €10 million
i. ___ €10 to €25 million
j. ___ €25 to €50 million
k. ___ €50 to €75 million
l. ___ €75 to €100 million
m. ___ €100 to €200 million
n. ___ €200 to €500 million
o. ___ €500 million to €1 billion
p. ___ Over €1 billion (How much? €_____)

Q7. What are (or will be) the TOTAL PROFITS or COST SAVINGS from this project/program/discovery after the project is completed? If the resultant product is expected to generate profits or saved costs, over the life of the product how large will be the estimated total cost savings or profits? For example, a better understanding of earthquakes that helps reduce the damage costs and saves lives has a high total cost savings:
a. ___ €1 to €100,000
i. ___ €10 to €25 million

b.	___ €100,000 to €250,000	j.	___ €25 to €50 million
c.	___ €250,000 to €500,000	k.	___ €50 to €75 million
d.	___ €500,000 to €750,000	l.	___ €75 to €100 million
e.	___ €750,000 to €1 million	m.	___ €100 to €200 million
f.	___ €1 to €2.5 million	n.	___ €200 to €500 million
g.	___ €2.5 to €5 million	o.	___ €500 million to €1 billion
h.	___ €5 to €10 million	p.	___ Over €1 billion (How much? €_____)

FOR PROJECTS THAT CREATED AN INNOVATION:

Q8. What was general category of the innovation? (Please select just one)
   a.   ___ <u>Basic Research</u>, including major discoveries and pioneering breakthroughs
   b.   ___ <u>Applied Research</u>, including incremental innovations and process improvements

Q9. How would you rate <u>the IMPORTANCE of this innovation compared with all other innovations</u> in this field over the last ten years, using a scale of 1 to 5 (<u>Please select just one</u>, with 5 being the highest). Note: for this study the importance is your opinion of how important this project is to experts in your area of research around the world:

   <u>Rating</u>
   5 ____   One of the top 2 to 3 innovations in the last decade
   4 ____   One of the top 5 innovations in the last decade
   3 ____   One of the top 10 innovations in the last decade
   2 ____   One of the top 25 innovations in the last decade
   1 ____   One of the top 50 innovations in the last decade

Q10. How would you rate <u>the IMPACT of this innovation to multiple organizations</u>, using a scale of 1 to 6 (<u>Please select just one</u>, with 6 being the highest):

   <u>Rating</u>
   6 ____   Its useful to over 50 organizations
   5 ____   It is useful to 10 to 49 organizations
   4 ____   It is useful to 6 to 10 organizations
   3 ____   It is useful to5 to 10 organizations
   2 ____   It is only useful to 1 organization
   1 ____   It is recognized ONLY by experts in the field

FOR ALL PROJECTS:

Q11. HPC INVESTMENTS -- What was the total HPC Investment for the project?
   (Note: only count or estimate the portion that was used for this project, and specifically for HPC resources -- include only the direct system costs, e.g. hardware, software, applications, interconnects, and storage used to accomplish this achievement).

a.	___ €1 to €100,000	i.	___ €10 to €25 million
b.	___ €100,000 to €250,000	j.	___ €25 to €50 million
c.	___ €250,000 to €500,000	k.	___ €50 to €75 million
d.	___ €500,000 to €750,000	l.	___ €75 to €100 million
e.	___ €750,000 to €1 million	m.	___ €100 to €200 million
f.	___ €1 to €2.5 million	n.	___ €200 to €500 million
g.	___ €2.5 to €5 million	o.	___ €500 million to €1 billion
h.	___ €5 to €10 million	p.	___ Over €1 billion (How much? €_____)

Q12. If this project/program/discovery created permanent new jobs **lasting beyond the project itself**, about how many full-time equivalent jobs were created? _____ (number of jobs created or saved)

Q13. How many years from the start of research was it before the first results appeared?
   _____ (years)

Thank you for participating in this study!