4 PUBLISHABLE SUMMARY

This section normally should not exceed 2 pages.
It shall be of suitable quality to enable direct publication by the REA. You may extract this wholly or partially from the website of the project, if suitable, but please ensure that this is set out and formatted so that it can be printed as a stand-alone paper document.
Please include:
• a summary description of the project objectives,
• a description of the work performed since the beginning of the project,
• a description of the main results achieved so far,
• the expected final results and their potential impact and use (including the socio-economic impact and the wider societal implications of the project so far).
You should update this publishable summary at the end of each reporting period.
Please include also, as appropriate, diagrams or photographs illustrating and promoting the work of the project, the project logo and relevant contact details.
Please ensure that all publishable reports submitted to the REA for publication are of a suitable quality to permit direct publication without any additional editing. By submitting the publishable reports to the REA, you are also certifying that they include no confidential material.
The address of the project public website should also be indicated, if applicable. The internet address should be active.
Attached documents: *Include where appropriate, documents containing diagrams or photographs and the project logo, illustrating and promoting the work of the project.*

EENP2 is an international Research Staff Exchange program under the Seventh Framework Programme "Marie Curie Action" to enhance scientific collaboration in the framework of particle physics between EU member states institutions and a network of Egyptian Universities. The project started on January 2013 and it is foreseen to have a duration of 48 months. The scientific objective is focused on the study of new particles production at the CERN CMS experiment in operation at Large Hadron Collider (LHC), the development of frontier particle detector technologies and the implementation of up-to-date GRID computing infrastructures. Besides its scientific scopes, EENP2 has the objectives to train young Egyptian scientists, to disseminate particle physics concepts and technologies, to reinforce the Europe-Egypt scientific collaboration. Ultimate objective is the development of an Egyptian scientific network of expertise to consolidate locally basic science research infrastructures and related technological applications.

The following table lists the institutes participating to the project.

Country	Institution	Department
Italy	Politecnico di Bari	Physics Department
France	Ecole Polytechnique	Laboratoire Leprince-Ringuet (LLR)
Egypt	Helwan University	Physics Department
Egypt	Cairo University	Computing Eng. Department
Egypt	Ain Shams University	Physics Department

Relevant information on the project organization and running, as well as links to documents and reports, can be found at the web address: ***eenp2.ba.infn.it***

EENP2 studies cover a wide range of fields, spanning from phenomenological particle physics investigation to detector and computing technologies. It is organised through different work packages (WPs).

WP1 on new particles search.
The objective is to perform reconstruction, analysis and simulation of collision events produced in CMS. The research work has been concentrated so far on the discovery of the Higgs boson. It will now also attach the study of its propriety as well as the investigation of Super Symmetric extensions of the Standard Model.

WP2 on detector development.
The objective is the study of innovate particle detectors to cope with future high background experiments. Both gaseous and silicon technologies are addressed. Emphasis has been given so far to the production of Gas Electron Multiplier (GEM) detectors and the development of a new generation of Resistive Plate Chamber (RPC) instruments. Silicon technologies will be more focused in the second part of the programme. The establishment of a gas detector laboratory in Helwan is in progress and some instrumentation have been commissioned.

WP3 on GRID computer application.
The objective is the setting up of a Mediterranean distributed computing infrastructure with connected manpower expertise to fulfil the requirement of several scientific communities. The training of expertise in Europe has allowed the start-up and the consolidation of GRID computing centres in each Egyptian university by proper installation of hardware and software resources. Preliminary computer infrastructure have been commissioned and are now running under the Egyptian supervision.

WP4 on training and dissemination.
The objective is the training of young Egyptian researchers on advanced data analysis, computing and detector technologies through their secondments to Europe and their participation to international collaborations. Dissemination of the knowledge has been pursed through proper regular meetings, general workshops and one large international school on high-energy physics.

EENP2 managed to achieve important results in terms of people exchange and training, infrastructure developments, enhancement of research capabilities of the partner institutions. In the period 2013-2014, 20 Egyptian scientists had the possibility to visit Europe and collaborate with the POLIBA and ECOLE groups on advanced research fields for a total of about 65 months. They joined advanced scientific collaborations, developing skills on data analysis, GRID technologies and detector technologies. Based on their experience, the setting up of data analysis centres, computer centres and detector laboratories was originated at the Egyptian partner institutions. In particular, HELWAN University is instrumenting a detector laboratory, while AINSHAMS University and CAIRO University are instrumenting computer GRID nodes. Those Egyptians scientist are now the seeds for further dissemination of knowledge and expertise in the country among, above all, young Ph.D and Post Doc researchers.

EENP2 was also active in promoting at management lever the collaboration among different Egyptian institutions toward a local integrated scientific organization, as well as their interface with high level European Institutions and research collaborations. Relevant is the organization of a network for high-energy physics coordinated by the Academy for Scientific Research and Technology (ASRT). Collaboration agreements with the European Organization for Nuclear Research (CERN), the Istituto Nazionale di Fisica Nucleare (INFN), the Institut National de Physique Nucléaire et de Physique des Particules (IN2P3) and the GRID computing collaboration ReCaS were also possible thanks to the support of EENP2 in establish scientists contacts.

For the following two years, EENP2 intends to further pursue these targets, by continuing the training program, finalize the mentioned infrastructures in Egypt, and support the organization of relevant dissemination events. Now is under discussion the organisation of a GRID computing school in May 2015 and the second edition of high-energy school in November 2015.

The next run of the LHC, starting in the spring of 2015, will set about answering some important questions. Its higher energy will enable the CMS experiment to probe more deeply for deviations from the Standard Model predictions, and to search for heavier Higgs bosons. It will be possible to measure directly this Higgs boson's coupling to the top quark, and to box in its possible coupling to the muon.

From the point of view of the scientific objectives for the term 2015-2016, EENP2 intends to attach the study of new Super Symmetry theories, for which a large variety of models exists. Investigating the phenomenology of some of them, which predict either new heavy particles or observable deviation from the Standard Model and comparing to the available data, is one objective of the future work.
On long term, LHC plan to increase significantly the instantaneous luminosity up to 5 10^{34} $cm^{-2}s^{-1}$ and to deliver an integrated luminosity of about 3000 fb^{-1}. The full CMS detector will require significant upgrade programs to maintain its excellent performance under these challenging conditions.
While the study of gaseous detectors will continue with tests in presence of high irradiation at the CERN Gamma Irradiation Facility (GIF), large emphasis will be given to the development of silicon detectors. Many test structures, each other different in substrate type and geometry, will be electrically characterized, before and after irradiation with neutron and protons, in terms of capacitance and resistance.

5 GENERAL PROGRESS OF THE PROJECT

Qualitative indicators of progress and success in line with work plan and milestones *(description of progress towards the milestones and deliverables)*
Attached documents: *Include where appropriate, one document containing complementary information on the work progress*

EENP2 successfully achieved the goal of attracting Egyptian scientists to Europe to work on relevant international research fields. In the period 2013- 2014, 20 Egyptian scientists were seconded to POLIBA and ECOLE for a total of about 65 months, out of which 28 months were used in 2013 and 37 months were used in 2014. The resources were allocated almost equally among the three research work packages (24 months to WP1, 24 months to WP2, 16 months to WP3) showing a good balance of activities. One additional month was allocated to WP4 activities.

Those numbers are in quite good agreement with the expectation of the Gantt table reported in the work document for the years 2013-2014.

EENP2 successfully met all the milestones as listed in the work document. A detailed description of the project achievement will be given in the next section. Here we schematically go through the milestones and briefly comment on their completion.

1) <u>Completion of training phase for GRID technologies</u>
   The training phase was completed. See detail in the "Project Achievement" paragraph related to WP3;

2) <u>First small size MRPC and GEM prototypes validated</u>
   GEM prototype validated. MRPC are still in the design phase, due to some difficulties in the procurement of the glass electrodes. However, emphasis has been given to standard RPC with innovative performances. See details in the "Project Achievement" paragraph related to WP2. Relevant publications in the attached publication list;

3) Sensitivity results for SM Higgs decaying into four leptons
   Study has been concluded on LHC RUN1 data sample. See details in the "Project Achievement" paragraph related to WP1. Relevant publications in the attached publication list;

4) First "High Energy Physics School" in Egypt"
   The school was held at Ain Shams University, 26 April to 1st May 2014 (http://eenp2.ba.infn.it/?p=94);

5) Completion of high statistics analysis for SM Higgs in four lepton
   Study is almost concluded on LHC RUN1 data sample. See details in the "Project Achievement" paragraph related to WP1. The final paper on the subject is under submission to international journals;

6) Advancement for GRID infrastructure in Egypt
   A TIER2 center is in development at the CAIRO Academy ASRT. Zewail City University, Helwan University and Ain Shams University are installing TIER3 centers. See details in the "Project Achievement" paragraph related to WP3;

7) Advancement on infrastructure preparation for the gas lab at HELWAN
   Equipment and software have been installed at Helwan University. Commissioning under way. See details in the "Project Achievement" paragraph related to WP2;

8) "Middle Term" workshop and status report
   The "Middle Term" workshop was held at Zewail City on 13-14 November 2014. See documentation at https://indico.cern.ch/event/351888/.

The status of deliverables is as follow:

- **D 1.1** (*Mass spectrum of ZZ* decaying into four leptons)*
  Delivered;

- **D 1.2** (*Mass spectrum of electron pairs at high mass (above the Z)*
  Delivered;

- **D 1.3** (*CMS center for data analysis operational in Egypt)*
  The data center is ready at the AINSHAMS University. A CMS analysis school is planned to take place in April 2015 to start the operation and review all the protocols;

- **D 2.1 (***Assembly and test of MRPC/GEM detectors)*
  GEM detector were delivered according to the planning. MRPC are still in the design phase, due to some difficulties in the procurement of the glass electrodes. However, emphasis has been given to standard RPC with innovative performances. Test are under way at the Gamma Irradiation Facility;

- **D 2.2 (***Characterization of high radiation tolerant silicon detectors*.)
  This study will be pursued in the second part of the project and the delivery is foreseen for end 2016.

- **D 2.3:** *Detector laboratory infrastructure at Helwan*
  Equipment and software installed at Helwan University. Commissioning under way. Full delivery foresees by end 2016;

- **D 3.1:** *Transfer advanced GRID concepts and technologies to Egyptian researchers*
  Delivered;

- **D 3.2:** *Release of a production level GRID job monitoring system and data access system*
  The monitoring system has been implemented and installed on new TIER2/TIER2 sites by using the ZABBIX tool.

- **D 3.3:** *Egyptian Sites in production*
  A TIER2 center is partially in operation at the CAIRO Academy ASRT. Zewail City University, Helwan University and Ain Shams University are installing TIER3 centers. Full delivery foresees by end 2016;

- **D 4.1:** *Collaboration meetings*
  Workshops and meetings delivered according to planning;

- **D 4.2:** *Academic lectures and specialized courses*
  A school on "High Energy Physics and related technologies" was held in 2014. Many seminars and lectures have been given. Egyptian scientists have joined international schools and conferences in Europe;

- **D 4.3:** *Publications and conference reports*
  Many publications were delivered. Full list attached to this report.

6. PROJECT ACHIEVEMENTS

Scientific highlights and research achievements in new particles search

The highlight of the first run of the Large Hadron Collider (LHC) was undoubtedly the discovery of a new elementary particle of a type never seen before. All the properties of this particle measured so far are consistent with those predicted for the Higgs boson of the Standard Model. It has zero spin (angular momentum), and it couples with other particles proportionally to their masses according to the expectations. In view of this discovery, the 2013 Nobel Physics Prize was awarded to Francois Englert and Peter Higgs for their prediction 60 years ago of the existence of this particle.

The POLIBA and ECOLE groups, reinforced by the Egyptian colleagues employed through the EENP2 project, were largely contributing to the discovery. The activity was primarily concentrated on the analysis of the most sensible channel for the Higgs study, the Higgs decay to four leptons (electrons or muons) through the ZZ* production. All the data collected by the CMS experiment at a collision energy of 7 TeV in 2011 and 8 TeV in 2012 have been used for the analysis. The work was primarily

devoted to the identification and reconstruction of four leptons and suppression of the backgrounds, among which the continuum ZZ* production is the most important. A significant excess was found around a four-lepton invariant mass of about 126 GeV. The results have been interpreted in terms of exclusion limit and significance of discovery by using a statistical approach. Once the discovery was established, the group focussed on the measurements of the mass of the new particle and tested different spin hypotheses; all the measurements showed consistency with the Standard Model prediction of a Higgs boson, responsible of the mechanism to give masses to the other particles.

The 2011 and 2012 data collected by CMS have been also interpreted in the context of a new model, the EWK singlet model where a new boson is predicted, in addition to the Standard model one, with a mass larger than 200 GeV and coupled to the Standard model Higgs. The analysis team made a relevant effort to reweight the Standard Model Higgs simulated samples in terms of the features of the new signal, the different cross section and width with respect to the Standard Model. No excess of events compatible with the observation of a new boson was observed. Results have been interpreted in terms of an exclusion limit on the mass of the new boson as a function of the additional parameters of the EWK single model. Results have reported in an analysis note and submitted to a scientific journal as a CMS paper.

In addition to this mainstream activity, the groups has also been involved in the search for heavy new particles, such as for example the Z' boson, expected in new models which extend the Standard Model predictions, and the Randall-Sundrum graviton. Final state with two opposite charge electrons and muons have been studied looking for peaks in the electron and positron pair invariant mass spectrum over a continuous background, at masses around the TeV. In this channel, the energies of the leptons range from several tens of GeV to more than 2 TeV. Specific methods of calibration, selection and reconstruction are needed with those very large transverse momentum/energy leptons. The analysis has been completed successfully, together with the implementation of a new method to correct saturation effect in the calorimeter. The background is predicted to be quite low but, due to the small number of expected events, it was estimated from data.

No excess was found by using 2011 and 2012 data and exclusion limit on the mass of the Z' was set to more than 2 TeV at 95% C.L. for several theoretical models predicting its existence.

The activity at POLIBA was mainly focussed on the study of the H $\rightarrow$ ZZ $\rightarrow$4l and Z' $\rightarrow$ $\mu\mu$ decay channels with the contribution of four Egyptian physicists hosted for few months. The study was pursued in parallel on the two main channels, sharing however a detailed study of the trigger, reconstruction and identification of the leptons. The group was involved in the implementation of the analysis code for the cut selection, the preparation of plots for the statistical interpretation of the results and the simulation of the Monte Carlo samples for the Higgs signal production and the background. A completely new code has been developed to handle the Z' $\rightarrow$ $\mu\mu$ analysis and results have been presented several times at the official meetings of the collaboration. The activity is now focussed on the preparation of the Run 2 analysis; a paper in preparation for half 2015, once the first bunch of data will be collected by CMS at a center of mass energy of 13 TeV.

The POLIBA team has been able to compete with groups from other institutes and attract other Italian colleagues to join the effort. Recently it has been awarded the "best analysis team" prize at the CMS Data Analysis School hosted at the POLIBA Physics Department in January 2015.

The work in ECOLE concerned different aspects of the analysis of data recorded in the CMS experiment during years 2011-2012 and the preparation of the data taking starting in 2015, especially those related to the Electromagnetic Calorimeter (ECAL).

Two Egyptian physicists seconded to ECOLE continued a study they already started in Cairo, in the High Energy Electron Positron Pairs (HEEP) international team of CMS. Their work profited from many discussions and help with experts working in the French laboratory.

A study was performed to recover the saturated crystals in the ECAL affected by "spikes" background. Those signals are due to ionization by the products of neutrons interactions of the light detectors (avalanche photodiodes). In the future data taking at 14 TeV, they may be even more disturbing, both in the acquisition trigger and in the off line selection.

Multi Variables Applicators (MVA) technique, already used by the ECOLE group for the Higgs boson discovery, was used to disentangle "spikes" from good signals. Promising results were obtained, showing a recovery of saturation at the 1.2%, better than the 5% obtained by a previous method. A CMS analysis note is in preparation.

A simulation study was also performed to understand the magnitude of this effect, especially for HEEP, during the new data taking at 14 TeV. A tuning of the "spike killer" algorithm at the Level One was performed. An analysis note is in preparation.

The understanding of ECAL performance is crucial for the selection of high energetic electron pairs, which can lead to the discovery of new physics beyond the Standard Model. In particular, new gauge bosons (Z' and W') form Grand Unified Theories (GUT) or extra spatial dimensions (Kaluza-Klein excitations of the graviton). A discovery should manifest itself first as a bump in the invariant mass plot of the electron pair known from Standard Model physics. The spin determination can then be utilized to separate the different hypotheses on the nature of this new particle. A simulation study of the angular distribution using MVA was performed for the future data taking in 2015. This work is continuing with frequent remote video meeting between ECOLE, Egyptian universities and other CMS collaborators involved in this research subject.

Besides these studies, an important scope of EENP2 has been the establishment in Egypt of a center for CMS data analysis at the Ain Shams University. In parallel with the training of young scientists, an effort was initiated to develop a local data center for analysis with up-to-date software environment. The data analysis facility is currently in operation providing local resources for analysis activities and offering an autonomous research context and new opportunities to students. The Egyptian, who had the opportunity to join the ECOLE and POLIBA teams, are currently initiating new local scientists to the data analysis technologies and tools.

Scientific highlights and research achievements in detector technologies

The CMS experiments implements different detectors technologies to ensure redundancy and rapid muons identification for the selection of interesting events. Among them, Restive Plate Chambers play a crucial role in determining with "nanosecond" accuracy the passage of charge particles produced in the proton-proton interactions. The POLIBA Bari group has relevant responsibility for the production and operation of the forward chambers, which have been installed recently in the experiment. The EENP2 project has allowed young Egyptian researchers to join this effort through the Bari group and develop important skills and knowledge on particle identification and gaseous detector. The effort of the seconded Egyptian scientists has been focused on three different research lines:

1. Construction, test and installation of the new 4th RPC CMS Endcap station. During the first long LHC shutdown period in 2012-2013, the 4th muon station has been instrumented in both

positive and negative Endcap. The Egyptian researchers were involved in all steps of the production and quality control procedure at the RPC CERN laboratory. They were involved on the commissioning of some chambers by means of the cosmic ray telescope installed at CERN. The detector performance were studied using a dedicated offline software for the cosmic muon track reconstruction. The Egyptians scientists were introduced to the tests and operation methodologies for the gaseous detector tests and certification;

2. Development of an improved RPC for the forward region of CMS. In the last two-muon stations, improved RPC, will provide the needed redundancy at modest cost, with benefits for neutron induced background reduction in the trigger and offline reconstruction. The POLIBA group has started an intense R&D activity to develop a new generation of detector that can handle the high particle hit rates of about 1 kHz/cm^2 expected at maximum LHC luminosity in this region. The activity is focused on the tuning of three major parameters that can improve the RPC rate capability: the resistivity of the electrodes, a new detector configuration with thinner electrodes and thinner gas gaps and new read-out electronics;

3. Development of Gaseous Electron Multipliers (GEM) detectors for the forward part of CMS. In the first two muon stations, where the muon bending angles are large and thus a precise momentum determination is most effective, GEM will be employed. The POLIBA group is involved in the construction and test of this new technology of gaseous detector.

Under the advice and help of researchers from POLIBA, the HELWAN University is building up an important infrastructure intended to boost the R&D activity in this field and serve as attraction point for training of young scientists and dissemination of knowledge in the field. The seconded scientists in Europe have been involved in the early preparation of laboratory tools and related software, by learning and duplicating systems in use at POLIBA and ECOLE. In particular, emphasis was given to the setup of a Data Acquisition System, using VME technology, the preparation of the power and gas distribution services, the development of the related control software. In parallel, the Egyptians scientist were introduced to the detector test and operation methodologies, by visiting the CERN RPC laboratory and by joining the cosmic rays test facility for chamber validation and the CMS RPC system operation during the Large Hadron collider proton-proton runs.

Those efforts have successfully lead to the completion of all the basic infrastructures for the start-up of the HELWAN laboratory. Next steps are the improvement of the gas system (at present running with only one gas) and optimization of the software for the offline analysis. Two spare CMS RPC Endcap chambers will be send soon to Helwan. The chamber performance will be studied with the local cosmic muon set up and the results will be conpared with what obtained at CERN on the same chambers. This will allow the validation of the hardware and software in HELWAN. Finally, some improved RPC prototypes, build by POLIBA Bari group, will be tested with the Egyptian cosmic muons.

Scientific highlights and research achievements in GRID computer technologies

EENP2 aims at the installation in Egypt of GRID infrastructure in compliance with the Worldwide LHC Computing Grid (WLCG) standards to enhance the CMS analysis local capability, but also to be beneficial towards a larger scientific community (ie. biomedical and computational chemistry) that would profit of robust and efficient computing facilities.

The Egyptians experts seconded to Europe have been involved in relevant GRID and computer activities at POLIBA and ECOLE. Emphasis has been given to gain experience for an autonomous TIER2/TIER3 installation in Egypt. Focusing on these needs, they were trained on the following main items:

- installation and configuration of PhEDEx; this is fundamental tool used to move the data among different sites;
- Installation and configuration of ZABBIX; this is an application used in the management of a computing centre.

A provisional installation was successfully implemented on the GRID centre at POLIBA, by attaching and understanding all the important steps. In addition, experience and knowledge on how to interact with the CMS collaboration to configure a new site was gained.

The installation and configuration of ZABBIX was performed both on server side and client side, and attention was given to the following developments:

- the use of the native sensors of ZABBIX;
- the creation of custom sensors based on BASH/PYTHON;
- the configuration and authentication of the ZABBIX frontend;
- the use of SNMP tool of ZABBIX to monitor the network infrastructure;
- the use of passive/active/auto registration of ZABBIX agent;
- the configuration of a ZABBIX proxy, useful in a national context for the development of a hierarchical monitoring infrastructure.

More recently additional work was done on provisioning an operating system via network installation, using both the classic DHCP/TFTP/PXE/KickStart pattern and Foreman approach. In this last case, the creation of new template and the customization of existing ones were achieved, in order to automate the installation of specific host profiles.

Finally some work on the implementation of the classic grid services (like WMS, BDII, sBDII, SE, CE, WN, ARGUS) was done, together with the development of batch system; also, a typical interactive cluster machine to be used as "frontend" to the farm services, was developed. The installations of the frontend and the ARGUS server were performed successfully at the POLIBA site and then reiterated at the Egyptian ones.

A TIER2 center is now in development at the CAIRO Academy ASRT to serve as relevant national computer facility and GRID main open access to other Egyptian universities and research institutes. Already three racks are installed hosting 66 CPUs. Additional 80 servers with 90 Tb storage and 1 Gb/s shared internet connection, will be installed soon. The installation of the harware and the operation of this center is steered, in the framerwork of EENP2, by European experts toghether with local experts who have been trained in Europe.
With the guidance of EENP2 experts, Zewail City University, Helwan University and Ain Shams University are also installing TIER3 centers that provide local facilities to access and use the ASRT TIER2. The Egyptian researchers are gaining experience in installing, configuring and managing a typical GRID site supporting CMS Virtual Organization, including the services needed to deal with official data transfers. They are also managing several tools needed to transfer data, submit jobs etc, in order to be able to become the first line of support for their local users. The astonishing progress that has been registered in this field in the last few month is certainly due to the effectiveness and the proper management of the resources made available through the FP7 programme.

6.2 Transfer of knowledge and Training activities (workshops)

Through the secondment possibilities granted by EENP2, several Egyptian researches have already spent a considerable fraction of time in Italy and France joining the research activities in one of the field of interest described above. During the visit to Europe, they were able to join the CMS collaboration meetings and other general conferences and workshops. By visiting European laboratories, they also have gained important expertise in the field of experimental physics, particle detector systems, software tools for data analysis and GRID concepts.

Some of the physicists joining the secondment program also had the opportunity through Italian INFN and France IN2P3 funds to travel to CERN and participate in the experimental activity on the CMS detector and data analysis. They were active in the construction and operation of the fourth layers of the RPC endcap detectors, finally installed in the experiment in the autumn 2014, in the R&D for the development of new GEM detectors, in the development of data acquisition systems and in the general running and operation of CMS. As results of this training and knowledge transfer phase, important infrastructures for GRID computing and gaseous detector R&D are now in preparation in Egypt and have been partially commissioned as described previously.

Recently, thanks to the EENP2 support, six Egyptian researchers could join the CMS Data Analysis School (CMSDAS, 19-23 January 2015) in Bari. CMSDAS is the official school that CMS organizes every year in US, in Europe and in Asia to train Ph.D and young post-docs to the physics analysis. It consists of practical sessions on physics objects reconstruction, identification, and physics analysis preparation for the data taking at LHC. The school is a fundamental step for training new scientists and create an excellence network for high-energy physics. Participation to the school provides opportunities for involvements in CMS working groups.

As far as GRID technologies are concerned, it is relevant to remind the Collaboration of Agreement between EENP2 and ReCaS, a project founded by the Italian Ministry for Scientific Research with the scope of building a distributed GRID computing infrastructure in Southern Italy. This agreement has allowed training staged of Egyptian scientists in the Bari ReCaS site and the participation of ReCaS experts to the setup of local GRID/CLOUD infrastructures. In this contest, EENP2 is now discussing with ReCaS the possibility of organizing a dedicated school on GRID/CLOUD technologies in Egypt next spring.

As part of the training program, several seminars, lessons and tutorials have been given in Egypt by European scientists involved in EENP2 to make available new knowledge and new technologies at a large group of students and young researchers. European experts and technical staff have spent short visiting period in the Egyptian University to train local staff and help in setting up the hardware and software infrastructures.

EENP2 has organized annual workshop to summarize the research activity. It has been decided to hold these events in Egypt to allow the largest participation. Very often, Egyptian researchers gave the reports, as evidence of their deep involvement on the research field. Those events have been widely broadcasted through internet using virtual meeting technologies and all the related document are available for consultation on the EENP2 INDICO data base (see http://indico.cern.ch/category/4907/ at the web site eeenp2.ba.infn.it).

An important milestone of this dissemination policy has been the organization of a "High Energy Physics School" (Ain Shams University, 26 April to 1st May 2014 (http://eenp2.ba.infn.it/?p=94), to introduce physics and technology to scientists and students coming from the entire North Africa area.

An intense programme of lectures was accomplished spanning from the most recent theoretical models (Standard Model and Super Symmetric models) to recent experimental results from the Large Hadron Collider operation at CERN. Emphasis was also given to experimental methods for data analysis, related technologies for particle detection, advanced GRID computing. A survey of possible applications of particle physics methods and instruments for health and environmental domains was finally discussed. In order to stimulate active participation, special sessions were foreseen where students could present and discuss their work.

6.3 Dissemination of results (conferences, publications...)

The vast scientific activity correlated to EENP2 has led to several publications on international journals and internal notes that are accessible world while through the WWW EENP2 page. Attached to the present report, a list of relevant publication is available. Many Egyptians scientists have had for the first time the possibility to sign as author important papers describing their contribution to the high-energy field and related technologies. Some of them had a chance to join international conferences and to present their work. An important conference, the "XII Workshop on Resistive Plate Chamber and Related Detectors" was held at the Beijing Tsinghua University (China) (ref: http://hepd.ep.tsinghua.edu.cn/rpc2014/) on February 2014. Some of the recent achievements of the EENP2 project have been presented at this conference.

In parallel, an important dissemination policy has been pursed through CMS Collaboration meetings and EENP2 workshops. The possibility offered by virtual meeting technologies to join CMS collaboration meetings and workshops has been valuable to allow direct participation of Egyptian scientists to the activity, both for presenting their work and to be updated on the collaboration developments.

Moreover, some of the Egyptians seconded and trained in Europe have been invited to give several talks at local scientific events.

EENP2 has organized two annual workshops for dissemination of the results. Those events have been widely broadcasted through internet using virtual meeting technologies and the related document are available for consultation on the EENP2 INDICO data base (see http://indico.cern.ch/category/4907/ at the web site eeenp2.ba.infn.it).

7. PROJECT MANAGEMENT

Overview of the activities carried out by the partnership; Identification of problems encountered and corrective action taken.
Attached documents: *Include where appropriate, one document containing complementary information on the project management.*

During the first two years, the EENP2 partners have always been proactive and collaborative toward the accomplishment of the project milestones. Thanks to the small size of the consortium, the management has been quite smooth through both official steering meetings, and frequent direct contacts.

All the official meetings have been broadcasted through virtual meeting systems and the documentation is available on the INDICO database of the project, together with the detailed minutes (see http://indico.cern.ch/category/4907/ at the web site eeenp2.ba.infn.it).
All this information is also easily accessible from the EENP2 main web page (eeenp2.ba.infn.it) which has been recently improved. Other relevant work documents, as well as useful links are accessible through this page.

As described in the previous sections, EENP2 has obtained important scientific highlights, which will not be further discussed. Here we would like emphasize its role in enhancing the scientific collaboration among the Egyptian institutions, which under the umbrella of EENP2 have significantly improved the local network capabilities with important outcome in term of global scientific impact in the country.

The EENP2 management, by successfully interfacing with the leading scientific institution of the country, the Academy for Science and Technology (ASRT), promoted the funding of new infrastructures and a new organization of the research in the high-energy domain.

On the other hand, EENP2 also promoted the Egyptian research towards European institutions. Since the European partners are deeply involved in the CMS collaboration, a reinforced link was established between CERN and the Egyptian network for high-energy physics with an important boost of activities in this field and the creation of new opportunities for young scientists to collaborate with the largest European laboratory.

Relevant work was also done to reinforce the bilateral collaboration between Italy and Egypt. A Memorandum of Collaboration has been signed by the EENP2 consortium and the Italian RECAS collaboration to enhance the transfer of knowledge in the field of GRID computing. This could result, as first important event, in the organization of a GRID computing school in April at the ASRT to promote training of new expertise.

Moreover, thanks to the EENP2 auspices, a bilateral agreement of cooperation between Instituto Nazionale di Fisica Nuclare (INFN) and ASRT has been recently signed. In the framework of this agreement, addition funds will be available by both partners for collaborations on nuclear and high-energy physics.
Thanks to the communication network established through EENP2, some Egyptian institutions are now applying for the "Erasmus+" call to promote students and teachers mobility toward POLIBA and ECOLE.

8. ADDITIONAL INFORMATION

Please indicate any additional information, which may be considered useful to assess the work done during the reporting period. The socio-economic aspect of the project may be addressed in this section.

Although EENP2 has significantly achieved important progress, in this section we would like to address minor critical issues, which have been encounters during the consortium activity.

The years 2013-2014 have been denoted by some social and political instability in Egypt. This situation has certainly affected the local capability to fully exploit the potential outcome of the EENP2 programme. In few circumstances, scientific initiatives were slowed down due to complex Egyptian dynamics. Also in this contest, the secondment of European scientists to Egypt has been rescheduled, in view of travel warning emitted by Italian and France foreigner ministry authorities time by time.

An additional problem is related to the heavy teaching load of the Egyptian researchers, that some time has prevented them from taking longer secondments to Europe.

In spite of these difficulties, EENP2 has been proceeding quite smoothly thanks to a reliable local management. Of course, the results of FP7 (and future Horizon 2020) programs such as EENP2 also depends from the local attitude to invest in research and technology and strengthen national infrastructures. We acknowledge that, although the world while financial difficulties that heavily affect also the south Mediterranean area, Egypt is making an incredible effort to potentiate its scientific an technological capability and to invest in new generation training and education.

We believe the EENP2 has played its little role by helping local academia in gaining awareness of the country capability.