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France
National Needs Analysis on STEM School-Industry Collaboration

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EXECUTIVE SUMMARY

Although in France a lot of initiatives exist in the field of school industry collaboration often co-financed by the Ministry of Education, few of these initiatives are national, while most of them are local or regional and are often not well known. One of the reasons for the lack of visibility is the fact that there is no national strategy as far as school-industry collaboration to promote STEM (Scienc, Technology, Engineering and Mathematics) is concerned and that there is also no formal national platform where these initiatives are brought together and are presented.

During the meeting some excellent examples were given of school-industry collaboration very often through Foundations initiated by industry such as C. Génial, or Course en Cours where Renault, Dassault Systèmes and the Ministry of Education organise a competition together. There are also a number of scientific foundations or organisations such as the La Main à la Pâte foundation (hands on science), Vigie Nature (Nature watch) and Sciences à l'école (Sciences at school) that are important actors for the promotion of STEM. Furthermore there are sectoral organisations such as UIMM representing the metallurgy sector and a wide range of industries with its Propulsion Tour.

They work on the one hand with the Ministry of Education and on the other in certain projects with industry. Also (science) museums or centres act as intermediaries for school-industry collaboration. Most of the collaboration initiatives concern competitions, vIsits of company representatives to schools, visits of classes to companies, initiatives to motivate girls for STEM studies and careers and help to implement a project. In the framework of school-industry collaboration a number of events, exhibitions and festivals have also been organised, some on a yearly basis. As a result of the collaboration resources and games have also been developed and attention was given to scientific entrepreneurship. The initiatives mostly focus on lower secondary schools (Collèges) and upper secondary schools (Lycées).

One of the main problems in initiating school-industry collaboration, especially in general education is the distrust of education towards industry. As far as technical and professional education are concerned collaboration with industry is more ommon as the programmes are tailored for the industry. Moreover schools for general education and industry are two different worlds that do not know each other and are thinking in stereotypes. This is the reason why most schools but also a number of companies prefer to collaborate with schools through foundations rather than collaborating directly. Schools also think that the Dgesco[1] and the Ministry of Education could play an intermediary role in creating trust between the partners and securing the partnerships. There is also the problem of making the offer of industry meet the demand of the schools. Existing initiatives from industry sometimes do not find enough candidates whereas certain initiatives do not find enough companies to welcome them and support them. A specific problem for schools in rural areas is the fact that there are often not enough companies in the neighbourhood with whom to collaborate.

Once the collaboration has been initiated there are several challenges as well for schools as for industry. The first challenge concerns the time invested in the initiatives: teachers often have to work on school-industry collaboration in their free time whereas companies can only devote a limited number of days to school-industry collaboration. Also the schedules of the schools and the companies are different. Therefore certain

[1] La direction générale de l'enseignement scolaire [Dgesco] – Directorate General of School Education - http://www.education.gouv.fr/cid978/la-direction-generale-de-l-enseignement-scolaire.html. It elaborates wi(thin the Ministry the education and pedagogical policy and the programmes for primary schools, for lower secondary schools (collèges), for the upper seundary general schools (lycées) and the upper secondary vocational and technical schools (lycées professionnels).

companies prefer to entrust the school-industry collaboration to foundations because in this way the work in the company will not be disrupted. The cost of the collaboration and especially the cost of transport for pupils is also a challenge.

According to the companies the mentality of schools and of the teachers should also change and they should be more interested in what is going on in industry and should also get to know the professions in industry better.

The work of the teachers involved in school-industry collaboration should be an integral part of their activities at school and should be valorised and valued and should also be shared by a team at school. The best way to integrate school-industry collaboration really into schools is by making it a compulsory part of the school curriculum. Thus not only the work of the teachers would be valorised but the work of the pupils could also be evaluated focusing on knowledge, competences, skills and attitudes acquired through cooperation.

The main reason why industry is interested in school-industry collaboration is the fact that industry is at present facing shortages on the industrial labour market in certain areas. They want to motivate young people for STEM studies and STEM careers and get these professions or careers in industry better known. Industry also thinks that the competences of some of their employees could be enhanced through school-industry collaboration. They see the collaboration with schools as one of the key actions in the framework of their Corporate Social Responsibility.

Schools also want to collaborate with industry because they want to motivate their students for STEM subjects and want to make the lessons more interesting and attractive. They think that by sharing resources the quality of STEM education in France could be enhanced. Schools think that quality resources should be disseminated online and that the best place to bring these resources together is on a specific platform dedicated to school-industry collaboration. Schools also think that school-industry collaboration can be used to enhance the continuous professional development of the teachers. For the moment this is one of the main axes of school-industry collaboration in VET (Vocational Education and Training)-schools.

Schools expect the companies not to see the schools as an audience for advertisements and companies want the schools to be flexible enough to implement the collaboration creatively. Both schools and industry expect the collaboration to be backed by the hierarch within the school and the company; also the inspectorate is expected to back and promote the school-industry collaboration.

The participants to the seminar listed a number of recommendations to enhance the school industry collaboration:

- First of all a national strategy for school-industry collaboration to promote STEM should be developed;
- School-industry collaboration should be integrated in the school programmes and curricula in order to be able to valorise the work of the teachers involved and to evaluate the work of the pupils involved. Also the work of the teachers in extracurricular activities should be valorised;
- Most participants agree that a national platform and/or regional platforms should be created where the offer and demand for school industry collaboration could meet and where the resources developed in the framework of school-industry collaboration could be disseminated. The Dgesco and the Ministry of National Education could play a key role in developing this platform;
- In order to reach rural schools virtual visits to companies should be organised and modern communication media should be used for other forms of school-industry collaboration;

- School-industry collaboration should be regarded as CPD[2] for the teachers and as such it should be integrated in the school development plans and in the personal development plans of the teachers;
- Evaluations should be carried out to assess the impact of school-industry collaboration especially the impact of these initiatives on the study and carreer choice of students who have participated.

It can be concluded that although there is no national strategy for school-industry collaboration in order to promote STEM, many elements are present that could be used as building blocks for such a national strategy. Both schools and industry think that the Ministry of National Education and Dgesco could play a pivotal role in developing such a strategy and creating a platform in order to implement the strategy. By taking into account suggestions and recommendations made during the seminar school – industry cooperation can become a win-win operation for all those concerned.

[2] Continuous Professional Development

NATIONAL KEY FIGURES ON STEM EDUCATION

EUROSTAT DATA (to be developed further)

		Year of data	[France]	EU 27	Source
Population		2008	64.007.193	497.686.132	Eurostat
Population by age	0-14 years	2008	11.835.593	78.074.400	Eurostat
	15-24 years	2008	8.130.999	61.946.834	Eurostat
Total expenditure on Education (in EURO)		2010	96.287.5	626.531.3	Eurostat
Expenditure on education as % of GDP			5.62%	5.08%	Eurostat
Financial aid to pupils as % of total expenditure at primary and secondary education			3.2%	3.7%	Eurostat
Financial aid to pupils as % of total expenditure at tertiary education			7.4%	16.7%	Eurostat
Mathematics, science and technology enrolments and graduates		2009	265.669 (TE students) 66.141 (TE graduates)	1.951.750 413.686	Eurostat
PISA Scores in STEM SL =Scientific literacy ML = Mathematical literacy R = Reading		2006 2009	495 (SL) 496(ML)488(Reading) 496 (R)	497(SL) 491(ML) 483 (R) 486 (R)	OECD

Chapter 1: National Policy on STEM Education[3]

1.1 National strategy on school-industry collaboration

Although a lot of initiatives exist to enhance school-industry collaboration and although they are often co-funded by the Ministry of National Education there are no real political strategies addressed to reinforce school-industry partnerships. Until now the government has mainly invested in the collaboration with industry for the continuous professional development (CPD) of teachers in technical and vocational schools and to a limited extent in the CPD of primary and secondary general school teachers.

1.1.1 National/Regional and Local organizations coordinating STEM school-industry collaboration

Although in France a lot of initiatives exist in the field of school industry collaboration, often co-funded by the government, the initiatives organised by the Ministry of National Education are mainly targeting teachers in technical and vocational schools, especially to train them in the use of new equipment and tools. Next to these, there are a number of other initiatives for other categories of teachers (primary school, lower secondary – Collège- and/or upper secondary general school) and these are mainly organised by Foundations such as C.Génial and La Main à la Pâte. The C.Génial foundation has listed the main initiatives and organising structures in an excellent preliminary document that was handed out during the meeting. Here below the initiatives presented during the one-day seminar are more largely expanded upon than those not presented.

During the meeting some excellent examples were given of STEM school industry-industry collaboration or of STEM-initiatives that are sponsored by industry. There are also a number of organisations either dealing with STEM in collaboration with industry or with school-industry collaboration in general. As far as organisations with a national scope are concerned the following organisations were mentioned:

C.Génial, a Foundation to enhance scientific and technical culture was created in 2007 by 6 big companies (Areva, Technip, EADS, SNCF, Orange and Schlumberger) with the prime objective to encourage young people to choose scientific careers. The foundation collaborates with "Sciences à l'école" and the Ministry of National Education. Among other initiatives, it organises competitions of innovative scientific projects in secondary schools and is active in all French regions. Since 2011 there are two strands: for lower secondary education (collège) and for higher secondary education (Lycée). As a reward the winners of the regional and national competitions can visit local or national scientific industrial partners such as Areva, Schlumberger, Technip, Saint-Gobain, BASF, IBM, Michelin, Total etc. To strengthen the link school industry. The Foundation also offers pupils the possibility to participate in international science competitions.

The Foundation "La main à la pâte" and the Academy of Sciences organise the « Que faire dans le monde? Un métier!/ What to do later in life? A profession». Lower secondary schools collaborate with companies on projects that anchor the classroom practices in the reality of the professional world (wood industry, aerospace, construction of greenhouses, transport, etc.). These projects were carried out in the framework of the EIST (l'enseignement intégré de science et technologie or integrated science and technology education; see annex II) that has been initiated by the Academy of Sciences and supported by the La main à la pâte Foundation. Each year 10 projects for 300 or 400 pupils are carried out.

In the framework of the La main à la pâte foundation Science Learning centres (Maisons pour la Science) have been established whose objectives are: Professional development of primary and lower secondary teachers, Partnerships with the scientific and industrial community, Promoting equal gender opportunities and Development and dissemination of pedagogical resources. The Science learning centres are 50% co-funded by the government in the framework of the Investment for the future plan.

The UIMM (l'Union des Industries et Métiers de la Métallurgie – Union of Industries and Professions in Metallurgy) has for 20 years been promoting school-industry collaboration and has as main objective making the professions in the metallurgic sector better known through inter alia an information campaign targeting a wider public (my future job), the training of career guiding officers in order to enhance the information given

[3] Please report from the information obtained during the national needs analysis workshop.

on the sectors, the information on professions and trainings of the technological industries (kit'métiers), activities in the framework of PDMF (the parcours de découverte des métiers et des formations – discovery pathway of professions and trainings)[4] such as a pedagogical kit, partnership contracts, the challenge mécano, a propulsion tour, where companies visit schools and also where classes go to companies.

Representatives of the **UIC (Union de Industries Chimiques/ Union of Chemical Indstries**) visit classes to talk about the chemical industries and the careers in these industries.

Also companies like **Dassault Systèmes** have taken initiatives to strengthen school-industry collaboration. Thus, "Course en cours[5]" is a project coordinated by Dassault and Renault where teams of young secondary school students just like F1 engineers, design, validate, manufacture and promote a mini race car powered by an electric engine. The objectives of the project are manifold: children learn to manage a project in team, they learn to analyze the specifications of a contract, use 3D to design, simulate and manufacture, but also to present the project, search for sponsors, create links with industry and work with a student tutor. The project also favours a multidisciplinary approach as the pupils have to refer to several disciplines such as Technology, Mathematics, Physics, French, English and Arts in order to finish the project successfully. The project also involves higher education students who act as tutors for the secondary pupils.

The **EADS Foundation** organises the competition "Imaginons le transport du futur" (Imagine transport for the future). It proposes to pupils of 12 to15 years of age to tackle sciences in a different way and to take the role of scientists or engineers. The youngsters are invited to design in teams means of air or space transport of the future.

Classe en enterprise (classes in the company) is an initiative of the FIEEC, the Federation of electrical, electronic and communication industries (la Fédération des industries électriques, électroniques et de communication) that enables secondary school pupils to attend lessons on the premises of a company for three days. While they are there they discover the professions and jobs that are specific for the company.

There are also a number of **organisations specifically targeting women** such as the organisation "**Elles bougent"** (they (women) move), the organisation **"Association femmes et sciences**" (women and sciences).

Moreover there are a number of organisations that are working at a more local or regional level.

Michelin runs the "Eurêkart" project in the neighbourhood of Clermont-Ferrand where industry is working together with the representatives of the Ministry of National Education, teachers and researchers. Pupils have to produce a technological object in partnership with a local company. Through their participation in the project and their contacts with the research community and working in teams the pupils acquire knowledge and competences in science and technology.
The Science Learning Centre (Maisons pour la Science) of Clermont – Ferrand organises CPD for tecahers to be involved in projects focusing on cooperation with companies such as Michelin.

At the Science Festival in 2012 **Universcience (**Palais de la découverte et Cité des sciences et de l'industrie/ the Palace of discovery and inventions and the City of Science and Industry) speed meetings were organised in partnership with the Association of 100,000 entrepreneurs between entrepreneurs and classes of MGT (Science and Technology Management).

IMS-Entreprendre pour la Cité (entrepreneurship for the city) together with **Intel** organises actions targeting women in three regions of France. The same organisation together with IBM, INTEL and many other companies also organises the "Un jour, un metier" (one day, a job) project where they make young people in disadvantaged areas discover different professions.

[4] This discovery pathway concerns a course and activities for all pupils starting from the fifth grade of primary school to the last year of secondary school. During the course the pupils discover a wide range of professions and different training strands.
[5] The title of the project has a double meaning: Ongoing race and race during the courses, thus referring to the fact that it happens during school time and takes place over a longer period of time.

STMicroelectronics and SOITEC (two companies), and a higher education institution, Grenoble INP, jointly host several three-day programs in France which enable youngsters to discover high-tech jobs and careers through fun-oriented, hands-on experiments, and interactions with industry professionals and engineering students. This program, called High Tech U, was initially developed by the SEMI Foundation. Participating schools select a few students from several classes, and the participants, upon their return, present to their classmates what they experienced, as a way to disseminate further the impact of this program. This program runs in France since 2007. Statistics on previous cohorts show that students who attended it are more likely than their peers to choose a STEM tertiary education".

Wet (Water Education for Teachers) Academy is organised internationally by Nestlé Waters. In France it collaborates with the Association "Vigie de l'eau" (water watch) and terre avenir". It is organised at four different sites in France.

Other associations like "Cap Sciences" (Cape Sciences), "Terre des Sciences" (Earth of Science),

1.1.2 Existing political strategies to increase the interest of students in STEM careers through school-industry partnerships

The Ministry of education has not developed an explicit strategy or policy to promote cooperation school – industry in general and to promote STEM through such cooperation. However, there are many implicit elements which could be brought together and which could constitute the building blocks of such a policy or strategy.

There are several initiatives focusing on cooperation between schools and industry and several of them are listed in the preliminary document developed for EUN Schoolnet by the Foundation C. Genial in the framework of the DG R & I FP7 project Ingenious (ECB or European community Board) project. Many of these initiatives have been briefly mentioned above.

These projects focus on various kinds of activities such as: support in implementing projects, competitions, projects with specific focus on women and sciences, classroom activities in which company representatives are involved, company visits or placements in companies and various other activities such as science festivals and fairs, the development of pedagogical kits, tools and games (all in close cooperation with companies).

Cooperation between school and industry has been directly and indirectly promoted by major players in the field of science education such as Foundations and companies. The Fondation C.Genial has several initiatives to promote science education. The Fondation La main à la pâte has done major work to promote science education since 1996 in close cooperation with the Ministry of Education. Many companies and banks such as Crédit Agricole, Dassault, Renault, Michelin, les Aciéries Aubert et Duval, EADS (plus related companies), Intel and sectorial organisations such as UIMM (Union des Industries et des Métiers de la Métallurgie), FIEEC (Fédération des Industries Electriques, Electroniques et de Communication), le Mouvement des entreprises de France (MEDEF), la Confédération générale des petites et moyennes entreprises (CGPME), l'Union professionnelle artisanale (UPA), l'Assemblée permanente des chambres de métiers (APCM), educational organisations such UdPPC (Union des Professeurs de Physique et de Chimie) have developed or are involved in projects which focus on cooperation between schools and industry to raise the interest for STEM in general and for certain STEM professions in particular.

French organisations, universities or Foundations have developed and implemented or have been involved in DG R & I FP7 project - SiS Science in Society programme -of which the objective was to promote STEM education in schools and in higher education. This was the case of the Fibonacci FP 7 project coordinated by the La Main à la pâte Foundation which focused on creating Higher Education institutions as reference centres in the field of STEM and which organised CPD for science, technology and maths teachers. This project also promoted the creation of community boards involving key stakeholders of education and industry to promote and support STEM education at local, regional or national level.

But next to these forms of cooperation the French Ministry of National Education has also taken other initiatives implicitly promoting school – industry cooperation.
Découverte professionnelle or Professional Discovery in the lower secondary school (Collège)

Since September 2005 an elective option of 3 hours or a 6 hour module were introduced in the 3rd class of the lower secondary school to enable youngsters to get more information about possible careers later on. However the objectives, the target audience and the contents of those two possibilities are different.

The professional discovery activites are based on multiple collaborations with industry. Several partners have committed themselves to help schools in cooperation with the Ministry of National Education: for example: the Ministry of Employment, Social Cohesion and Housing, le Mouvement des entreprises de France or the Organisation of Companies in France (MEDEF), la Confédération générale des petites et moyennes entreprises or the General Confederation of Small and Medium Enterprises (CGPME), l'Union professionnelle artisanale the Professional Union of crafts (UPA), l'Assemblée permanente des chambres de metiers or the Permanent Assembly of the chambers of trades (APCM).

The professional discovery of 3 hours per week

This 3 hour elective option has to be seen in relation with the "Parcours de découverte des métiers et des formations" (Discovery Pathway of professions and training possibilities) which since September 2009 has been introduced in all schools and which concerns all students from the 5th class of the upper secondary school (Lycée)". There is a misunderstanding here, due to the fact that "la cinquième" in France means the 2nd year of lower secondary school (Collège). Pupils enter in "sixième" (the sixth), then move to "cinquième" (the fifth), all the way to "première" (the 1st) and Terminale (final class). It is a kind of countdown, whereby the first 4 years (from "sixième" to "troisième") constitute the lower secondary education, and the last 3 ones (from "seconde" to "terminale") constitute the higher secondary education. Le "Parcours de découverte des métiers et des formations" therefore stretches from the 2nd year of the lower secondary school to the end of higher secondary school.

This first introduction of students to the professional world should contribute to enlarging and completing the general education of lower secondary (Collège) students.
This 3 hour elective option has to be seen in relation with the "Parcours de découverte des métiers et des formations" (Discovery Pathway of professions and training possibilities) which, since September 2009, has been introduced in all schools and which concerns all students form the 5th class of the upper secondary school (Lycée) to the final year of the general, the technical and the vocational secondary school. This pathway should help students developing their future professional pathway.

The professional discovery module of 6 hours per week
The professional discovery module (6 hours per week) is organised for an audience of students who who alreay know they will continue in vocational training. They are usually students who are academically weaker and who are willing to be involved in a project that offers them additional professional training at the end of the third class of the Collège (junior high school).

This professional discovery module of 6 hours has to be seen as a major effort to reduce the number of students who leave the education system without any qualification whatsoever.
The main objective is to help the students developing their personal project and their learning project by getting more information about the professional world and its vocational training pathways. It also focuses on the possible bridges between vocational training and the normal education system.

1.1.3 Main challenges in implementing these policy actions and in assessing their impact

One of the key difficulties to develop and implement good practices in school-industry cooperation in STEM is how to mobilise and motivate all stakeholders in the world of STEM education in general and in schools in particular.

Cooperation school – industry in general and the dialogue between work and education to promote STEM education in particular is made difficult by the fact that the different stakeholders are locked up in their own specific areas of work at institutional level. There are few contacts on this topic between the different ministries, between the regions and the 'rectorats' (the administrative structures at regional level in charge of education). There is no or little cross-fertilisation between all the stakeholders.

The cooperation and dialogue school – industry on how to promote STEM education is also impeded by the fact that there is no culture of cooperation between those two groups. There is a kind of distrust between the two which makes it difficulties for the two partners to understand how a balanced win-win situation can be set up.

To solve this distrust more possibilities should be set up for education and industry to meet, to be in dialogue with one another and to exchange on what they can do and how they can do it. If cooperation school – industry is to be successful it has to be based on co-conception of joint initiatives which are characterised by a win – win situation for all those involved. Representatives of education and of companies could also meet in the framework of a platform for STEM education which is expanded upon later on in this report.

All those in charge of education at all levels should be aware of the potential of school – industry cooperation and how it can be a win-win operation for all partners involved. However, many teachers and school heads are suspicious of industry and commerce and do not really believe they can contribute to enhance the quality of education. Taking away this distrust is a major challenge.

Cooperation with companies - through partnerships - should not be seen by schools just as a means to secure sponsoring (some extra money for certain activities) or just as a means to get information about certain professions. It should be seen as an opportunity for pupils to acquire through the cooperation with industry STEM knowledge, skills and attitudes which can be useful in their personal and professional life. It may raise their interest and motivation for STEM which can result in later HE studies in these fields.

School heads are not really aware of the importance of cooperation school – industry to improve STEM education and will not necessarily put this cooperation high on the agenda of the school HR development plan. This is definitely the case in primary schools and in general secondary schools, collèges and lycées as the school head in France doesn't have the control of CPD.

A change in school culture (including a change of attitudes of the teachers, heads and other members of school teams) will have to take place to make those schools aware of the advantages of school – industry partnerships and cooperation to promote STEM and other subjects. A change in culture can only be brought about by giving better information at all key people in decision-making jobs and by giving professional development to both teachers and heads. Heads of schools should also be aware that parents (who work in companies!) can make a very valuable contribution to school – industry cooperation. In this way an institutional culture of partnerships focusing on school – industry cooperation can be developed. Such a culture should lead to the creation of a living tissue of representatives of school education and industry cooperating with one another to achieve the common goal of better education and better professional opportunities for all youngsters.

Vocational and technical schools by nature have paid and are paying a lot of attention to this cooperation school – industry as it is vital in terms of finding placements for their students to practice the technical and technological competences and skills and attitudes acquired in the VET school. The programmes of the VET-schools are drafted together with representatives of industry and with employers. Within the Ministry of National Education there is also the CERPET (centre d'études et de ressources pour les professeurs de l'enseignement technique), the centre for studies and resources for teachers in technical education that aims at bridging the gap between the world of industry and economy and teachers of management, scientific and industrial subjects. It also wants to develop partnerships between the Ministry of National Education and companies and constantly inform teachers about emerging professions in industry. The CERPET is linked to the general inspectorates of economy and management and of sciences and industrial techniques. Moreover 10% of the budget of the VET schools is generated by the so-called "taxe d'apprentissage" (tax for learning paid by companies).

If school – industry cooperation is not part of the pedagogical project of the school it is not considered to be a priority for CPD and it will not be integrated in the HR development plan of the school. This means that the activities of teachers involved in cooperation school –industry will be on an individual basis outside the other officially recognised CPD activities.

The lack of interest of the head is reflected in the lack of interest of the teachers. Furthermore the teachers consider themselves to be ill-equipped to be involved in school – industry cooperation activities in general and to promote STEM in particular. There is no or little continuous professional development (CPD) focusing on school –industry cooperation. School –industry cooperation is not a part of the professional development plan of a teacher as it is not integrated in the school development plan.

When teachers decide to involve themselves in school – industry cooperation it is in general without any recognition of their investment and time by the school or by the education system as such.. One of the key questions is thus how to valorise teachers for their investment in promoting school – industry cooperation.

Although there is the Plan Académique de Formation (the Academic Development Plan) [6]it could be enhanced in many ways. CPD is organised in such a way that only a limited number of days are dedicated to it during one school year. In general CPD is not structured in a way to incite teachers to be involved in it. Teachers cannot be involved in in-depth CPD (which takes several days) as there is no money available to pay for replacement staff for the teachers who are being trained. There is furthermore no professional reward or official recognition given to the teachers who are involved in such CPD.

CPD is still seen too much as an individual activity of every teacher and not as a contribution to a collective effort to improve education within the school (as part of the pedagogical project of the school). CPD should focus much more on teamwork of teachers which is not the case at present. CPD should lead to the creation of learning communities of teachers who can compare their classroom practice and stimulate one another. Reflection as a team of teachers on their professional activities is in many cases still not considered to be real CPD.

Pre-service teacher education furthermore is giving no attention whatsoever to school – industry cooperation in France. Most European countries similarly do not focus on this kind of cooperation in pre-service teacher education except in very few countries such as Scotland.

There are also a number of challenges and difficulties as far as school-industry collaboration is concerned thet are mentioned in the preliminary report for the meeting.

- For their project « Professeurs en entreprise » (teachers in companies) the C.Génial foundation finds it difficult to mobilise teachers in their free time and even when they enrol it is not certain that they will turn up;
- The EADS Foundation has the same worry concerning the «Imaginons le transport du futur » (Imagine the transport of the future) competition and finds it difficult to recruit enough classes;
- Many organizers also find it difficult to disseminate the information to the teachers concerned;
- The association “Femmes et Science 53” (Women and Sciences 53[7]) has difficulties finding partner companies who want to pilot the action in their region;

[6] PAF: The CPD Plan of the Académy (PAF) provides educational personnel with the opportunity to continue to learn and grow through CPD or Continuous Professional Development. The PAF is organized according to the three goals of the educational project of the Académié with its its 40 training objectives: Success: creating the conditions for the success of every student; Equity: leave no one behind / give every student all possible opportunities
Solidarity: work together in solidarity. The PAF is organized in five main areas: Transversal CPD, CPD for specific subjects, CPD for specific jobs in education (guidance or support, documentation)
CPD for ATSS personnel (admin., technical, social and health staff), CPD for management people in education
The PAF is published annually in the spring, enrollments for the following year are open to the beginning of September for all staff. In the PAF there is also school-based on-site CPD as a response to requests for teams in the framework of particular issues to be addressed within the educational policy of the school.

[7] 53 refers to the Mayenne department in France whose capital is Laval.

- There is also a kind of weariness concerning school-industry cooperation in especially in those schools that have been collaborating with a particular industry for a long time but also in a number of companies. Schools want to diversify their offer as far as projects and certain companies are being called upon for too many projects;
- Although the intention of the DP3 elective course and DP6 module (see above) in the Collège curriculum is good it has led to a decrease of the number of contracts with industry as the schools rather want to focus on a wide range of professions rather than on one single sector or project;
- It is also regretted by participants that the Ministry of National Education is not actively involved in the school-industry projects.

In order to enhance the communication with schools Intel now communicates through an intermediary organisation (IMS Entreprendre pour la Cité/ IMS entrepreneurship for the city) to organise together with the Ministry of Education its actions such as « Déployons nos Elles » (girls, spread your wings[8]) and « Un jour, un métier » (one day , a profession).

As far as evaluation of the project or activities is concerned, the participants agree that it should be carried out although it is not always easy and obvious to implement. Evaluation enables improving the content of the projects and meeting specific demands. Usually the evaluation is carried out through satisfaction surveys or satisfaction interviews. However, the responses of teachers on the activities carried out are not systematic and there are few suggestions to improve the project activities. It would therefore be interesting to turn to the pupils and foresee some time at the end of the project activities to gauge the reactions of the pupils on what they have just experienced.

The active participation of teachers and companies in certain projects and their decision to stay involved in a project for several years, is also a way to assess its quality and usefulness. The example is given of « Classe en entreprise » (class in a company) where the first year companies are often reluctant to participate but virtually always want to participate the next year.

It is not only important to measure the appreciation of the activities, but it is also necessary to assess the long-term impact of the activities on the choice of study of the pupils who participated in the project. In how far have the initiatives to promote STEM influenced the study choice of the pupils? How many pupils have chosen a scientific strand? These would be interesting answers and would help to prove that the school-industry actions carried out are necessary and even essential. The key problem is how to get this information. In a structured and scientifically correct way.

A national platform for school industry-collaboration in STEM (if it would be created) could also measure – in collaboration with higher education research institutes - the impact of these initiatives on the choice of pupils' concerning their studies in higher education or their professions.

[8] In French the word she and wings is pronounced the same

1.2 CONCLUSION

France does not have an explicit political strategy or policy to enhance school-industry collaboration in order to promote STEM.

Although a number of excellent initiatives are taking place to enhance school-industry collaboration (sometimes in cooperation with the Ministry of National Education), these initiatives are often scattered and some of them only have a limited impact because they are not structurally embedded in the curriculum or the school development plan and are only mobilising schools for a short while.

Furthermore many of those initiatives are not enough known. Moreover, most of these initiatives are not explicitly focusing on schools-industry collaboration although this collaboration might be an important element of the initiative.

However, there are many implicit elements and initiatives that could be brought together and that could constitute the building blocks of such a policy or strategy. The creation of an explicit policy or strategy to promote school – industry cooperation could be facilitated by setting up a platform involving all stakeholders in thet field of cooperation school – industry.

Chapter 2: STEM Education - The Industry Perspective[9]

2.1THE PRESENT SCHOOL-INDUSTRY COLLABORATION

There are quite a number of industry initiatives at national level. C.Génial listed in its report 11 of them (see full report in annex I). The most important ones have been mentioned in the section above. The main activities concern helping to set up a project, the organization of competitions such as the competition that has been initiated by the C.Génial foundation together with “Sciences à l’Ecole” and activities addressing women and trying to motivate them to take on sciences. Moreover there are visits of representatives from industry to classes and visits of classes to companies and other initiatives. There are also initiatives where didactical resources and games have been developed and fairs, events and exhibitions have been organised in collaboration with science museums or centres.

2.1.1 Motivating Factors and expected benefits for the industry

Collaboration between the world of Education and the industry are primarily driven by:

- The desire to inform young people on careers in science and technologies;
- Counterbalancing the stereotypes and misconceptions about the industry.

The main reason why industry wants to collaborate with schools is the fact that they are at present faced with **shortages in the industrial sector** and they expect that collaboration with schools will help them meeting the present and future skills needs concerning STEM in order to be able to implement their strategies and enhance their competitiveness. Although there are a lot of redundancies in the industrial sector, the number of people who are recruited annually exceeds the redundancies. Just for the metallurgy sector more than 100.000 people annually retire or move to other sectors and have to be replaced. The sector mainly needs qualified operators, engineers and technical staff: this means that the industry needs better qualified people with competences at a higher level.

Research has shown that students determine their career choices depending on their interest in a particular area and their perception of the prospects of employment in this areaThey are also influenced by their families and social background. Positive contacts with science and technology at an early age can have an impact on the long term, while a negative experience at school, is very detrimental to the future choices.

[9] Please report from the information obtained during the national needs analysis workshop.

The representatives of industry therefore also want to enhance the view youngsters have of the industrial sector. It was clearly pointed out in the presentation of Dominique Rojat during the seminar that the image of industry in the media is blurred and is either negative (referring to the negative impact of industrial activities on the environment, scandals in the industry etc.) or an embellished positive image reflected in advertisements. The former is pseudo-scientific and usually believed by audiences whereas the latter is purely regarded as publicity not to be believed.

Industry wants to inform the general public, promote certain professions and make them better known in order to attract youngsters to jobs in the industrial sector. The industry also wants to get rid of a number of preconceived ideas about the industry and they want to show that industry is at the heart of innovation. Thus they hope to attract more youngsters to industry and want to motivate them to choose for professions or trainings in the industrial sector. In order to meet those future needs it is not sufficient that students choose studies in STEM but also that they choose STEM careers.

Teachers are a key factor in shaping the career aspirations of their students: they transmit their vision to their students. It is therefore very important that they are also addressed in the school-industry initiatives.
A lot of teachers do not know the various career opportunities that exist in sciences and technology. Most of them have never visited a company. Updating their knowledge can be done by working with industries. Thus, the establishment of collaborations between schools and industry can contribute in a positive way to encouraging more students to turn to science and technology when they make their study or career choices.

Employers have much to gain from the participation of their employees in such activities because the skills developed through voluntary actions are relevant to the business.
The analysis of the perception of employees who have participated as volunteers in the initiatives, shows that their motivation and commitment (for the company and for those activities) have increased through this participation.
Collaborations with schools can also improve the reputation of the company.

2.1.2 School profile preferred by industry

Generally speaking companies prefer to invest time in higher education or higher secondary education and especially in departments or strands where students have already chosen scientific or technical studies. These students understand what the companies are talking about and they can be recruited in the short term by the companies.

Certain projects are only possible when the company is situated near the school. This means that schools in certain areas of France - where the industrial companies are less numerous or too far away from rural schools - might not be able to participate in as many activities in the framework of school-industry collaboration as others.

There are also a number of conditions that should be met by the school according to companies. The head (or management team and school board) of the school must support the school-industry collaboration, the school must be flexible in the organisation of the activities and the teachers must also be flexible and motivated.

2.1.3 Key challenges in initiating the school-industry collaboration

There are a number of challenges that must be faced when initiating school industry collaboration. The main challenge is that schools and industry are two worlds that do not know each other. Companies also see as one of the key challenges the fact that teachers are not interested enough in what happens in companies and in

industrial activities (with the exception of VET[10]-schools). Representatives from industry also regret that many teachers do not know the professions in industry and that present and future professions do not feature in exhibitions about trade and industry. They also think that certain elements of the programmes are no longer relevant.

Another challenge is the image that jobs in industry have in schools and general. There are too many stereotypes and schools do not necessarily know all the professions that exist and are needed in industry.

The attitude of certain teachers is also a challenge according to the representatives from industry and they think their attitudes should change although they recognise that some young teachers are more pragmatic and recognise the value of school industry collaboration.

The companies admit that it might be a problem to arrange enough industrial visits in certain regions because there are not many companies present in the region and because the proximity of the company is an important criterion as well for the schools as for the companies. However, they add that the shortage of industrial companies willing to organise school visits might also have to do with the fact that schools tend to choose big companies. Therefore also small and medium size enterprises should be better known and they should also feature on the platform for school-industry collaboration together with existing projects. For the regions where the industrial capacity is insufficient to cater for all schools, virtual visits can be organised instead of in situ visits and training courses can be offered online. The MOOCS (massive open online courses) prove that online courses can be very successful. Also in the framework of the Maisons de la Science (Science centres) some training courses have been given online. The university of Strasbourg already organises online courses in certain faculties (inter alia in Arts).

2.1.4 Key challenges in maintaining the school-Industry collaboration

In order to maintain the school-industry collaboration it must remain attractive and useful as well for the school as for the company. It should clearly remain a win-win situation for parties involved.

As the teachers are the ones who decide what happens in the classroom, the representatives from industry think it is important to initiate collaboration with teachers' associations. Once some teachers have been convinced, these teachers could be disseminating the success of their projects. Representatives from industry think that in order to better disseminate the success of flourishing projects, social media (Linkedin, Facebook, and Twitter) should be used to valorise these projects and also make them more visible. Industry representatives also point out that the link with industry should be more visible when communicating about existing initiatives and collaboration school-industry.

In some cases school heads are unwilling to adapt the timetable of the lessons to enable certain forms of cooperation school-industry such as visits to companies or practice periods (internships) in companies or to maintain them.

Time or the lack of it is also a challenge for industry. In the framework of their Corporate Social Responsibility (CSR) companies could commit themselves to spending a number of hours or days a month to the school-industry collaboration.

The cost of training pupils is quite high and it would therefore be more cost-efficient for companies to train teachers who in turn are better equipped to train their pupils.

[10] Vocational education and training

2.2 CONCLUSION

It can be concluded that the representatives from industry are willing to invest in school-industry collaboration because of the present shortages in STEM careers on the labour market.

Although they meet certain challenges and difficulties in collaborating with schools the representatives from industry are willing to invest in school industry cooperation and they hope that the school-industry collaboration will lead to more and better STEM graduates and to a better knowledge of what is going on in industry and of industrial careers.

Chapter 3: STEM Education – The School Perspective[11]

3.1THE CURRENT SCHOOL-INDUSTRY COLLABORATION

The main involvement with industry of the schools at national level happens in collaboration with Foundations like C.Génial or “La main à la pâte” (hands on Science) or in collaboration with structures like Vigie Nature (Nature watch) and Sciences à l’école (Sciences at school). There are also numerous science centres or museums in France like Universcienceand la Cité des sciences et de l’industrie de la Villette (and others) that facilitate the collaboration between school and industry. Moreover there are organizations like the Femmes et sciences” (women and sciences) association that are specifically targeting women.

3.1.1 Motivating factors and expected benefits for the school

The representatives of the schools and the Ministry of National Education hope that the collaboration with industry will help the schools to implement an active pedagogy and inquiry based science education so that pupils can learn better, can better understand science and technology and are better prepared to use science and technology in their personal and professional life.

The schools also hope that industry can help them find the necessary resources to implement this active pedagogy. In the first instance they think of sponsoring certain activities but they are also convinced that industry can help them develop better pedagogical resources and that sharing the experience of the companies and the schools will lead to better science and technology education.

Schools admit that there is sometimes a gap between the curriculum and/or teachers' perceptions of the industry and the actual practices in the industry and the real world of science and scientists.

Schools also see an opportunity for the professional development of their teachers. Teachers should be able to use the latest technology or know what the latest developments in science are. Industry can help the schools, the inspectorate or the national ministry of education to organise this type of CPD.

3.1.2 Industry profile preferred by school

The schools are adamant that the collaboration with industry should not be an advertisement campaign of the companies they are working with and that the collaboration should be based on the notion of partnership and a win-win outcome for both the school and the industry as far as education and training are concerned. They should be sharing their expertise and experience and thus support each other and thus come to a common shared culture.

The company the schools want to collaborate with should not be too far away from the school for practical reasons. Otherwise the benefits of the school-industry collaboration are outweighed by the costs.

3.1.3 Key challenges in initiating the school-industry collaboration

As was already mentioned before, schools and industry are two worlds that do not know each other. The teachers present at the seminar confirm that is easier to work with and share expertise with teacher training institutions or higher education or research institutions than with industry. Moreover there are the challenges

[11] Please report from the information obtained during the national needs analysis workshop.

of how to finance the collaboration and the question of what the long-term outcomes of the collaboration should be.

The schools that have already collaborated with industry point out that they have rarely had the experience that companies wanted to sell their products and thus were only interested in cooperation for commercial resaons. However, in order to alleviate the fear for this kind of company interference and remove this obstacle it is suggested that an institutional relay should be put in place and that the Dgesco or the Ministry of National Education should secure the partnership by signing overarching agreements with companies or industrial sectors. In fact partnerships could be concluded between the Dgesco or the Ministry of National Education and industry.

Another challenge is to make **the demand for collaboration school-industry meet the supply**. Although a lot of initiatives are taken, the needs of the schools and the industry are not met. Moreover some of the initiatives and tools that are available are not fully taken advantage of. There are plenty of initiatives but teachers do not know what is really valuable and what is most suitable for them. This means that there is not enough communication about the existing initiatives and that better communication should be put in place. Also here the Dgesco or the Ministry of National Education could play an important role.

In 2012 the CAST (Correspondant académique science et technologie), Academic correspondents for Science and Technology, were created. They could or should play an important role in developing school-industry collaborations. However, many of these CAST are still trying to define their role. Also the IPE (Ingénieurs pour l'école), Engineers for schools could play an important role in initiating school-industry collaboration. They were indeed created to bridge the gap between schools and companies.

It is suggested that a regional or national website could be set up listing the existing initiatives and the resources that have been developed and are available. The representatives of the Dgesco and the Ministry of National Education point out that the existing subject related platforms and websites are not used frequently and are little taken advantage of. In fact the intended platform should be a place where demand and supply can meet and where pedagogical resources are put at the disposal of all teachers and where existing initiatives and resources are shared. The problem is not that there are not enough initiatives but the fact that the existing initiatives are **not visible enough**. The positive example is given of PrimTICE (ICT for Primary schools) that is quite successful and well known and where the website of the Ministry of National Education has contributed to its success.

The suggested platform could be an environment where there could **be communities of practice and where teachers could exchange on their respective experience**. This platform could also strengthen the sustainability of the InGenious project, being an environment where more support could be provided for that type of community to be developed at national level.
Also the fact that **collaboration with industry is not valorised in the schools** (no recognition of investment of teachers in it!) and is not taken into consideration when evaluating teachers and pupils is a considerable challenge. However, it is pointed out that the activities resulting from school-industry collaboration can be assessed through the evaluation of the key competences (socle commun des compétences) acquired by the pupils. Some teachers also state that it is easier to evaluate school-industry collaboration when it is integrated into a project. The collaboration school-industry should also be taken into account when drafting new curricula and programmes.

Time or the lack of it is one of the major challenges. Collaboration with industry is a time consuming job as well for the teachers as for the representatives from industry. A visit to a company should be well prepared and there also needs to be follow-up otherwise it will probably not be efficient and effective. Very often it is the responsibility of one teacher although it should be a team effort within the school. Other teachers should not only be interested but also share the work. When the work is shared and distributed in a different way it would be easier to implement school-industry collaboration. The work within the school should also be organised in a different way. More courses could be developed together with other teachers and industry, thus saving time that is otherwise used to develop course materials. Thus, pedagogical resources of excellent quality can be made available which save time for the teachers so that they can then devote more time to other aspects of the collaboration with industry. It is therefore important to find tools and practices that can

be distributed and disseminated on a large scale. Long term partnership will be more interesting than short term projects, enabling schools and industries to plan a common project in all its components.

Certain teachers are rather sceptic about school-industry collaboration and wonder whether they should find their inspiration in what happens in industry to make their lessons interesting. They also wonder whether the school-industry collaboration has an impact on the pupils. Teachers who have already participated confirm that there is an impact on the pupils if the visits are well prepared and are part of a pedagogical framework. This can be prepared by research organisations or science museums.

Teachers **also wonder whether companies would be able to arrange enough visits for all the classes** (e.g. three visits per year). Especially in certain regions this might be a problem. In order to manage the flux of students to companies they ask whether it would be possible to have a calendar on the website of the company indicating when the company can be visited by schools. They refer to the visits to the musée des arts et metiers where visits are scheduled and booked by the teachers.

The cost of transfer to companies and the mobility of students is another challenge to be dealt with also because the transport of the students is the civil responsibility of the teachers.

Lastly there is the pyramidal hierarchical structure in France, which is in itself a challenge to be dealt with as all levels of the hierarchy have to agree with the collaboration between school and industry.

3.1.4 Key challenges in maintaining the school-Industry collaboration

Too many people in industry (especially the SME) show little interest for school – industry cooperation, and do not see which contribution industry and commerce can make to education.

SME and federations of industry are mostly interested in giving information to youngsters about the professions for which they need to attract youngsters as there are shortages. The focus should be much more on which competencies, skills, attitudes and knowledge youngsters can acquire which will be helpful in their future personal and professional life and which will raise their interest for STEM studies in HE. This doesn't exclude giving information about professions but the two should be combined.

As mentioned earlier companies should also focus much more on CSR, Corporate Social Responsibility, showing to youngsters how companies contribute to develop and strengthen a sustainable society with companies which take their societal responsibility. Companies can show how STEM education and certain STEM careers can contribute to bringing about a more sustainable and ecological society. As the ROSE study has shown girls are especially attracted by those 'social or societal/social ' careers

The fact that certain companies (especially SME) are not interested in school – industry cooperation is reflected in the fact that the employees are not interested to be involved in it.

If things are to change companies in general and SME in particular, will have to mobilise their employees in various ways to invest time in school –industry cooperation. This can happen by training members of company staff to intervene in school to inform teachers and pupils about life incompanies. It is also important to organise activities for youngers that enable them to acquire certain knowledge, skills, competencies and attitudes through cooperation with industry. These issues should be thoroughly discussed when representatives of industry and schools prepare their cooperation and discuss concrete activities.

Companies should also be made aware that employees involved in school - industry cooperation by intervening in classrooms or schools are very enthusiastic about such activities. Experience shows that they are more motivated for their own job in company afterwards.

To maintain an existing school – industry cooperation it is important to evaluate on a regular (annual!) basis the impact of the cooperation. Subsequent to the evaluation the cooperation can be modified taking into account new needs of the schools and the new expectations and possibilities of the companies.

3.1.5 Benefits and challenges schools encounter during the activities/practices

Schools have difficulties organising school – industry cooperation as it is not explicitly part of the curriculum. Both for pupils and teachers it is often seen as something extra added on to the curriculum and hence it is seen as an extra burden. There is a lack of flexibility of the curriculum and of the school organisation to integrate cooperation school – industry in it. However, certain schools think that if competitions such as the CGénial competition were part of the curriculum they would not be that successful and pupils would not have that much fun participating in it.

Especially rural schools may have specific problems to be involved in school – industry cooperation. It will be more difficult for them to go and visit companies and company representatives will be less willing to travel great distances to go to such schools. Other possibilities will have to be looked into such as a bus (promoting industry) travelling to schools in rural areas.

Cooperation school – industry should have clear objectives which are agreed upon and laid down in a cooperation contract. Such a contract will define the activities to be involved in, the support the school can expect from the company, what the company expect from the school etc. This contract will also foresee a regular (possibly) annual evaluation of the cooperation to improve it.

3.2 CONCLUSION

The schools conclude that they highly value the school-industry collaboration on the condition that industry takes into account the needs of the teachers and the needs of education and training and plays an impartial role. Cooperation school – industry should therefore have clear objectives which are agreed upon and laid down in a cooperation contract. It should definitely not focus on commercial purposes to promote certain products within schools.

Schools think that there might be problems in certain regions for school-industry collaboration because there are not enough industrial companies available. They therefore think it might be appropriate to make use of modern technologies such as virtual visits or travelling buses etc.

The schools especially see a role for industry as far as the professional development of the teachers is concerned. Industry could help the schools bridging the gap between education and the labour market.

Chapter 4: The design and implementation of STEM practices[12]

4.1THE DESIGN OF STEM PRACTICES

4.1.1 Degree of collaboration between teachers and STEM professionals

For the moment the collaboration between teachers and STEM professionals is mostly limited to the vocational and technical schools. The collaboration in the framework of traineeships of pupils is usually the main type of collaboration and teachers try to find qualitative traineeships for their pupils. Industry also provides traineeships for teachers where the latter could update their skills and get acquainted with new technologies but these are not a success. The main reason for this lack of interest could be that teachers have to do those placements during their holidays.

Next to this collaboration that is usually practised in VET-schools, industry often participates in school boards (especially of VET schools) and representatives from industry participate in the final integrated tests of the students in technical and vocational schools. Also in the professional bachelor programmes (IUT) and in the BTS (Short cycle higher education, two years) there is a structured collaboration between education and industry.

In general secondary schools the collaboration between school and industry is far less structured if not non-existent. Sometimes there are STEM professionals that visit schools such as in the framework of e-skills week or campaigns to motivate more youngsters for STEM careers but there is rarely a real structured collaboration in those schools. It is hoped that this will change when a structured policy or action plan is develop, possibly through the mediation of a platform.

4.1.2 Characteristics which make practices successful to design

There are a number of characteristics that make practices useful but also attractive and successful to design. Strong and efficient cooperation between education and companies to promote STEM should be built on a virtuous relationship between school and industry.

Moreover, cooperation school – industry to promote STEM **should be set up and encouraged at all levels of education**: primary, lower secondary (collège) and upper secondary (lycée). Cooperation between school and industry should also **include cooperation with research institutions ad researchers**. Either visits to research centres or involvement of researchers in the classroom. It may involve different groups of people: the company staff or researchers, teachers, teacher educators, HE students or PH.D. students as tutors (buddies, role models), parents etc. If HE students are involved it should be part of the normal student activities and rewarded through e.g. ECTS credits. This exist already in some universities or Grandes Ecoles in France and in many HE institutions across Europe.

Cooperation school – industry should **have clear objectives which are agreed upon and laid down in a cooperation contract**. Such a contract will define the activities to be involved in, the support the school can expect from the company, what the company expects from the school etc. This contract will also foresee a regular (possibly) annual evaluation of the cooperation to improve it.

A **clear policy and strategy developed by the ministries concerned** (ministry of education and ministry of HE and research) will create a solid basis for the development and implementation of strong and lasting school – industry cooperation. There should also be clear legal basis to support and facilitate it, thus encouraging cooperation school – industry.

[12] Please report from the information obtained during the national needs analysis workshop.

Integrating the collaboration into school programmes and curricula or in projects would also enhance the success of school-industry collaboration as it wouldenable teachers and heads to evaluate and valorise the activities. There should be a clear link between the activities set up in the framework of school – industry cooperation and this so-called "Socle des competences clé" or key competences framework. The knowledge, competences, skills and attitudes acquired by the pupils within the activities focusing on school – industry cooperation should be assessed as part of the normal education process.

The participants all agree that first of all the school-industry collaboration **must be backed by the school** and especially the head of the school as well as by the **company.** The school organisation should be **flexible** enough to enable the development and the implementation of concrete cooperation activities. The autonomy of the school should be used to enhance flexibility. It goes for itself that the backing of the ministry is a key condition to make this work

School –industry cooperation should be part **of the pedagogical plan and of the pedagogical strategy of the school**. The cooperation should be integrated in the school year at different moments and not be limited to a one event. It should possibly also be integrated in the continuous professional development (CPD) plan of individual teachers.
The role of the head, his management and the board of governors of the school is crucial to the success of the cooperation.

School – industry cooperation should also be **supported by the inspectorate**. They should be trained to understand the full potential of school –industry cooperation to promote STEM. They should also be trained to support schools in implementing strong cooperation school –industry. They should take into account school –industry cooperation when drafting inspection reports based on visits to schools and teachers.

Cooperation school –industry should not be limited to visit to companies or to small internships or placements in companies. It should also focus on (joint) **development of pedagogical materials or tools**, sharing equipment or expertise, involving company representatives in professional counselling processes etc. The **knowledge** of teachers and of persons in the company **must be shared**. There are a lot of tools of the companies that can be useful in education. If the teacher and the company share their knowledge this can lead to high quality outcomes.

It would also be interesting if companies and schools were **sharing industrial equipment or buying equipment together** thus bringing down the cost. Companies could also give the possibility to schools to use their equipment in order to train pupils or teachers and heads of school should be sitting together to prepare together the purchase of e.g. ICT equipment. Teachers should also be used to train company personnel within the company.

Cooperation school-industry should **be focusing on active an innovative pedagogical approaches** in STEM education such as IBL, Inquiry-based Learning or problem-solving, project work or business games. The pedagogical approaches should take into account both the competences of the teachers and of the representatives of industry. Cooperation activities should also focus on multidisciplinary approaches including STEM subjects and other subjects such as native language or foreign language etc. Thus, there could be team teaching involving two ormore teachers from different STEM subjects or involving both a teacher and a representative of a company. Even HE students could be involved at this level as they will act as role models for the pupils in the schools.

The development of strong cooperation school – industry should also include possible placements or shadowing periods in companies in other European countries funded through the appropriate education and training programmes of the Commission.

The involvement of members of the staff of the school and of the company will bring about knowledge, competences, skills and attitudes which are **useful in their respective professional context and environment**.

The objective of the cooperation school –industry should also be the **continuous professional development of the teachers and of the staff of the companies.** Thus, the contribution from the representatives of industry should be seen as part of the CPD of the teachers and the sharing of expertise with the teachers could also be

seen as CPD of the staff of the companies. Cooperation school – industry should focus both on individual CPD and on collaborative CPD involving various teachers of one school. In this way it will become a win-win relationship for both.

Good project management can also make a project successful. In this respect it is interesting to know that e.g. Dassault has given training in project management. Tecahers should be trained to manage projects so as to make best use of them.

The **search for partners** and the fact of being part of a real partnership can also **be gratifying** and make the project or activity successful. Networks of agents of education and companies should be created to stimulate exchanges of expertise and experience.

Some participants think that in order to be successful the projects should be **innovative** and leaping forward whereas others think that innovation should be introduced step by step.

4.1.3 Characteristics which make practices challenging to design

Schools have difficulties organising school – industry cooperation as it is no **explicit part of the curriculum**. Both for pupils and teachers it is often seen as **something extra added** on to the curriculum and hence it is seen as an extra burden. There is a lack of flexibility of the curriculum and of the school organisation to integrate cooperation school – industry in it.

In some cases **heads of schools are unwilling to adapt the time table** of the lessons to enable certain forms of cooperation school – industry such as visits to companies or practice periods (internships) in companies.

Especially rural schools may have specific problems to be involved in school – industry cooperation. It will be more difficult for them to go and visit companies and company representatives will be less willing to travel great distances to go to such schools. Other possibilities will have to be looked into such a bus travelling to schools in rural areas. The ASTEP initiative (see annex II) involving engineering students or M2 students who intervene in primary schools to support science teachers is meeting the same problems.

4.1.4 Funding to design STEM practices

In order to design practices there is not so much funding needed. However human resources are needed as well in the schools as in the companies to design good practices. National authorities but also industry should make sure that in order to design these practices people have to be freed from other tasks

4.2 The Implementation of STEM practices

4.2.1 Fitting STEM practices within the school curriculum

As mentioned above the collaboration between school and industry should be based on the acquisition of the key competences of the “Socle de competences clé” (framework of key competences). A clear curricular framework that supports the implementation of school –industry cooperation to promote STEM would also enable students to see it as part of their normal curriculum. The collaboration school-industry should indeed not be a stand-alone activity but should be integrated in the programme of the pupils and be seen as a way to acquire key competences as described in the “socle commun des competences clé”, the framework of key competences defined by law in France.

In order to make the STEM practices fit in the curriculum the activities and projects should be integrated in the annual pedagogical plan of the school. The CPD plan of the tecahers is in its turn based on it. This would definitely facilitate the implementation.

4.2.2 Characteristics which make practices successful to implement

In fact all the characteristics that make practices successful to design also make them successful to implement. As well as for designing the STEM practices it is also crucially important for the successful implementation of the STEM practices that the head of the school (and also the school board) as well as the CEO of the company and the inspectorate support the project or the practice.

Cooperation should be built **on clear agreements between the two partners laid down in a contract with** clear objectives, agreed activities, and evaluation to improve. The contract should clearly focus on a win – win situation for all parties involved.

Schools could be **supported by organisations specialised in stimulating school –industry cooperation**. These organisations should act as mediators to facilitate school – industry cooperation and to help implement the school-industry collaboration.

In order to implement practices successfully industry should take into account **what the schools or the teachers need and what they will use.** The involvement is motivating for the teachers and will enhance and facilitate the implementation.

Several participants also stress that in order to implement STEM practices successfully cases or materials should be designed that can be made available to a great number of teachers. **Advertising certain "good" practices and projects on academic websites** can thus be a way of securing the success of a project. However, the best advertisement for a project is the fact that teachers enjoy participating in it and that they have a positive impact on their colleagues and peers. Interest and active participation of parents is also an important element to promote school – industry cooperation and make it sustainable within the school.

The practices must be experienced as useful as well by the school as by the company. It should be seen as a win – win operation for both the partners. As well the teachers as industry should be involved in designing the practices. Thus**, the sharing of expertise and/or equipment** can really make the practice successful.

In order to be effective the involvement of companies in schools and classes should **be well prepared, carefully implemented and possibly thoroughly followed-up** in close contact with the partners in the schools.

If the existing **tools and resources in foundations**, associations, companies, ministries and other local or regional educational authorities and in individual projects were **pooled** it would definitely increase the chances of success. Projects should in fact be multi-industrial. A STEM community could be set up where not only STEM practitioners from France but also from Europe could meet. This could lead to twinning on a French and European scale. The development of quality cooperation school –industry should be supported by collecting and disseminating good practices at national, European and international level.

The involvement of teachers and other members of staff in school –industry cooperation should get some form of **reward or recognition**. The school-industry collaboration could be **recognised and valorised** e.g. through a kind of ceremony focusing on teachers, pupils and schools. Teachers could be granted a special label and this could also apply to schools. As far as the pupils are concerned the activities within the school-industry collaboration should be also be evaluated in terms of competences, skills and attitudes acquired. In fact it is essential that the efforts of all participants are recognised and valorised.

Taking advantage of modern technologies can enhance the success of school-industry collaboration. Next to in situ visits of companies open and distance trainings and visits can be organised. Good quality tools and resources can also be made available online thus saving time for as well the companies as the teachers concerned.

4.2.3 Characteristics which make practices challenging to implement.

One of the key difficulties to develop and implement good practices in school industry cooperation in STEM is how to mobilise and motivate all stakeholders in the world of STEM education in general and in schools in particular.

All those in charge of education at all levels should be aware of the potential of school – industry cooperation and how it can be a win-win operation for all partners involved.

Many teachers and heads of schools are suspicious of industry and commerce and do not really believe they can contribute to enhance the quality of education. Taking away this distrust is a major challenge.

Cooperation with companies - through structured partnerships - should not be seen by schools just as a means to secure sponsoring (some extra money for certain activities) or just as a means to get information about certain professions. It should be seen as an opportunity for pupils to acquire through the cooperation with industry STEM knowledge, skills and attitudes which can be useful in their personal and professional life. It may raise their interest and motivation for STEM which can result in later HE studies in these fields.

Heads of school are not aware of the importance of cooperation school – industry to improve STEM education and will not necessarily put this cooperation high on the agenda of the school HR development plan. This is definitely the case in primary schools and in general secondary schools, colleges and lycées.

A change in school culture (including a change of attitudes of the teachers, heads and other members of school teams) will have to take place to make those schools aware of the advantages of school – industry partnerships and cooperation to promote STEM and other subjects. A change in culture can only be brought about by giving better information at all key people in decision-making jobs and by giving professional development to both teachers and heads. Heads of schools should also be aware that parents (who work in companies!) can make a very valuable contribution to school – industry cooperation. In this way an institutional culture of partnerships focusing on school – industry cooperation can be developed. Such a culture should lead to the creation of a living tissue of representatives of school education and industry cooperating with one another to achieve the common goal of better education and better professional opportunities for all youngsters.

Vocational and technical schools by nature have paid and are paying a lot of attention to this cooperation school – industry as it is vital in terms of finding placements for their students to practice the technical and technological competences and skills and attitudes acquired in the VET school. If it is **not part of the pedagogical project of the school** it is not considered to be a priority for CPD. If a teacher is involved in it will be on an individual basis outside the other CPD activities.

The lack of interest of the head is reflected in the lack of interest of the teachers. Furthermore the teachers consider themselves to be ill-equipped to be involved in school – industry cooperation activities in general and to promote STEM in particular. There is no or little continuous professional development (CPD) focusing on school –industry cooperation. School –industry cooperation is not a part of the professional development plan of a teacher as it is not integrated in the school development plan. If teachers decided to involve themselves in school –industry cooperation it is in general without any recognition of their investment and time by the school or by the education system as such. Thus this kind of CPD focusing on school- industry cooperation will be organised outside their normal working hours. One of the key questions is how to valorise teachers for their investment in promoting school – industry cooperation.

CPD is organised in such a way that only a limited number of days are dedicated to it during one school year. In general CPD is not structured in a way to incite teachers to be involved in it. Teachers cannot be involved in in-depth CPD (which takes several days) as there is no money available to pay for replacement staff for the teachers who are being trained. There is furthermore no professional reward or official recognition given to the teachers who are involved in such CPD.

CPD is still seen too much as an individual activity of every teacher and not as a contribution to a collective effort to improve education in the school. CPD should focus much more on teamwork which is not the case at present. CPD should lead to the creation of learning communities of teachers who can compare their classroom practice. Reflection as a team of teachers on their professional activities is in many cases still not considered to be real CPD.

Pre-service teacher education furthermore is giving no attention whatsoever to school – industry cooperation in France. Most European countries do not focus on this kind of cooperation except in very few countries such as Scotland. Involvement of future teachers in tutoring activities to promote STEM should be looked into.

Cooperation school – industry in general and the dialogue between work and education to promote STEM education in particular is made difficult by the fact that the **different stakeholders are locked up in their own specific areas of work at institutional level.** There are few contacts on this topic between the different ministries, between the regions and the 'rectorats' (the administrative structures at regional level in charge of education). There is no or little cross-fertilisation between all the stakeholders.

The cooperation and dialogue school – industry on how to promote STEM education is also impeded by the fact that there is **no culture of cooperation between those two groups**. There is a kind of distrust between the two which makes it difficulties for the two partners to understand how a balanced win-win situation can be set up.

To solve this distrust more possibilities should be set up for education and industry to meet, to set up a dialogue with one another and to exchange on what they can do and how they can do it. If cooperation school – industry is to be successful it has to be based on co-conception of joint initiatives which are characterised by a win – win situation for all those involved. Representatives of education and of companies could also meet in the framework of a platform for STEM education.

4.2.4 School-industry collaborations that would be positive from the educational point of view but that are not feasible to carry out.

The main problem that was mentioned concerning school-industry collaboration that would be interesting from an educational point of view but not feasible to carry out were industrial visits of pupils from rural schools. Although some of these schools are interested in school-industry collaboration it is often not feasible because of the lack of industrial companies in the area. Visits to companies (or visits from representatives of companies to schools) would become too expensive and time consuming. Therefore the possibility was mentioned of virtual visits or online courses.

Another item that was mentioned was the training of pupils of VET-schools. Although several companies admitted it would sometimes be interesting to train pupils from technical or vocational schools, they generally prefer to train the teachers because this is more cost-effective;

4.2.5 Funding for implementing STEM practices

One of the key problems to promote school – industry cooperation is how to finance it especially when it concerns SME as they have little or no funds to invest in such activities. Finances are e.g. Necessary to pay transport of pupils to companies to visit them. Hence it is very important when discussing cooperation with industry that schools explicitly discuss this issue and look at all the financial implications of cooperation.

Many of the projects that have been presented are organised by associations, foundations or organisations that point out a lack of resources or funding to implement their activities. They add that it is difficult to find adequate funding.

Schools very often hope to find sponsoring through companies. This vision of school – industry has to be enlarged on the one hand focusing on knowledge skills, competences and attitudes that pupils and teachers can acquire through such cooperation as mentioned earlier and on the other hand working on career orientation and future studies in higher education.

It is suggested to propose to use part of the "taxe d'apprentissage" (learning or professional development tax) to finance school – industry cooperation. This would mean that part of these taxes paid by companies can be given to schools if they prove that they set up a well-structured cooperation project between school and industry with clear target groups, well-defined objectives and activities, a solid appropriate pedagogy taking advantage of the cooperation between school and industry, a thorough evaluation of the results for pupils, for teachers and for the school etc.

4.3 ASSESSMENT OF THE IMPACT OF STEM PRACTICES

4.3.1 Definition of clear objectives in the school-industry collaboration

Although the main objectives of the schools and the companies in initiating school-industry collaboration are the same viz. motivating young people for sciences and the jobs and careers in STEM the focus in schools is more on offering attractive and quality STEM education whereas the focus with industry is mainly on attracting more youngsters towards STEM careers.

It is therefore not surprising that the projects that have been initiated by industry are virtually all geared towards getting to know better the industry and its professions or on promoting entrepreneurship.

On the other hand the projects initiated by scientific organisations like la Fondation la main à la pâte focus in the first instance on better and more attractive STEM education.

One does however not exclude the other. On the contrary, scientific research has shown that there is a clear link between motivation and achievement and young people who do well in STEM subjects might more easily turn towards STEM careers.

As mentioned earlier pupils make their professional choices based on their interest in a certain area or field &nd taking into account the job opportunities in the area concerned.
Positive contcats with science and technology at a young age may have a positive impact in the long term whereas a negative experience concerning science at school will also have a negative impact on career choices later on.

Research into this could reveal interesting information which could be beneficial to student career counseliing. It is also advised to take into account the results of key research studies such as those of the ROSE project (Relevance of Science education, University of Oslo and others) in general and in particular to raise the interest of girls for certain STEM careers in particular.

4.3.2 Use of evaluation methods to assess the impact of collaborations

All participants agree that the collaboration school-industry should be assessed and that especially the impact of the collaboration should be measured in terms of impact on the choice of study and careers of the pupils and students who have participated in the initiatives. It is suggested that the impact could be measured in collaboration with research institutes that have already assessed the impact of other initiatives and that have the tools to measure this impact.

4.4 CONCLUSION

As well industry as the schools want to assess the impact of the school-industry collaboration. Although it will be fairly easy to measure the quantitative impact of the collaboration (more students and graduates in STEM) it will be much more difficult and time consuming to assess the qualitative impact of the school industry collaboration.

Assessment of school – industry cooperation should be carried out by the different partners concerned: the schools and the industry in collaboration with research institutes.

Tools should be developed to facilitate the assessment. It could also prove to be useful to look at the assessment tools that have been developed by different other European countries to assess school –industry cooperation.

Chapter 5: Recommendations and Conclusions[13]

5.1 RECOMMENDATIONS

5.1.1 Recommendations for national STEM policy

Cooperation school-industry in order to enhance STEM should be integrated into the school programmes and curricula, not only of technical and vocational schools but also of general secondary schools.

The Ministry of National Education should encourage all schools to set up cooperation projects with industry. Furthermore the ministry should invite all schools to involve their teachers and pupils in two projects per year; these could be visits to companies or other activities.

The inspectorate should also promote school –industry cooperation. However, they will only do so if they themselves have been trained in this field, have had experiences and are convinced of the many benefits of school – industry cooperation.

CPD should be organised focusing specifically on school-industry cooperation as part of the professional development of the teachers interested in it. This means teachers should trained to be able to set up and be involved in school industry cooperation. Thus it should be integrated in the PAF, the Plan Académique de Formation. The CAST, the Correspondant Académique Scientifique et Technologique, could support the development of school – industry cooperation to promote STEM if his or her brief is enlarged to do so.

Cooperation school –industry should also be integrated in pre-service teacher education. The possibility should exist for future teachers to take a module during their initial training to get to grips with school – industry cooperation. Future teachers could be involved in school industry activities (e;g. visits to companies) while doing their Erasmus mobility (SMS opr SMP) . Representatives from companies could also be involved in ESPE or teacher educators from ESPE could be involved in companies abroad. This within the framework of Erasmus staff mobility.

More use should be made of the existing information and communication technologies in order to enhance school-industry cooperation: amongst others virtual visits to companies could be organised, web-based experiments relying on some authenticity and industrial based activitiesmaterial could be carried out and resources could be made available on-line.

A website or portal should be launched focusing on school-industry cooperation involving all the key stakeholders in education and in industry at all levels. The decision-makers (ministries and local or regional educational authorities), the companies or national or sectorial organisations of companies should be involved, teachers and teachers' unions should also be involved together with parents' associations.
This website should describe all key initiatives in this field, give information about all the key agents involved and should facilitate the matching between schools and initiatives.

Several countries across Europe have developed such a kind of platform to promote STEM focusing inter alia on initiatives built on cooperation school – industry. In those countries this platform coordinates all school – industry cooperation activities or all activities to promote STEM (including school-industry collaboration) for which the ministry and/or industry make available money to schools on a project basis.

The first steps subsequent to the March 2013 Paris Ingenious seminar could be to send the present report to the Ministry of education and to suggest the organisation of a seminar in which all key stakeholders involved in industry – school cooperation could be involved. The Ingenious report and the Livre blanc of la Fondation la main à la Pâte prepared for the May 2013 seminar on professional development of science teachers, could be presented as a starting point for discussions to collect the first ideas for such a platform..

[13] Please report from the information obtained during the national needs analysis workshop.

Such a platform could according to the participants to the Ingenious seminar i.a. focus on the following activities:

- Develop a coherent reflection on industry – school cooperation to promote STEM education;
- Support policy-makers and decision-makers in developing policies to promote school –industry cooperation to enhance STEM education;
- Organise a meeting place for stakeholders in education and representatives of companies to reflect on and improve school – industry cooperation;
- Stimulate dissemination and valorisation of information of good practice concerning existing school – industry initiatives to promote STEM by organising a website and other dissemination activities such as workshops, seminars etc.
- Stimulate cross-fertilisation across different school – industry cooperation initiatives promoting STEM
- Promote institutional cultures both in schools and in companies to strengthen school – industry cooperation;
- Enhance the sustainability of the school – industry cooperation initiatives;
- Bring together companies that intend to set up cooperation school – industry to promote STEM education;
- Organise matching between the demand of schools and the offers of companies as to school – industry cooperation;
- Create synergies between national or regional, local initiatives and link up with the existing activities in the framework of the InGenious project;
- Etc.

Such a platform should not be a straightjacket and pilot monolithically school – industry cooperation. It should support the development of all possible ideas and initiatives concerning more and better school – industry cooperation to promote STEM across Europe.

5.1.2 Recommendations from industry

- Companies insist that the activities that are proposed in the framework of school-industry collaboration should not take too much time and shouldn't disturb the activities of the company.

- Initiatives that can be carried out at any moment of the school year are much easier to implement taking into account the agenda of the company staff member than activities that have to take place on pre-set dates during the school year.

- The activities proposed to the companies should be ready to implement and easily repeated. The representative from industry should be given all tools and information needed to implement the project. The activities and tools should be easily adaptable and the time spent on the preparation and the implementation of the project should be limited.

- Some companies prefer to delegate their involvement in a project to an association. Thus, the company would be able to continue its activities normally although some of its employees might dedicate some of their free time or working time to the project. If associations are involved they mainly support companies in terms of logistics and administrative issues such as insurance, transportation, paperwork related to the righ of image (persmiison to publish pictures of students), assessment surveys etc;

- It is important to invest in good and convincing communication and to dedicate enough resources to it. By communicating success stories of successful initiatives that are being implemented and are developing, other companies might be interested in participating in school-industry collaboration. Companies and staff involved in school-industry collaboration should testify about their involvement and thus attract followers.

- The school-industry activities can be regarded as activities in the framework of the CSR (corporate social responsibility) of the companies. They can be a lever for other CSR activities.

5.1.3 Recommendations from schools

For the moment too many teachers are still preparing and implementing the school-industry collaboration in their free time. Therefore a number of measures should be taken in order to facilitate school-industry collaboration.

- As mentioned above, the teachers but also industry would like to see school-industry initiatives integrated in the school programmes and curricula. Thus the time invested by the teachers in school-industry collaboration would be valorised and valued.

- The management of the schools (the heads, their management team and the board of governors of the school) plus the Recteurs d'Académie and the inspectors should see to it that school-industry cooperation is integrated in the school HR development plan (which exists in several EU countries) and in the individual professional development plans of the teachers. The backing of the head and other members of the board of management is a key element to incite teachers to get involved. Schools should be incited to use their autonomy to promote school-industry cooperation.

- The involvement of the teachers in projects and the collaboration with industry should be recognised as a professional competence and the CPD of the teacher should include these competences.

- The involvement of the teachers should be better rewarded and valorised. This is only possible with the support of the hierarchy. Rewards like the ones given in the framework of the national C.Génial competition (accompanying the pupils to the national final or visiting a company with them) or of European inititaives such as Science on Stage (a European initiative designed to encourage teachers from across Europe to share best practice in science teaching) are considered to be gratifying and motivating for the teachers to be further involved in school-industry collaboration.

- Teachers should be able to rely on a coordinator in their school who would be responsible for finding partner companies and dealing with the administrative burden, thus facilitating the work of the teacher who would only have to concentrate on implementing the project itself.

- In each Académie (academic district), Academic Correspondents for Science and Technology (CAST) have been appointed since the beginning of the academic year 2012, who have to coordinate the activities promoting scientific culture. Their role should be clarified and also extended to counselling and accompanying teachers in designing and implementing school-industry collaboration. The CAST could also have the responsability of online community manager concerning school – industry cooperation.
Furthermore there are in the Académies also CARDIE (Conseiller académique en Recherche-développement, innovation et experimentation) who are advisors promoting research, development, innovation and experimentation in education in school education. Cooperation between the CAST and the CARDIE concerning school – industry cooperation is strongly recommended. In some cases the CARDIE and the CAST are the same person.

5.2 BRIDGING THE GAPS

5.2.1 National short-term objectives

For the moment there is no national strategy on school-industry collaboration to promote STEM although a lot of initiatives are supported and funded by the Ministry of National Education in order to enhance STEM education in schools. Most of these initiatives are focusing on the in-service training of teachers in technical and vocational schools or in-service training of teachers in STEM subjects.

The short-term objectives of the companies to be involved have to do with the fact that they want to make STEM careers better known and want to attract more students to STEM studies and careers. For the moment companies are indeed faced with shortages on the labour market as far as STEM careers are concerned and they want to find enough well trained youngsters willing to take on a career in STEM.

The objectives of the schools concern mainly the fact that they want to offer attractive STEM education and want to enhance the competences of their teachers in STEM.

5.2.2 National long-term objectives

For the moment the long-term objectives are identical to the short term objectives and still very general. In order to keep the existing initiatives and activities efficient and effective they must be implemented by highly motivated partners.

However, the school-industry partnerships are often fragile in the long-term because they rely on a personal relation between two persons. Therefore it is better to have an intermediary organisation to support and maintain the partnership.

As far as the involvement of companies is concerned it is also better to work with intermediary organisations that can recruit several companies in order to cooperate with the National Ministry of Education.

5.3 CONCLUSION

It is clear that there should be a national strategic plan in order to enhance school-industry collaboration to promote STEM. It is also clear that the building blocks for such a strategy are present and that the existing initiatives could be the basis for a comprehensive strategy.

As well schools as industry stress that there should be a comprehensive approach involving all levels of education and all forms of learning.

LIST OF ABBREVIATIONS

ASTEP: Accompagnement en Sciences et Technologie à l'Ecole Primaire – Support for Sciences and Technology in primary schools

ATSS (personnel) : Adminsitratif, Technicien, Social et de Santé)

CAST : Correspondant Académique pour les Sciences et la Technologie

CPD: Continuous Professional Development

CSR: Corporate Social Responsibility

Dgesco: Direction générale de l'enseignement scolaire – Directorate General of school education

DP 3: Découverte Professionnelle – Professional discovery (3 hours)

DP 6: Découverte Professionnelle – Professional discovery (6 hours)

ECTS : European Credit Transfer and Accumulation System

PAF : Plan Aacdémqiue de Formation

PISA: Programme for International Student Assessment

ROSE: The Relevance of Science Education study

STEM: Science, technology, engineering, and mathematics

VET: Vocational Education and Training

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ANNEX I

inGenious: COLLABORATION SCHOOL-INDUSTRY IN FRANCE

Preliminary document prepared by C.Génial

INTRODUCTION

I-About this document: identifying initiatives in France

As part of the InGenious project, European Schoolnet, has organised in collaboration with the C.Génial Foundation, a seminar to reflect about cooperation School-Industry in the areas of science, technology, engineering and maths (STEM).

This report was drafted in preparation of this seminar and to identify and collect the collaborative initiatives that have been organised in France by the Ministry of National Education (teachers, students, institutions ...) on the ne hand and the world of business and industry on the other to motivate young people to turn to studies in the fields of mathematics, science and technology and to make these studies more attractive.

The C.Génial foundation has tried to identify initiatives in which companies are directly involved. They mainly identified initiatives aimed at primary and secondary education.

The identification of best practices was carried out through an online questionnaire by the C.Génial Foundation, a Foundation for Scientific Culture and technology created by six major companies (Areva, Technip, EADS, SNCF, Orange and Schlumberger) with the aim of encouraging young people to move into scientific professions:

https://www.surveymonkey.com/s/inG_Practices_FR

This link will remain active throughout the duration of the inGenious project.

II-School-Industry Collaborations: motivations and benefits

Collaboration between the world of Education and the industry is primarily driven by:

- The desire to educate young people on careers in science and technologies;

- Counterbalancing the stereotypes and misconceptions.

Students determine their career choice (and therefore also their study choice) depending on their interest in a particular area and their perception of the prospects of employment in this area. In addition, positive contacts with science and technology at an early age can have an impact on the long term, while a negative experience at school, is very detrimental to the future choices.

Teachers are a key factor in shaping the career aspirations: they transmit their vision to students. It is therefore very important that they are stakeholder in the initiatives and that the initiatives also address them. Indeed, there is sometimes a gap between the curriculum and teachers' perceptions of the world of science and scientists. A lot of teachers do not know the various career opportunities that exist in sciences. Updating their knowledge can be done by working with industry. Thus, the establishment of collaborations between schools and industry can contribute in a positive way to encouraging more students to turn to science and technology when they have to make their career choices.

Moreover, the involvement of employees in this type of collaboration also brings many benefits:

- Employers have much to gain from the participation of their employees in such activities because the skills developed through voluntary actions are relevant to the business;

- The analysis of the perception of employees who have participated as volunteers in the initiatives, shows that their motivation and commitment have increased through this participation;

- Collaborations with schools can also improve the reputation of the company.

III. Initiatives in France

Several channels were used to identify promising School-Industry projects:

- The Ministry of National Education listed a number of practices;

- The largest and most active companies in the field were contacted (Dassault, Systems, EADS, Intel, STMicroelectronics) as well as federations of companies (UIMM, UIC ...);

- C.Génial also approached Universcience (Palais de la Découverte or Palace of Discovery and the City of Science and industry) to see in which actions in this area they were involved;

- The AMCSTI (Association of Museums and centers for the development of scientific, technical and industrial culture) also participated in the census and forwarded the questionnaire within its network which allowed C.Génial to collect more examples;

- Finally, the activities carried out by the C.Génial Foundation have also been listed.

These channels have enabled to provide a representative picture of the initiatives in France although the list is not exhaustive and not all of all initiatives that have been organised in France have been listed. As noted above, the questionnaire is still accessible and this report will evolve until the end of inGenious project.

THE INITIATIVES IN FRANCE

Twenty initiatives based on school-industry cooperation were identified. These initiatives have been classified.

Almost every project places the student at the center and tends to give him an active role. In fact, many initiatives offer students the opportunity to conduct an experiment using objects, tools etc. Note that only one initiative is exclusively for teachers: "Teachers in business." It is also important to note that among these initiatives only 11 are developed at national level.

In each case, there is a strong business involvement in the preparation of the action with the world of education. The teachers were also asked to prepare their classes and monitor students as well in the case of projects that are carried out over a year, such as a competition or even when the activity concerns company visits. This is essential and can provide content suitable for students that meet the needs and objectives of both parties.

Most projects are run either by teachers or by active professionals of the the company. Partnership and exchanges start when designing the activity until the implementation and the follow-up.

I-Support for the implementation of project

Name of the initiative	"Partnership Agreement"
Organising structure	UIMM (Union of Industries and Trades in the Metallurgy)
Description of the initiative	Establish partnerships between a class or a group of students and business. Students will visit the company once or several times during the school year to complete their project. The projects range from the presentation of a profession or the production cycle for making a product or the construction of a metal object. The idea is to establish partnerships between a class or a group of students. In many regions a presentation day of the project is organized at the end of the year with a contest and prizes. Approximately 120 projects are organised and 2,000 young people participate per year.
Scope	National
Target audience	Teachers School students

Name of the initiative	"What to do in the world? A job! "
Organising structure	La main à la Pâte (The Foundation hands-on Science) and the Academy of Sciences
Description of the initiative	Lower secondary schools and companies combine their skills during the school year to carry out various projects that anchor the classroom practices in the reality of the professional world (wood industry, aerospace, construction of greenhouses, transport, etc.). This work was conducted within the framework of Integrated Science and Technology Education (EIST) initiated by the Academy of Sciences and supported by the Foundation hands-on science. Each year, there are 10 projects with 300 to 400 students.
Scope	National
Target audience	Teachers Heads of schools or other school leaders Secondary school pupils

Name of the initiative	Festival of Science and Technology with the project "a principle, a company, a manipulation "
Organising structure	Association Terre avenir (Association Future Earth) co-organized with the Aube des Sciences (Dawn of Science Association)
Description of the initiative	The classes are associated with a local company, to explore a physical, chemical or biological principle used in the manufacturing process. Visits, meetings, exploration and "restitution" as a "manipulation" or experience, that can be repeated by young people to their peers during the days of the Festival. A close partnership with the business has been established with a project manager within the company. In 2012, there were 9 stands, 9 classes (from primary to secondary education) and 9 companies (Malting Bellows, paper Emin Leydier Routes waterways, SITA Region East Greenhouses Mériot, DDT, Bonduelle catering, EDF, NPP, SAIPOL) who designed, manufactured and submitted a joint project (Entertainment was provided by the students).
Scope	Local
Target audience	Teachers Primary and Secondary education school pupils

Name of the initiative	Eurêkart
Organising structure	Michelin
Description of the initiative	Manufacture a scientifically challenging technological object in partnership with a local company. Participating in a research community and in the teamwork of researchersenables young people to acquire knowledge and know-how in science and technology.
Scope	Local (City Clermont-Ferrand)
Target audience	Teachers Primary and Secondary education school pupils

II. Competitions

Name of the initiative	Course en cours (Ongoing race in the courses)
Organising structure	Association « Course en cours » financed by Dassault Systèmes and Renault
Description of the initiative	Project for educational success deployed throughout the country. It is a multidisciplinary educational project focusing on science and techniques, developed by Dassault Systèmes and the University of Versailles Saint-Quentin en Yvelines in 2005. The project is repeated annually as a competition for junior and senior high school students. They have to design and manufactured miniature vehicles using the software (CATIA) and techniques identical to those used by the industry. Each year, 11,000 students participate in the competition. They are tutored by students in higher education. Therefore the project has earned the project the label "Cordées de la Réussite" (Groups roped together for success). This competition combines multiple technical and scientific skills with artistic work (design a graphic identity,design a stand),and a marketing strategy (search for sponsors), a communication strategy. Language practice is also important as students have to present the project in English before a jury. The project has received numerous awards including the "Creativity and Innovation 2009" award.
Scope	National
Target audience	Teachers School students Students of vocational and technical education University students

Name of the initiative	"Imagine the transport of the future"
Organising structure	EADS Foundation
Description of the initiative	A competition that is each year open to 24 lower secondary school students (6th, 5th, 4th classes) The classes participating in competition are located in the academies (academic districts) where the Group EADS is situated (Aix-Marseille, Bordeaux, Créteil, Nantes, Toulouse, Versailles). In order to help and support the students in their project, the students are supervised by the pedagogical team of their class and are put in contact with representatives of the the company. The " EADS Ambassadors" are employees of the Group EADS (EADS, Airbus, Eurocopter, Astrium, Cassidian). They introduce students to their job, their career as well as the diversity of careers in science and Technology. They also greet each participating class during site visits and can provide their assistance during the the project.
Scope	National: 6 Academies (Aix-Marseille, Bordeaux, Créteil, Nantes, Toulouse, Versailles)
Target audience	Lower secondary school pupils

Name of the initiative	"Competition C.Génial"
Organising structure	Ministerial initiative Science at School in partnership with the C.Génial Foundation
Description of the initiative	This competition allows high school students to present an innovative project in scientific and technical fields. Students are expected to use their acquired knowledge and skills from different scientific and technological disciplines (physics chemistry, mathematics, technology, life and earth sciences) for a scientific project. Preference is given to projects that are carried out in partnership with the world of science and in particular with scientific companies. These collaborations can take the form of methodological support (for example, the development of an experimental model) of hardware or software support, sharing of information, transfer of skills ...). The best projects are chosen in finals per academic district and in a national final The rewards for the winners include company visits (Schlumberger, Areva, Technip, Saint-Gobain, BASF, Total, Michelin, Asconit).
Scope	National
Target audience	Teachers Secondary school students Students of vocational and technical education

Name of the initiative	"Innovation Competition" (innovation Cup)
Organising structure	STMicroelectronics in France
Description of the initiative	The competition offers teachers the opportunity to participate in a contest with their class. The goal is to create an innovative tool of interest to industry. This can be part of an innovation competition organized by industry or focus on a theme (Eg in 2010: "Making life easier and better"). The top 3 proposals are rewarded prizes funded by industry.
Scope	Local
Target audience	Students from primary to tertiary education

Name of the initiative	CASTOR computer competition France
Organising structure	The French edition is organized by ENS Cachan, France IOI (Association Promoting French participation in IT International Olympiads) and the INRIA (Public Research Institute). Partners are: Pasc@line (NGO Promoting cooperation school and IT companies), CNRS, SIF (Computer Society of France and EPI (Association Public Education & IT
Description of the initiative	Castor Computer competition aims to help young people understand the computer and computational sciences.

	It was created in Lithuania in 2004, and is organized in 21 countries, including France since 2011. Each country organizes the contest independently in the same week, in accordance with common rules. Countries meet annually to prepare a set of questions, each of which performs its own selection of thirty topics, some of which are common to several levels of education. About 505 000 European students participated in the 2012 race. The competition is held every year around the beginning of November. It takes place under the supervision of a teacher, in the computer room. The 2012 edition was a great success, with more than 90,000 participants across 721 lycées and collèges from all over France. The competition covers various aspects of computing: information and representation, algorithmic thinking, application usage, data structures, logic games, computer and society. • The contest lasts 45 minutes and includes 15 to 18 questions. • It is free and requires no prior knowledge of computers. • The competition is divided into four levels covering the college and lycée: 6th-5th / 4th-3rd / 2nd / 1st-Terminale (final year). • Students participate alone or in pairs, in the computer room. • The competition takes place over a week in early November. • It can be performed at any time that week. • Detailed corrections are proposed shortly after the closing. • Prizes and diplomas are offered to participants according to their score. • The subject of the contest can be replayed online throughout the year.
Scope	National and international
Target audience	Pupils from collèges and lycées

There are many French science competitions and those mentioned above are those which were identified as having a link with companies (other than funding). It is however important to mention other major competitions such as Physics Olympiad France, the Olympics of Engineering Sciences, Geosciences the Olympics, the national Cemistry Olympics or the competition " Faites de la Science" (Hands on Science). A first document listing all the existing competitions in France is available at the Olympics of Physics website: http://www.odpf.org/pdf/repertoire_des_concours.pdf.

III. Women and Science

Name of the initiative	"Club of higher secondary students"
Organising structure	“Elles bougent” (Girls on the move) association
Description of the initiative	The project offers schools the opportunity to become partners of the association “Elles bougent” (Girls on the move) in order to enable them to teach their students the passion for science and encourage vocations of female engineers and technicians. The network “Girls on the move” includes companies, godmothers/mentors, higher education students and schoolgirls. Throughout the year, the members contribute by promoting the role of women in technical professions and in the industrial sectors. The partner schools commit themselves to communicating with their students on events and activities undertaken in the framework of the association and to promoting meetings between mentors and higher secondary schoolgirls. They facilitate the attendence of their pupils to the events of the “Girls on the move” association as they are the contact point of the association in their region. They also facilitate other activities that have the same objective. Through its partner institutions, the “Girls on the move” association tries to bridge the gap between the schools and the professional world in industry by increasing opportunities for meetings between mentors from industry and partner institutions and schoolgirls.
Scope	National
Target audience	Girl students in higher secondary education

Name of the initiative	"Actions in schools"
Organising structure	Association of “Femmes et Sciences” (Women and Science) in partnership with associations of Women and mathematics and Women Engineers
Description of the initiative	Members of these three associations show young girls and boys, their enthusiasm for their work, during visits and discussions.
Scope	National National (in particular regions Ile-de-France, Alsace, Midi-Pyrenees Rhone-Alpes)
Target audience	Students in lower and higher secondary education

Name of the initiative	"« Les filles, osez les sciences ! » ("Girls, dare to do science! "
Organising structure	Association of Women and Sciences 53
Description of the initiative	The action "girls dare to do science!" aims at making young people discover professions in science and technology and at working on stereotypes in order to encourage girls to start in such professions. The project consists of: - A traveling exhibition "Girls, dare to do science" to lower and higher secondary schools of the Mayenne department - Interventions in class with female professionals or higher education students (Especially volunteers, who work in their own name and not on behalf of their business);

	- Company visits with small school groups. The only company with which the organization works directly for the moment Thales that has been awarded the equality award and is therefore interested in all activities concerning women and science: classroom interventions and site visits. For the moment the company is developing partnerships with other local companies: Two companies have shown interest (AIM Emaplast); - Theme Day around gender equality, where meetings of pupils are organised with (mainly female) professionals who are active in six areas where women are barely present :manufacturing, construction, entrepreneurship, agriculture, transport,Science & technology.
Scope	Local Scope (one French département: Mayenne)
Target audience	Teachers School leaders Students in lower and higher secondary education Family members and members of the entourage of the pupils

Name of the initiative	"Déployons nos Elles" (Girls, spread your wings)
Organising structure	Association IMS entreprendre pour la Cité avec fort partenariat d'Intel / IMS Association entrepreneurship for the City in close partnership with Intel
Description of the initiative	The objective of this project is to make girls discover "men's jobs" . The project is set up in partnership with 30 companies and 40 lower secondary schools in France (In the Ile-de-France, Pays de la Loire and Rhône-Alpes). Female crane operators, heads of financial services, computer scientists ... meet lower secondary pupils to present their careers and their typically male jobs. In exchanges with these young students, the employees help fight the preconceived ideas and stereotypes that girls can have about these professions. They are accompanied by their male colleagues to allow young boys to change their view on women exercising certain professions.
Scope	Local Scope (of 3 regions: Ile-de-France, Pays de la Loire and Rhone-Alpes)
Target audience	Teachers Students in lower secondary education
Note	Intel is the preferred partner and IBM works with "IMS – Entrepreneurship for the City" that is an intermediary organisation for the Ministry of Education. These activities are carried out in the framework of the CSR (Corporate Social Responsibility) of the Intel Corporation. These activities do not only deal with science and technique.

IV. Classroom Visits

Name of the initiative	« Ingénieurs et techniciens dans les classes » Engineers and technicians in the classroom
Organising structure	C.Génial Foundation
Description of the initiative	The objective of this initiative is to let engineers and technicians speak in secondary school classes about their pathway, their career, their business

	and their profession. This meeting gives young people an idea about the engineering profession and helps them in their study and career choice.
Scope	National Scope
Target audience	Junior high and high school students
Note	To cover the whole country, the C.Génial Foundation relies on regional partners: OPE in the Lyon region, Terre des Scieces (land of Science) in the Angevine region, the Exploradôme in the Val-de-Marne, Science animation in Toulouse and Future Earth in Seine-et-Marne. The Animath association conducts a similar operation in collaboration with the Society of Industrial and Applied Mathematics, the C.Génial Foundation and Texas Instruments. This project called "« Les maths, ça sert ! » "Maths are useful "Is conducted in Ile-de-France, Toulouse and the Nice region.

Name of the initiative	"The chemistry presentations "
Organising structure	UIC (Union of Chemical Industries)
Description of the initiative	Depending on local issues (human and material resources, etc..) the activities are generally limited to participation in a forum or a conference. The speaker tries to reach young students (junior high or high school) and establish a diaogue with them through various media (CD-ROM training package containing eight experiments, movies, etc..). Following the presentaion or discussion, the speaker (active or retired professional of a chemcal company) presents the sector of the chemical industry and its professions starting from his own concrete professional experience.
Scope	National Scope
Target audience	Junior high and high school students

V. Visits to companies

Name of the initiative	« Professeurs en entreprises » Teachers in companies
Organising structure	C.Génial Foundation in partnership with the Association of Earth Sciences (Pays-de-Loire)
Description of the initiative	This initiative enables secondary school teachers to meet engineers and researchers in companies: guided tours of the state-of-the-art facilities with modern technologies and small group discussions conducted by top scientists. The operation takes place every November on 3 or or 4 predefined dates according to the school calendar (mostly the Wednesday afternoon). In 2012, 63 industrial sites in research or production opened their doors to more than 600 teachers, principals, study and career counsellors and work supervisors all over France.
Scope	National Scope (19 academies)
Target audience	Teachers School leaders principals Counselors

Name of the initiative	« Parcours Découverte» or « Discovery pathway »
Organising structure	Initiative of the Picardy region supported by the association Ombelliscience
Description of the initiative	These educational discovery pathways are oranisd during the school year and take place in three stages: - Preparing students; - Highlight of the activity: meeting; - Follow-up to be made by the students..
Scope	Local Scope (1 region: Picardy)
Target audience	Teachers Students Students of vocational and technical education

Name of the initiative	«Company visits»
Organising structure	Cape Sciences Association
Description of the initiative	Under the program Air & Space Science, a strong partnership has developed with local businesses in the aerospace environment. This program also supports school projects (primary school and high school). Cape Sciences synergizes two axes of the program (academic and industrial) to bring together and organize site visits where schools can discover a real business environment.
Scope	Local Scope (one city: Bordeaux)
Target audience	Pupils of primary and secondary school Students of vocational and technical education
Name of the initiative	«Ecole du végétal» "Schools"
Organising structure	Association Land of Sciences /terre des Sciences
Description of the initiative	In collaboration with the cluster Végépolys in Pays-de-Loire, and at the demand of the teachers, discovery trails of companies, laboratories, trades and training for students in junior and high school have been developed together with the teachers. . The main objective is to make youngsters discover companies, jobs and training in relation with plants and other vegetation. Another objective is to integrate the tools of scientific culture into school life. The laboratories welcoming the students are: INRA, Agrocampus (engineering school), University of Angers, Study and Control Group of Varieties and Seeds (GEVES) and twenty other companies in the Pays-de-Loire region. This activity has developed over the last twenty years and has grown since 2012 with the support of the regional project “young people of the Loire region successful in science and technology”, supported by the Investment in the future fund.
Scope	Local Scope (in one region : Pays-de-Loire)
Target audience	Teachers School leaders

	Secondary school students Students of vocational and technical education University students

Name of the initiative	« Décode la Science et le développement durable » or « Decode Science and Sustainable Development »
Organising structure	Association terre avenir – Association the Future of the Earth
Description of the initiative	Implement interventions in schools (schools, junior high and high schools) on three themes: water, energy and climate. These interventions are made by the association, but may also involve researchers or engineers, specialists in the subject. For younger pupils workshops (making experiments) are available; for older students discussions or meetings with researchers are organized. In a second stage visits to companies or laboratories are available. They are related to the topic discussed at the conference (wind farm, power station, pumping area, LSCE ...). The business partners are EDF, Météo France, TOTAL, Veolia,SOFIPROTEOL, Eau de Paris.
Scope	Local Scope (2 French départements: Seine-et-Marne and Essonne)
Target audience	Teachers School leaders Counselors School librarians institutions Primary and secondary school pupils Students of vocational and technical education
Note	The project has started in September 2012. In the proposed calendar interventions in schools and visits to laboratories and companies will take place from December 2012 to June 2013.

Two other projects propose to discover companies by visiting the sites, but they concern not only sites related to science and technology.

This is "One day, a job" a project where junior high school students from schools in disadvantaged areas can discover different professions and the professional world (under the Vocational Discovery option). These meetings take place in the Ile-de-France, Rhône-Alpes and Provence Alpes Côte d'Azur. This project is part of the Intel CSR (Corporate Social Responsibility) activities. IBM is working with "IMS entrepreneurship for the City" association that is an intermediary for the world of Education.

The association terre de Sciences (lland of Sciences) in Angers also offers junior high schools and high schools of the Pays-de-Loire to discover laboratories or local businesses. Another initiative, "Made in Angers" also offers visits to local businesses.in the framework of the operation of industrial tourism organized by Angers Loire Métropole,

VI-Other interesting initiatives

Name of the initiative	"Class in the company"
Organising structure	UIMM (Union of Industries and Trades in the Metallurgy) and FIEEC (Federation of Electrical Electronic and Communication)
Description of the initiative	The initiative has been initiated since March 2009, and is being deployed all over the country. A class is moved into the premises of a company where a meeting room is used as a classroom and opens the eyes of the young people for the jobs and professions within the company. This concept offers the possibility of a class, to immerse itself in the heart of business life. A didactic methodology allows to give a first positive and concrete image of the company, its business and people who work in it. Classes are held normally (the teachers move to the company) and four time slots of 1h are replaced by four sessions to discover jobs and professions. The principle is adaptable to the site, to the needs of the teachers and of the pupils. In 2012, between 50 and 60 companies were involved (with 100 to several thousand employees).
Scope	National scope
Target audience	Secondary school pupils Students of vocational and technical education

Name of the initiative	"High Tech U"
Organising structure	STMicroelectronics in France via the SEMI Foundation
Description of the initiative	For three days, students of the second year (36 for each session) discover different trades or principles of microelectronics through activities on the sites of ST Crolles, Soitec and Grenoble INP. Between 2007 and 2013, 13 sessions have been held with three sessions in 2013. This project is specifically designed for girls.
Scope	Local Scope (1 Department: Isère)
Target audience	Higher secondary school pupils

Name of the initiative	"Science and technology of the trades for all"
Organising structure	Science Animation Midi-Pyrenees
Description of the initiative	Tell the students the story of everyday technical objects (e.g. the door of an aircraft or an anti-cancer drug), from conception to realization while the professions and different people are presented who played interfered role in the development and manufacture of the object. The project includes two steps. First a mediator of the science center comes to the class (High school). Then he accompanies the students during the visit of the company.
Scope	Local Scope (1 region Midi-Pyrénées)
Target audience	Higher secondary school pupils
Note	The project is being developed and the call for applications was launched in February 2013 to all schools in the region (Toulouse, Lot and Tarn priority).

Name of the initiative	"WET Academy" (Water Education for Teachers Academy)

Organising structure	Nestlé Waters in partnership with the association La Vigie de l'eau (Water watch)
Description of the initiative	WE (Water Education for Teachers) is an international education program with water. Each year, educational workshops are offered at school (Cycles 2 and 3) on a day to raise awareness of water issues in partnerships with Nestle Waters. Water watch welcomes children in its local site and prepares educational workshops with Nestlé employees who animate the big day In 2012, 10 classes have been received during the day. In 2013, 10 classes are listed again for April 4, 2013..
Scope	National Scope (4 bottling plants)
Target audience	Primary school pupils (8 to 11 year olds)

OTHER INITIATIVES

When listing the school-industry practices in the InGenious project, C.Génial has received descriptions of many other projects that concern School-industry collaboration to a lesser degree, although they all aim to educate young people for science and scientific professions. Here is a brief presentation of these other initiatives, classified by category.

I-Festival and Events

Many major scientific events in France also offer opportunities for school pupils.

The Science Festival, founded in 1991, is led by the Ministry of Higher Education and Research. This event takes place every year in October for 5 days and favors exchanges between the scientific community and different audiences by setting up animations, exhibitions, debates throughout France. The next edition will be held from 9 to 13 October 2013.

More information about: http://www.fetedelascience.fr.

The Industry Week was held for the 3rd time March 18 to 24, 2013. During the 2012 edition, company visits and open days represent more than half of the events, the other half is divided between lectures, visits of education institutions, entertainment and hands-on workshops, career fairs, exhibitions ...

Read more: http://www.redressement-productif.gouv.fr/semaine-industrie.

Week for Sustainable Development held in 2013 1 to 07 April and whose theme will focus on the energy transition. The future of the Earth Association for example, participated in 2012 in this event by offering schools a welcome by scientific mediators who explained the mission, the knowledge and professions of the business partners present, and how biodiversity was taken into account in these professions (2012 theme). For more information about the 2013 edition:

http://www.agissons.developpement-durable.gouv.fr.

More locally, the Picardy region organizes the **Spring of the Industry**. This initiative under the responsibility of the Regional Council, is mounted in partnership with the Ministry of National Education, professional organizations, Chambers of Commerce and Industry and the Ombelliscience Picardie association. From March 14 to April 7, 2013, the 8th edition was held. This event offers the opportunity to schools to visit about 89 companies or to set up educational projects with higher secondary schools throughout the school year. This year, seven projects have been implemented with the support of professionals who gave a lecture in class, and then invited the students to visit their site.

II- National or European Fairs or exhibitions created by (or in partnership with) companies

Other structures have developed exhibitions, fairs or workshops to present scientific professions in companies. Two examples are given here:

This is the case of **Propulsion Tour** organised by the UIMM which offers junior high school students (third and fourth year of the Collège) and high schools (Lycées), interactive modules for the discovery of the industrial world to focus their attention on economic, social and environmental issues that are met by industry and technology. Two caravans are going to meet the students and their teachers as well as the general public. One presents an exhibition of the Industrial City, presented as 3 D illustrations. The other offers young people the possibility to participate in the "Drive for success" game which consists of manufacturing a vehicle in a virtual workshop.

For more details on this initiative: http://www.lesindustries-technologiques.fr/actualite/decouvrez-les-metiers-de-lindustrie-en-vous-amusant .

The Visiatome of Marcoule is itself a museum area with pedagogical workshops in the field of science and especially energy. This center belongs to CEA and AREVA is one of the partners who contributed a lot in the design of the permanent exhibition. http://www.visiatome.fr.

Intel ISEF The Intel International Science and Engineering Fair; There are also European AND French science fairs which are affiliated to Intel ISEF The Intel International Science and Engineering Fair , the world's international large largest pre-college science competition, Provides an annual forum for more than 1,500 high school students from over 70 countries, regions, and territories to showcase their independent research as they compete for more than $ 3 million Annually. The Intel ISEF is the first global science competition for students in grades 9-12. Further information: http://www.societyforscience.org/intelisef2013

III Resources and educational kits

There are also projects that provide information on careers and studies to help students and teachers.

UIC has recently developed www.lesmetiersdelachimie.com site to show the role of chemistry in everyday life and how one can get involved to "change the world of tomorrow," with a business in this sector.

The UIMM meanwhile, has designed since January 2013, an **educational kit** for teachers and educators to help them develop a course around industrial themes.

To download the kit: http://www.les-industries-technologiques.fr/enseignants .

IV-Games

To make science learning more fun and show their practical application in the professional world, games are also available on the Internet.

The Company “We Want to Know” offers the DragonBox with a serious game designed to teach algebra that can be used in the classroom by a teacher. It is now the subject of university research in schools in the United States by the Center for Science Games. Several tests have already been carried out in classes in Oslo, Norway. http://dragonboxapp.com.

UIC offers two online games to secondary school students. Super Kimy addresses 7-11 year-olds. (Www.superkimy.com). A serious game for 13-18 year-olds presents the chemical industry, seen from the inside: www.projetm2c.com.

V. Scientific Entrepreneurship

This last category should be mentioned, as it is to show students that scientific studies can also lead to starting their own business.

Universcience organised at the Science Festival in 2012 and in partnership with the Association of 100,000 entrepreneurs, **speed-dating** between 8 entrepreneurs and two classes of MGT (Science and Technology Management), of the Lycée Jules Siegfried in Paris.

For two hours, students are confronted with the realities of the business by professionals who shared their entrepreneurial adventure. The first edition intended to explore entrepreneurship and scientific and technical professions. The initiative should be renewed with a more scientific and technical focus.

The C.Génial Foundation presented for the first time **the C.Ingénieux prize** in 2011. It aims to promote technical and scientific entrepreneurship among young people by giving an award to a young female or male business executive who is considered a role model of success. This person is rewarded for his/her personal involvement in the creation of an innovative business-related to sciences and technology. More information on the site:

http://www.cgenial.org/?c=Prix_C.Ingenieux_266.

THE CHALLENGES

Through questionnaires, a number of difficulties were identified in the implementation and deployment of the initiatives:

I-mobilization and recruitment of schools and businesses

The effectiveness of long-term partnerships is based on highly mobilized partners. However, this is frequently as one of the great difficulties for many projects. The points below illustrate these difficulties:

- For "Operation Professors companies' proposed by the Foundation on C.Génial in the free time of the teachers, it is difficult to get participants and to know in advance if teachers who have registered will be present.
- EADS Foundation mentions the same concern about the competition “Imagine the transport of the future “where there are difficulties to recruit participating classes.
- Several people mentioned the difficulty to inform teachers about projects: information does not flow smoothly to the teachers.
- In contrast, the association Sciences and women 53, struggles to find business partners to become drivers of the action on their territories.
- To remove the difficulties in contacting a business, Intel has chosen to work with an intermediary an association (IMS Entrepreneurship for the City) to organize with the Ministry of National Education the actions "Girls move your wings “ and "One day a job."
- And even for long-lasting actions there is a kind of fatigue with participants. The UIMM states about some of it partnership contracts: "We have implemented some of these contracts 20 years ago and actually some schools and some companies have stopped mobilizing on that subject. Note that since 20 years relationships with schools and businesses have developed dramatically, schools are increasingly called upon for other projects and wish a variety of themes of intervention. In addition also businesses are called upon for many other projects. The arrival of the DP3 elective course in junior high schools (Collège) has contributed significantly to reducing the number of contracts. Teachers do not wish to invest any more in one single project in one single business. "

In general many promoters of prject complain about a certain distance and a lack of investment from the Ministry of National Education

II-Funding

Most of the projects are supported by organisations or associations that complain about a lack of means (grants) to design and deploy their actions. Several mentioned that looking for partners to finance these operations is complicated.

Costs related to the project alsoconcern transport and projects are sometimes difficult to organize because of a lack of resources, especially when it comes to moving one or more classes.

III-Coordination between the two parties

Beyond the funding of the project, the meeting between schools and industries can be complicated to implement because it must succeed in coordinating two agendas, two different types of rhythm and succeed in the action within an often already filled annual program.

It is emphasized by Cape Sciences in Bordeaux that organise company visits: one must take into account the constraints of each actor. The Exploradôme even added that the implementation is sometimes difficult because the number of intermediaries, on the side of the company and because of difficulties in matching schedules of businesses and schools. The Earth Association also points to future significant delays associated with the approval of the project by both parties and the implementation (especially matching agendas).

Geographic IV-Dependence

Some operations depend on the geographic location of the business and can not find schools nearby, leaving aside many institutions.

DRAFT RECOMMENDATIONS

I-Recommendations to businesses

In general, companies do not have much time to devote to activities that are not related with their production process. In addition, for most of them, it is interesting to work with tertiary education students who are already attending scientific or technical studies that can be hired in a short time

To facilitate the implementation of actions at all levels of education, several tracks can be explored:

- Ensure that the proposed action does not take too long (maximum 2-3 days per year and employee) and does not disturb the life of the company. Companies also think initiatives that can occur at any time of the year, according to the agenda of the company, are a real asset (unlike the events that have to take place at set dates in the year).
- The proposed actions should if possible be easily repeatable according to the companies. They must provide the user with all the tools and information necessary for the proper implementation of the project. They are nevertheless capable of adapting the project to each participant, but the time spent on the preparation and implementation should be kept short.
- Companies can also choose to invest in a project, by delegating it to an association. While this structure may be composed of employees of the company, they will spend their time outside of work and the company can continue to function normally.
- It is important to rely on persuasive communication and put more means into the project. Success stories about initiatives that work and develop, it may encourage other companies to participate. Successful companies must testify about the project to create followers.
- School-Enterprise can be carried out in the framework of the CSR (Corporate Social Responsibility) of the companies. This is a lever to implement these actions.

II Recommendations for Teachers and Education

Just as businesses, teachers have little time to devote to the preparation of these activities, in addition, for some of them the activities are extra-curricular and outside school time. It is therefore important to think about how these exchanges with business can be facilitated and developed.

Integrate these initiatives in the curriculum

- Encourage school heads to give more attention to these operations and integrate them in the project of the institution.
- The involvement of teachers in collaborative projects with companies should be recognized as a professional competence and professional development and each teacher should acquire such skills.
- The commitment of teachers in this type of actions should be recognised and be given greater recognition and reward. The support of the hierarchy is essential. Bonuses such as those proposed in the competition C.Génial (accompany students to a national final or visit a company with them) are all actions that encourage teachers to involve themselves.
- Teachers should be supported in their institution by a coordinator who could find partner companies and deal with administrative aspects making the work of the teacher easier so that he can focus on the project itself.
- In each Académie (France is subdivided into 26 académies or educational districts) there is a Scientific and technological Correspondent (CAST, Correspondant académique scientifique et technologique), since September 2012 to coordinate the actions of Scientific Culture. Their role should be clarified and expanded to counseling and support for teachers who are implementing school-industry partnerships.
-

III. Organizations facilitating school-industry dialogue

Most of the difficulties faced are caused by the complexity of the collaboration and the additional effort the school as well as the company must make. It should be noted that although each party sees the value of the collaboration, the main objectives of each party diverge.

Organizations, whose role is to facilitate and foster relationships between schools and industry play a crucial role in improving the effectiveness of these collaborations. They can be public, private or under a public-private collaboration.

Their added value is the following

- Facilitate connections: these organizations have the potential to organise more structured cooperation between businesses and schools, thus avoiding individual discussions and facilitating the dialogue between the different parties. They also play a role as moderator and facilitator and can overcome some of the difficulties reported by the schools. They find time to approach companies and know what speech to adopt.
- Broadening the scope: in many cases it is more obvious for these organizations rather than for one company alone, to organize events on a national scale, to reach a large number of schools (and students).
- Variety of content: to the extent that these organizations are linked to several companies, they can offer a wider variety of content to schools.
- Neutrality: in France, school-business relationships are viewed with skepticism. The fact that this type of collaboration is proposed, for example by a group of companies through a Foundation facilitates the establishment of partnerships.

- Commitments concerning long-term school-industry collaboration are often fragile especially when they rely on a relationship between two people. The existence of an organization that supports the partnership helps to maintain relationships in the long term.
- Recruitment: an organization (multi-business) can more easily recruit new companies to cooperate with the Ministry of Education as they can work together for common concerns.

In France there are several such organizations: the Foundation's hands-on Science and the Foundation C.Génial are two examples. Their role is to develop actions that initiate, structure and sustain initiatives over time. It is also believed that professional organizations can play an important role to show the attractiveness of jobs in their field (UIMM UIC ...).

As far as the actors of scientific culture are concerned a number of Science Centres (ISTAC) and associations play also a very important role in the development of regional actions. It may be noted, however, that their role in the development of School-Industry actions remains marginal compared to all other actions undertaken by the scientific culture centers (exhibitions, debate science society, educational activities, etc..).

We may also mention the initiative “Engineers for the School" (IPE), combining companies and Education. IPE are available to Education for a period of one to three years, renewable once. The establishment of school-industry collaboration may fall within the scope of the tasks entrusted to IPE.

The fact remains that all these organizations are still not sufficiently developed to present all the benefits mentioned above. For example, none of them can claim to be able to find enough companies to present the schools a varied and wide range of companies throughout France. It should be noted that most of these organizations are quite young and therefore still in a development phase.

It would certainly be interesting for the country if different actors could coordinate and expand their offer. The question of creating a national platform for coordination of actors arises.

IV-Is there need for any new initiatives?

The listing of French initiatives has shown that there are plenty of ideas and that numerous proposals exist in the country. The approach is rather to say today:

"Try to extend the most relevant existing initiatives ".

However, we note that:

- None of the initiatives identified proposes a real traineeship for the students of the third year. For the moment the activities rather resemble business tourism and they could be enhanced if they are better designed and be an opportunity to further explore science and technology.
- All tools that exists should be brought together making use of ICT and be provided online.

V-Evaluation

The evaluation of actions should not be overlooked, even though it is not always easy to implement. The evaluation can improve the content and respond to specific requests. These assessments usually take the form of questionnaires.

However, It is observed that the feedback on the activities of the teachers is not systematic, and few remarks are given to improve the project. Feed-back of students could also be further developed by providing time at the end of the project to survey and gauge what they have just experienced.

If a project is renewed each year by the teacher (or the company) it is a good indication of its quality and usefulness. For "Class in company" for example, companies may be reluctant in the first year, but they want almost all renew he initiative the following year.

It is important to collect the assessments of activities. It is also necessary to measure the longer-term impact of these actions on the choice of studies and careers of the students encountered. To what extent will these actions be decisive for the students? How many students choose scientific studies? The answers to these questions complement the assessments and would prove the role of these actions between the school and the company vital and necessary.

The national platform mentioned above, could also be used for measuring the impact – in partnership with university research laboratories - of these initiatives on the choice of scientific studies by the students.

ANNEX II

Key initiatives promoting science education in France

Several initiatives exist to promote STEM subjects and STEM careers and professions that not necessarily focus primarily on school – industry cooperation. Some of those are mentioned here below as they can in various way contribute to or integrate school – industry cooperation.

Partnerships secondary, higher education, research and industry

Partnerships at local or regional level involving various stakeholders that can support the renovation in science teaching and learning, are one of the cornerstones of several initiatives in France to promote science and technology education. This is definitely the case for both the La main à la Pâte initiative and the PRESTE the Plan for renovation of science and technology teaching and learning in the primary school.

Also at the level of the secondary school several examples of good practice can be given in France as to cooperation between schools, industry, higher education institutions, local authorities etc. here below a few are briefly outlined.

The EIST pilot project: Integrated science and technology teaching

The EIST or Enseignement Intégré de Science et de Technologie au Collège or Integrated teaching and learning of sciences at the lower secondary school is an experiment or pilot project resulting from the partnership between the Ministry of Education and the Academy of Sciences

The experiment, within the framework of the orientation law for the future of the school and based on the implementation of the modernised programmes of scientific disciplines and on the definition of the common base of knowledge and of the competences was implemented at the beginning of the school year 2006-2007 in the sixth class of the Collège (lower secondary school) and is being implemented also now in the fifth class of the Collège. In most cases it was implemented for a trimester period; in some cases for the whole year.

EIST aims are: to develop the pupils' curiosity and giving them the taste of experimental sciences and of technology; to implement the investigation approach prescribed in the new science programmes; to build an integrated scientific education implementing the programmes of three disciplines (chemistry-physics, Life and Earth sciences, technology); to facilitate the transition from the primary school to the first year of the lower secondary school (Collège).

The general objectives of the pilot project mentioned above can be translated into operational objectives within the collèges:

- The teachers of the three disciplines (chemistry-physics, Life and Earth sciences, technology) have to be associated in a common and joint work;
- Organise an integrated teaching of sciences and technology, given by one teacher during at least 30% of the school year (3,5 hours in the 6th form);

-Test the steps to be taken to involve up from the 6th form the teachers of physics and chemistry by adding half an hour to the timetable of the pupils.

To facilitate the monitoring and the comparison at national level, a common work group was set up to select indicators so as to measure to which extent the acquisition of knowledge and competences is promoted linked to science and technology and to measure if this integrated teaching of sciences has an impact on the number of pupils taking scientific and technological studies in the further years of the Collège and the Lycée (upper secondary school).

Each pedagogical team that takes part in the pilot project has to define its characteristics and the directives for its work. A contract will be drafted that will mention, for each lower secondary school, the objectives to be reached by the pilot project, the modalities of the pilot, the means available, the persons involved, the partners to be associated, the support or monitoring to be envisaged and the evaluation to be carried out. The contract will also clearly mention that the pilot project will last four years. This contract will be signed by the Collège and the Recteur d'Académie and will be revised on a yearly basis taking into account intermediate results, unexpected effects and contextual developments.

The experimental design of Integrated Science and Technology (EIST) education has been the subject of an evaluation conducted by the DEPP, which followed a cohort of students enrolled in the sixth form (1st year of lower secondary or Collège) up from September 2008. An analysis of progression of these students (three measurements made up to the end of the fifth form) shows no significant effect on the performance of students who received the EIST compared to the pupils of the control sample at this phase of the experiment. This lack of effect concerns both the cognitive performances as well as the attitudes toward science.
The effects of selection bias, attrition, or the choice of measuring instruments are also discussed.The study specifically addresses the methodology for measuring student gains over time through the construction of a common scale of performance to be used during the three periods the measurements took place. A key result is the general decline in the level of interest and motivation in science, in the first year of the lower secondary school (Collège in France)

Evaluation of the effect of integrated science and technology teaching device (EIST)
First results of the analysis of progression of students on three measurement time
Marion Le Cam, Thierry Rocher, Office of Student Assessment, DEPP, MENJVA

The PRESTE reform: integration of the innovation in the curriculum

In June 2000, the French Ministry of Education decided to let all schools benefit from the expertise acquired within the framework of La Main à la Pâte by setting up a plan for the renovation of science and technology teaching at primary school level (PRESTE). This plan, independent from the initiative in itself, takes its expertise into account and integrates it as an innovative pilot project.

The PRESTE, Plan de Rénovation de l'Enseignement des Sciences et de la Technologie à l'Ecole or the Plan for the renovation of the teaching and learning of sciences in the primary school (abbreviated in French to PRESTE) was developed and implemented in order to promote within the primary school

an approach based on scientific investigations. The idea is to propose to the curiosity of the pupil objects and phenomena of the world surrounding them and to articulate or link to one another scientific learning, the use of mathematics and use of the numerical world.

The renovation in the teaching of sciences intends to give to all the pupils the basic elements of science education described in the school programmes, making us of the inquiry-based science education approach.

To bring about such a through in-depth renovation of science teaching and learning all the levels and all the stakeholders of the educational system had to be mobilised and numerous partnerships had to be set up. It is important to reach a large cohesion with the different educational mechanisms and structures that exist in the country. Although the PRESTE Plan is limited to the primary school, lower secondary schools can associate themselves to the plan for renovation.

Cooperation between primary schools and lower secondary schools also contributes to facilitate the transition from one to the other and enhance continuity in science education across primary and secondary education.

There are steering committees to monitor and steer the implementation of the PRESTE plan for renovation at national level (for the whole country), at the level of the Académie (more or less a Region) and at the level of the Départements.
The PRESTE plan also gets the support of the local authorities through support of the municipalities.

For the implementation of the new programmes, an important effort was made to support and help teachers by making available to them exercise sheets, knowledge sheets and other accompanying documents that can be downloaded from the site of the National Centre of Pedagogical Documentation (CNDP).

Sciences à l'école or Sciences at school

The "Science at school" initiative was formally proposed by the Ministry of education to the recteurs d'académies (the heads of the 26 académies) on 26 March 2004. It aims to support and to encourage the implementation of projects promoting scientific culture in lower secondary schools (collèges) , in general , technical and professional upper secondary schools (lycées) and in the preparatory classes for the grandes écoles (HE institutions preparing i.a. engineers) . The objective is to stimulate scientific careers with youngsters and to encourage new pedagogical practices focusing on inquiry-based science education, on project work, on multidisciplinary and on partnerships with stakeholders in the fields of science and technology. These activities intend to promote educational innovation and are to be integrated into transversal set ups, scientific and technical workshops and science clubs.
In each Académie a correspondent is the liaison between the schools and the "Science at School " initiative; It is usually an IA-IPR (genera l inspector) usually in physical sciences) or a project manager

Seconded by the rectorat of the Académie. Since September 2011, some of the correspondents are supported by a reference person of the Foundation C.Génial [14]to organise the eponym competition in their lower secondary school or college.

"Science at School" has the human and financial resources that come from the Ministry of Education National, the Ministry of Higher Education and Research and the CNRS. The support group of "Science at School" is located at the Observatoire de Paris which takes an active part in the operations conducted. The C.Génial Foundation is a favoured partner of "Science at School" and participates in its budget.

Several actions are coordinated by "Science at School" national level:

- The loan of equipment and educational support in the fields of astronomy, meteorology, Seismology, particle physics, genomics (e.g. Astro at school, Cosmos at School, Genomes at School, Weather at the School, Sismos at school…)
- Financial support to scientific interventions in classrooms (such as e.g. Operation scientists / engineers in classrooms ")
- The development of free resources for schools by various associations and/or research organisations (e.g. "Operation LUNAP")

"Science at School" runs national academic competitions (through C. genial) and is in charge of the French participation in European and international competitions (EUCYS, Castic and SOS) as well as in national and international Olympiads.

- The European competition EUCYS (European Union Contest for Young Scientists) at the initiative of DG Research and Innovation of the European Commission. This is an annual competition among young scientists (14 to 20 years of age) from over 40 countries in Europe (as well as participants from the USA, China and Japan). It aims to promote cooperation and exchanges between young scientists and takes place once a year in a country of the European Community.
- CASTIC (China Adolescents Science and Innovation Contest Technology) which is a Chinese competition equivalent to the European one mentioned above.
- SOS or Science on Stage is a competition for secondary school science teachers.

Graines de sciences or seeds of science: http://www.fondation-lamap.org/fr/graines-de-sciences

"Seeds of Science" is the name given to the autumn university organised by the Fondation La main à la pâte which brings together every year since 1999, scientists with the primary school teachers, resource teachers and teacher educators or trainers. Each researcher conducts workshops related to his or her research activities, while focusing on the specific characteristics of la Fondation la Main à la pâte. This means that it focuses strongly on inquiry-based science education, illustrating information given with simple experiments, and involving teachers, which leads to challenging and rewarding

[14] C. Génial is a foundation of public interest that regroups the educational activities of such major company groups: Areva, EADS, France Télécom, Schlumberger, SNCF and Technip.

exchanges. Each workshop is much more th an a mere lecture as it puts the teacher in a state of discovery so that everyone can "live" and "practice" science, so that it becomes more accessible, familiar, and more enjoyable.

Seeds of Science is composed of several phases: first there are real encounters between participants (in a synchronous way-) and afterwards virtual exchanges making use of ICT communication (asynchronous way).

For several years, the Foundation des Treilles has created the physical conditions that enabled twenty to fifty people to meet during five to seven consecutive days of the Autum University. Later on, according to the year, the OHP (Observatory of Haute Provence), the Institute of scientific studies of Cargèse or the School of physics of Houches gave the necessary support. To make the autumn university possible.

Exchanges between researchers and science teachers are informal during meals and free time. They are more formal in small groups of ten, during three-hour workshops in which each of six to eight invited scientists works on topics related to his or her field of research with very concrete and practical activities: ants, earthquakes, animal migration, brain drugs, robots, bridges, random chaos, physics of a heap of sand, statistics, etc.. This is an opportunity for all school teachers and researchers to ask questions and most importantly to question themselves. The approach to science is not disciplinary.

Later, during a school year, exchanges occur via the Internet. A mailing list is created, and a private space on the website of the Fondation la Main à la pâte. The texts written by scientists are often subjected to the criticism of teachers in primary school. Educational resources created by teachers are made available online. These multiple exchanges have lead to the publication of nine books for teachers and parents wishing to accompany the children in the discovery of science.

A significant percentage of teachers who participated in Seeds of science became subsequently trainers/educators and inspectors. Those who remained in their classrooms have developed further inquiry-based science education.

The National Museum of Natural History (MNHN) http://www.mnhn.fr/

The National Museum of Natural History is, by the diversity of its offer a very rich space for continuous professional development of science teachers teaching SVT (sciences of life and Earth). Among the proposed actions, participatory science programmes constitute an offer which may be of interest to teachers and their classes without geographical boundaries.

The National Museum of Natural History is an institution dedicated to scientific research and to the dissemination of culture the nature under the auspices of the Minister of Higher Education and Research and the Minister of Ecology, Sustainable Development and energy. The research mission of the Museum relies on huge collections and a strong scientific and human potential. Its scientific mission is inseparable from its educational and cultural mission.
The Scientific activities - research missions, education, conservation, expertise, valorisation, dissemination of knowledge and of educational and cultural activities - are taken care of by 10 departments of which there are two types: research departments and dissemination departments. Seven departments are devoted to research and follow many paths of exploring life. The Museum thus offers a Master degree “Evolution, Natural Heritage and Society" focusing on multidisciplinary education linking sciences of nature and of me. It integrated the doctoral school "Science of Nature and Man" based on a thirty research units.

The Museum provides teachers with many classroom activities and allows them to develop innovative projects. The range of topics is broad, it covers all levels from elementary to upper secondary school and focuses on the acquisition of scientific knowledge related to the curriculum extending to the understanding of global challenges such as changes in biodiversity and the responsibility of men in this area.

The Museum also offers CPD to teachers to refresh or supplement their knowledge making use of thematic modules to help them build activities. There are also distance learning opportunities and teachers can download the training documents made available during the CPD. A forum is open online, scientists respond to questions from teachers and students.

The CPD offered by the Museum is open to primary and secondary school teachers. They deal with themes related to the life and Earth sciences or cover larger multidisciplinary fields. The CPD may take the form of conferences, events, workshops, tours, internships which are part of the PAF (the plans académiques de formation or CPD plan of the académie). Meetings are organized at the level of the académies or with associations of teachers.

The (ODL) Open and Distance Learning platform offers courses for secondary and higher education (primary education is in preparation) and classroom activities. For the second school the activities focus on various topics (scientific expeditions, biodiversity, sustainable development, scientific methods and practices and science and laboratory in secondary classes, ...)

Finally, the Museum has initiated a program of participatory science entitled "VigieNature" (Nature watch) which invited teachers to follow (observe) a number of common species at national level through a network of volunteer observers. Several items are thus proposed: "the wild ones in my street" focusing on wild plants growing in town, Opération escargots" or "operations snails" observing snails or " Spiloll" follow-up pollen spreading insects by taking pictures of them. The website "Vigienature-school" is dedicated to the school. It makes students aware of biodiversity and develops the scientific process and investigation by applying inquiry-based science education.

ASTEP initiative or Accompagnement en Sciences et Technologie à l'Ecole Primaire

Students from engineering schools or students in the final year of their master studies (M2) support as "tutors" primary school teachers in science teaching. Special attention is given to the following elements: the training of the students to be 'mentors' or students, the preparation of the teacher accepting to work with an engineering student as a support person in their classroom,, the development of a credit system to integrate the efforts and the time of the engineering students into their normal curriculum.

These activities are coordinated into the **ASTEP initiative or Accompagnement en Sciences et Technologie à l'Ecole Primaire** (Support in Science and Technology in the primary school) which is supported by the Ministry of Education.

An example of ASTEP: The Ecole des Mines, Nantes and Coaching science teachers: partnerships engineering depts. & schools

The Ecole des Mines de Nantes, a school of engineering, has been involved for many years an original partnership with local primary schools and educational institutions. This partnership aims at encouraging and facilitating inquiry-based science learning at primary and secondary school. It consists of: primary school teachers' coaching by engineering students and professors, training workshops for primary school teachers, secondary teachers' coaching by PhD students.

The main goal is to get primary school teachers more self-confident in scientific teaching, after working in pairs during a few months, and to help secondary teachers carrying out experimental inquiries in their classroom.

The Ecole des Mines simultaneously developed since 1996 hands-on learning for its own students: learning by doing, problem-based and project-based learning ... all ways of teaching strongly impacted by Main à la Pâte (hands on Science) experiences.

The information described the organisation, rules and requirements, main data, advantages or outcomes of this partnership. These include new skills for engineering students and for the Ecole des Mines' educational methods.
The main conclusion is that both primary and secondary schools, on the one hand, and universities and engineering schools, on the other hand, could gain a lot if bridging a little the gap that naturally exists between them. A win-win situation for both.
Conferences have been held with title such as "The pupil, the teacher and the scientist: sharing science and technology". These events give the opportunity to understand Science and Technology coaching, so as to enable all people to feel concerned and to become responsible citizens taking into account scientific and technological developments in our present-day society.

The Fondation la Main à la Pâte and its initiatives (hands on science)

Although this a foundation has been mentioned in the body of the report as a presentation was made by a representative at the inGenious seminar in Paris in March 2013 some further information is given here below expanding on it and its major initiatives.

The main objective of the La main à la pate initiative launched in 1996 by i.a. by Nobel Prize winner Charpak is to innovate science education in the primary school. The key to the innovative La main à la Pâte method is the inquiry-based approach. Children are invited to investigate a scientific problem in a structured way involving several clear pedagogical steps.

By prompting pupils to use argument, whether oral or written, this process takes part in language learning, in acquiring an independent attitude that is heedful of others. It is based on teachers achievements, the networking of their skills and the creating of effective synergies with external actors, inspectors and educational advisers, college of education training staff (formerly the IUFM nois the new ESPE), teaching specialists in science and other subjects, **scientists, researchers, engineers, students from science universities or from the Grandes Écoles, top HE Colleges of engineering,** parents.

In June 2000, the French Ministry of Education decided to let all schools benefit from the expertise acquired within the framework of La Main à la Pâte by setting up a plan for the renovation of science and technology teaching at primary school level (PRESTE). This plan, independent from the initiative in itself, takes its expertise into account and integrates it as an innovative pilot project. La Main à la Pâte" keeps its own dynamic as well as its own features, namely linking with scientific partners and networking participants for a better exchange in the field.

Cooperation with the scientific or research / industry community takes different forms:

- The network of scientific consultants is composed of some one hundred voluntary scientists (**researchers and engineers**) that help primary school teachers that have questions or meet difficulties in implementing their science lessons. A coordinator dispatches the questions received to the appropriate scientist or researcher so as to provide the teacher with the best answer. Efforts are made to formulate the answers in concrete easy language.

-**The cooperation with institutions of higher education (mainly engineering schools**) through which engineering students act as tutors and go and support primary school teachers in the classroom. They also act as role models for the children with whom they are in contact. The students involved in those activities are trained to do so. They may also get credits for the work they do as it is considered (in some cases) as part of a subject that could be called 'Social or societal entrepreneurship.

In order to realize their objectives La main à la Pâte has the support of a team of around fifteen full time persons (Lamap team), of a Scientific Council and of a Committee of partners which is intended to give ideas and financial support to the action of the Académie.
The creation, development and implementation of 15 pilot resource centres is very import for the support which is given to schools in implementing La Main à la Pâte. They organise training, they go into schools to help teachers, they can welcome teachers and their pupils in the resource centre to do experiments. They can also cooperate with the pilot schools to disseminate the innovative inquiry-based pedagogy towards other schools.The representatives of the 15 centres also meet on different occasion to share experiences and strengthen their work the schools. The resource centres are also strongly cooperating with the local authorities that in some cases support the centres by giving them financial support for the equipment. All of them are linked to other local partners such as institutions of higher education, research centres etc. to strengthen their activities.

The Académie has undertaken to provide French schools with an Internet network, enabling the teachers involved in La main à la Pâte, to link up with one another, and also linking them to the world of research. Next to the official website of the Lamap there are the so-called mirror websites which are websites started up by some of the international partners. Access to the mirror websites is available on the Lamap website

The partners of the La Main à la Pâte Initiative are the French national Ministry of Education, the ESPE (Ecoles Supérieures du Professorat et de l'Education, up till the end of 2012 IUFM) who train future teachers, the Institut national de recherche pédagogique ,INRP (National institute for educational research), the Corps des Professeurs des écoles (The schoolteachers corps) which is a

crucial interlocutor for the Académie and a number of the Grandes Écoles (top universities in engineering education.

Various Bodies and Associations, both public and private, support La main à la Pâte, in diverse ways:
- the Department of Technology (Direction de la Technologie, DT) of the Ministry of Research, and the Inter-ministerial Commission of the Town (Délégation Interministérielle a la Ville, DIV) have contributed to the financing of some of the Académie's activities,
- the Fondation des Treilles, which is hosting seminars, and publishing books, the Société Française de Physique, and major companies such as **EDF (électricité de France), France-Télécom, Michelin ...**

The Inserm youth clubs (branches)

The Inserm (Institut national de la santé et de la recherche médicale or National institute of health and of medical research) is the only French public body entirely dedicated to biological, medical research and public health.
In 1986, the Inserm creates a Network Inserm Young people, intended for the 15-20 years who:

- are curious,
- wish to understand new issues of the medical research,
- like to reflect in group without being assessed or evaluated,
- want to communicate with and question scientists, research workers.

The young people involved, are supported by one or more teachers in a general or professional / vocational school or by a coordinator in a social or scientific organization or association (NGO).
The Réseau Inserm Jeunes (Inserm Youth Network) can help projects by making its scientific competence network (highly skilled research workers) and means of communication available.

Numerous branches of the Réseau Inserm Jeunes (Inserm Youth Network) were created in France but also in Europe (Barcelona, Berlin, The Hague, Bucharest, Budapest, etc.) or outside Europe (Canada, Tunisia, etc).

In 2005, new objectives were defined:

- Reflecting on the progress of biomedical research and in public health;
- Active participation during a year in the weekly meetings of the branches of the Network;
- Since the beginning of the school year 2006-2007: setting up of a project around research subjects with a societal connotation: nutrition, addictions, and vaccines;
- Organisation of Inserm Youth Health Cafés, open to the public.

The scientific knowledge mission of the Inserm was reaffirmed at the time of the signature in January 2006 of “the European charter and the Code of good conduct for the research workers' recruitment".

Contact and further information: pacsale Mansier: pascale.mansier@tolbiac.inserm.fr
Website: http://www.reseau-inserm-jeunes.org/reseau.htmlhttp://www.reseau-inserm-jeunes.org/reseau.html

The Ariane cities project

The Communauté des Villes Ariane (the community of Ariane cities) is a network of about twenty European cities involved in the ARIANE programme. The objective is promote interest in science education in cooperation with industry and researchers. http://www.ariane-cities.com

Different activities have been set up so far:

A. Les Mureaux: an Intercultural Seminar that has already become a tradition (this year end of March). The second intercultural seminar in the 2006-07 series (Lampoldshausen, Les Mureaux, Madrid) took place for a full week, hosted by the City of Les Mureaux. The 30 young participants could admire the EADS facilities, visit Paris and continue learning about the importance of European cooperation in space.

B. Toulouse: Scientific Holidays for high school students, 9 to 18 July. In collaboration with CVA partner associations Planète Sciences and with Peuple et Culture, the Holidays brought together 25 high school students from 9 Ariane cities for a very successful programme of scientific and intercultural activities. The full-day visit to the Cité de l'Espace (Space city) was one of the highlights, as it provides an ideal learning experience on space science, engineering and applications.

C. Lampoldshausen / Heilbronn: Summer School for aerospace engineering students and young professionals: 29 July to 23 August. CVA's four-week course. This year the course brought together a record number of 36 students and young professionals from Augsburg, Barcelona, Bordeaux, Bucharest (through the CVA-EUROAVIA agreement), Bremen, Heilbronn, Les Mureaux, Madrid, Stuttgart, Toulouse, Turin and Zurich. In cooperation with the cities of Heilbronn and Lampoldshausen, Heilbronn University, DLR and a number of local sponsors, the course focused on the next generation launchers for Europe, as well as their ground facilities for propulsion testing and launch. The syllabus starts as usual with one day of intercultural training and team building exercises, and takes advantage of the space propulsion test range at Lampoldshausen and the availability of expert lecturers from Arianespace, CNES, DLR, EADS-Astrium, ESA, SNECMA/Safran, and the Universities of Bremen, Liege, Toulouse and the International Space University.

D. The "REVA internet portal project" will be the virtual platform for meetings, data sharing and dissemination for REVA: Réseau Educatif des Villes Ariane (Ariane Cities Education Network).

The purpose of the Network is to promote education and training in Space activities by:

- facilitating interactions between those involved in secondary, vocational and university training,
- encouraging the development and dissemination of new teaching methods,
- stimulating students' curiosity and interest in scientific disciplines and encouraging them to choose these study options,
- enabling students to meet and interact with the relevant education authorities.

Contact and further information:
http://www.villes-ariane.org/

Cité des sciences et de l'industrie, la Villette

The activities of the Cité des ciences et de l'industrie are a good example of scientific cultural mediation. The objective of scientific cultural mediation is to make science and scientific culture more accessible to all layers of the public ranging from pupils, youngsters to all groups of adult learners. Science museums and science centres are more and more focusing on the one hand on the dissemination of scientific culture, scientific knowledge and on enhancing the interest and the awareness for sciences and its applications within real life situations. One of the objectives of the Cité des sciences et de l'industrie in Paris is to enhance scientific cultural mediation.

The Villette classes, conceived by la Cité des sciences et de l'industrie de Paris, La Villette (the City of sciences and industry of Paris La Villette), allow a primary or secondary class to spend a week devoted to the study of a scientific or technical topic in Paris. The stay is spent mainly in La Cité des sciences (minimum 4 half-days) and also enables the classes to make use of the scientific and cultural resources of the Paris area.

Villette international classes "Science in French" are organised for foreign pupils / students from 15 to 19 years of age who have learned at least for three years French at school. Such and international class lasts four days and enables pupils to implement in such a class a pedagogical project, in French and to work in an interdisciplinary way during this international class thanks to the resources available at the Cité. Such international classes at la Villette give the opportunity to pupils to meet other pupils from other countries and to set up a real linguistic and cultural exchange focusing on scientific themes.

The objectives of those classes are the following ones: Use French in authentic situations through an immersion approach , Discover and learn to use a French scientific vocabulary , Be confronted with new learning environments , Learn to be autonomous in research activities and Develop one's scientific knowledge and competences

A tailor-made programme supported by scientific mediators, is built on elements available in the museum as it enables to make use of the resources at the Cité des Sciences et de l'Industrie de la Villette.
The teacher of the visiting pupils attends a four-day preparatory session and builds the programme of pedagogical activities with the mediator in charge of the specific theme to be addressed.
This visit enables the teacher to discover the permanent and temporary exhibitions on themes such as astronomy, maths, genetics, energy, sustainable development or to discover the special exhibitions focusing on topics of particular interest in the news.
Teacher can also chose the way in which work will be done with their pupils so that they can well prepare and follow-up the work of the pupils during their four-day stay at the Cité des Sciences et de l'Industrie La Villette.

Villette discovery classes are organised with the objective to have pupils learn in an environment where plenty of resources, information and support are available. It contributes to the development of the autonomy of the pupils and it stimulates their interest and curiosity. Experience shows that

motivation is largely increased for science and technology when they are confronted with science and technology in a creative and very often playful way.

Villette project classes are based either on proposals from teachers, or on experimental topics proposed by the Cité des sciences. The management of a project class requires a special commitment of the teachers that should not be underestimated, but it also is a particularly rich teaching adventure.
The project classes last four days: two days are standard for all pupils and the other two days can take into account the wishes of the teachers. The last two days are usually split in half-day activities. The teacher of the visiting pupils attend a preparatory session and builds the programme of pedagogical activities with the mediator in charge of the specific theme to be addressed. Thus the visit links up with the pedagogical project the pupils are working on at school.

The project Cité en alternance (City in alternation) is a tool worked out by the Cité de sciences et de l'industrie of Paris La Villette. This project concerns pupils and their teachers of a class of the collèges located in an education priority area (ZEP) near the City of sciences and of industry. Alternating work in the Cité dessciences and work at the collège, pupils acquire knowledge, skills and attitudes while getting acquainted with a place of scientific and technical culture. Teachers discover all the resources of the Cité, try out pilot activities and acquire varied methodological tools to build their own project.

The pupils registered within the framework of this action benefit from an individual subscription to the City of sciences and of industry: they come either with their professors during school time, or on an individual basis out of school time.

Contact and further information: tel. 00 33 140057698 or e-mail: educ-info@cite-sciences.fr
Website: http://www.cite-sciences.fr ; go to "éducation"

Découverte professionnelle or Professional Discovery in the lower secondary school (Collège)

Since September 2005 an elective option of 3 hours or a 6 hour module were introduced in the 3rd class of the lower secondary school to enable youngsters to get more information about possible careers later on. However the objectives, the target audience and the contents of those two possibilities are different.

The professional discovery activites are based on multiple collaborations with industry. Several partners have committed themselves to help schools in cooperation with the Ministry of National Education. For example: the Ministry of Employment, Social Cohesion and Housing, le Mouvement des entreprises de France or the Organisation of Companies in France (MEDEF), la Confédération générale des petites et moyennes entreprises or the General Confederation of Small and Medium Enterprises (CGPME), l'Union professionnelle artisanale the Professional Union of crafts (UPA), l'Assemblée permanente des chambres de metiers or the Permanent Assembly of the chambers of trades (APCM).

The professional discovery of 3 hours per week

The optional professional discovery (3 hours weekly) aims to provide students with a first knowledge of the professional world by discovering trades, professional environments and the economic and social environment in general.

Concepts and knowledge covered should allow to understand the reality of the world of business, often ignored by students. Activities available to students who choose this option must help them discover a wide range of professions and vocational training and must highlight the changes which affect those professions or careers.

This first introduction of students to the professional world should contribute to enlarging and completing the general education of lower secondary (Collège) students;
This 3 hour elective option has to be seen in relation with the "Parcours de découverte des métiers et des formations" (Discovery Pathway of professions and training possibilities) which since September 2009 has been introduced in all schools and which concerns all students form the 5th class of the upper secondary school (Lycée) to the final year of the general, the technical and the vocational secondary school. This pathway should help students developing their future professional pathway.

The professional discovery module (6:00)

The professional discovery module (6 hours per week) is organised in particular for an audience of students who volunteer to be involved. They are usually student who are academically weaker and who are willing to be involved in a project that will to continue training them at the end of the third class of the Collège.

This professional discovery module of 6 hours has to be seen as a major effort to reduce the number of students who leave the education system without any qualification whatsoever.
The main objective is to help the students developing their personal project and their learning project by getting more information about the professional world and its vocational training pathways. It also focuses on the possible bridges between vocational training and the normal education system.

Industry week and the school – business week

For several years the ministry of education has been promoting the organisation of a week focusing on the one hand on industry and one week focusing on cooperation school – business. These weeks are implemented across the different Académies (regional educational authorities) in different ways.

Industry week

This week allows the general public, especially young people, to discover industry and the companiesconcerned by it through open days in companies, professions forums focusing on professions and careers, educational workshops, competitions, conferences, debates etc.
The main objectuive of this week is to bring the worlds of industry, Education and Higher Education

closer together and to promote cooperation and understanding. A set of local actions of information, communication and education are organised to promote and enhance the awareness of industry and enhance the attractiveness of industry among young people.
It is now essential to highlight the interests of business and industry careers, to attract new talent and meet future recruitment needs. By 2015, more than a million jobs will indeed have to be created or renewed: 130,000 jobs in the mechanical industry, 105,000 in the metalworking, 155,000 in maintenance. These jobs also require 150,000 jobs engineers, manufacturing managers, study and research.

The activities organized concerning this week may differ according to the Académie (or regional educational authorities) concerned as the activities will be focusing on the industry which is present in each region. For example the activities of the week for the central region of France which is the sixth French industrial region will be focusing on the sectors of pharmaceuticals, cosmetics, rubber and plastics, food processing, automotive.

The School-Business cooperation Week

Week School-Enterprise aims in general to facilitate dialogue between the Ministry of Education and the world of business. The objectives are : to improve mutual understanding between the worlds of education and business, to Strengthen exchanges and links already existing partnership in the region and in the academies and encourage new initiatives, to establish a dialogue between teachers and business leaders in the long term, in a spirit of openness and reciprocity.

Issues at stake for the different target groups

For principals, teachers and business leaders:
- Create the conditions for a genuine dialogue in a spirit of mutual openness;
- Be aware of the constraints of each of those groups in promoting cooperation;
- Recognize their respective contributions to the education and training of young people and their integration into working life, to be able to work much more in complementarity;
- Share on core careers , the trends and developments within those.

For companies:
- Disseminate entrepreneurship by establishing lasting relationships between businesses and schools;
- To introduce students to the life of the company and show them its many facets. Give them a clearer vision of professional opportunities;
- raise awareness for both the economic dimension of the company (its products, customers, processes, development) and the human dimension (the company as a living organism composed of men with very different skills and courses) .

For students:
- Develop an entrepreneurial awareness and attitude and convey to them the positive values companies stand for showing that a company is creating wealth and promoting personal development;

• Motivate and increase their desire to learn, to facilitate their integration into working life;
• Allow them to better inform and orient themselves with a clearer understanding of the issues and the operation of a business.

Driven at the national level, it includes actions implemented locally in the academies. This year, the School Week-business comes primarily on the promotion of entrepreneurship.

Examples of School – Business cooperation week

Promote entrepreneurship

In the Academy of Caen, students learn about businesses by creating a mini-company. This is an educational project that brings together student volunteers and teachers around the creation of a product or service. In Normandy, 42 mini-companies involved 660 pupils, students and apprentices.

Students discover what companies look like: company classes

In several academies, classes will be set up for several days within the walls of a company so that pupils can discover what the inside of a company looks like. They meet professionals and learn about their work environment, in addition to their regular classes. In the Academy of Caen, a class moves to at Renault Trucks to 3 days. Students make a presentation at the end to the company officials and teachers to show what they have learned.

In other Academies, students visit companies that cooperate with Education. This is the case in Bordeaux, for example, where students learn about industrial facilities worldwide and the leading European aerospace industry: Bordeaux Aquitaine aerospace (BAAS). They meet engineers, senior technicians and technicians who deal with design, production and maintenance.

To introduce students to the jobs and careers

In the Academy of Besançon, the partners in the relationship school-business meet for four interactive performances in which an actor-trainer illustrates the themes of the week in a humorous way. The show provides a dialogue with the students about employment and policy issues and stereotypes based on an educational kit, "the wall of prejudice." Testimonials from professionals complete the activity.

In the Academy of Caen, students discover scientific careers, with testimonials, an exhibition and a film. In the Academy of Grenoble, schoolchildren visit innovative companies. After a debriefing, they feed back what they have learned. In the Lyon academy, 460 students participate in a rally "energy innovation", with five companies in the area. The students afterwards participate in a quiz with companies to measure their knowledge.

Strengthen links between education and business

In the Academy of Reims, businesses open their doors to teachers, guidance counselors and

psychologists. At Caen, EDF invites teachers to a day of discussions with employees. Young people receive a learning a tour of the facilities and the EPR site.

In Rennes, business leaders meet with school leaders to facilitate the dialogue between the respective structures they are responsible for. The objective is to make both groups aware of the issues and constraints of each kind of organization: business and schools.

To enter the school-business relationship in the long term, the Week is also an opportunity to establish sponsorships, activating pairs between schools and business representatives. Together they can implement actions related to the discovery of business, the development of entrepreneurship, etc..