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Quality WIL based model for IVT and CVT

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Abstract

Since 1992, our WIL based model for vocational training leads to a Master degree in the production field. It is designed to cop the company needs and satisfy the personal and professional projects of learners and apprentices. In consistency with our partners' requirements (industrials, professional unions), training process and organisation respect a quality charter for engineers. Therefore this accredited training focuses on each actor's goal; learner, company, training centre. Model is an academic curriculum based on a professional profile of competencies for process engineers developed with the industrials. It includes a formative work situation designed to achieve both ability acquisition and company results. Training process is designed respecting a sustainable strategy. Main points are; **recruitment process** (backgrounds, motivation, company involvement), **training of the company mentor and school tutors** (roles), **the engagement letter** (company results and formative goals), **wining trio**, **inductive pedagogy** and **project based learning** completed when necessary by **remedial activities** and **personal enrichment activities**, group cohesion improvement through **seminar and proofreading experience and interviews**, **benchmarking**, and finally, **cooperative assessment**. Respecting consistency of practices with sustainable development leads to a positive impact on social (recognition) and economic (existence) fields and finally on the ability for transfer (fair). This model allows graduate engineers to face the future dealing with innovation, mobility and sustainable development as they are coached and guide to urge their personal evolution and ability acquisition (leadership for project management) through personal improvement axes identification. Training is of course evaluated by the learners and through accreditation considering; design, employability, realisation, organisation, research and industrial partnership, international actions.

Keywords: work based learning, professional skills, tutoring and mentoring, inductive pedagogy, remedial activities, apprenticeship, sustainable development, sandwich course, training process, cooperative assessment, apprentice booklet and e-portfolio, value management, LLL

1. Introduction

The proposed trainings lead to the Master's degree (chartered engineer) in the production field issued by the Ecole Polytechnique Universitaire de Lille (Engineering College of the University of Lille; North of France). It is part of the national Polytech network composed by 12 French Engineering schools covering five main domains (mechanics, computer science, electricity and electronics, civil engineering and food processing and biotechnology) taking advantages of research context (Nuninger et al., 2011). The academic syllabus lasts 5 years (2 years after high school + 3 years) as shown in Figure 1. The IESP Department (Ingénieur d'Exploitation des Systèmes de Production) is dedicated to Life Long Learning and Apprenticeship, in charge of both training realizations in the production field: Initial Vocational education and Training (IVT) and Continuing Vocational education and Training (CVT). Since 1994, it is realised in partnership with the Institut des Techniques d'Ingénieurs de l'Industrie du North-Pas-de-Calais (ITII N-PdC): the link with the professional union (metallurgy). It is an accredited diploma by the Commission des Titres d'Ingénieurs (CTI) since 1992 for CVT. Another way of access was also created in 2004 based on apprenticeship (ICT). Historically, the training project is a response from the university to industrial demands: lack of engineers with technical skills and management abilities for the production

process, whatever the field is; taking into account personal and professional evolution of employees. Figure 2 shows how each one (company, university) complement in a global approach around the learner: learner and mentor make the link and give consistency; a real partnership. The training process sticks to the following value: “Learning in a different way to become an engineer!”

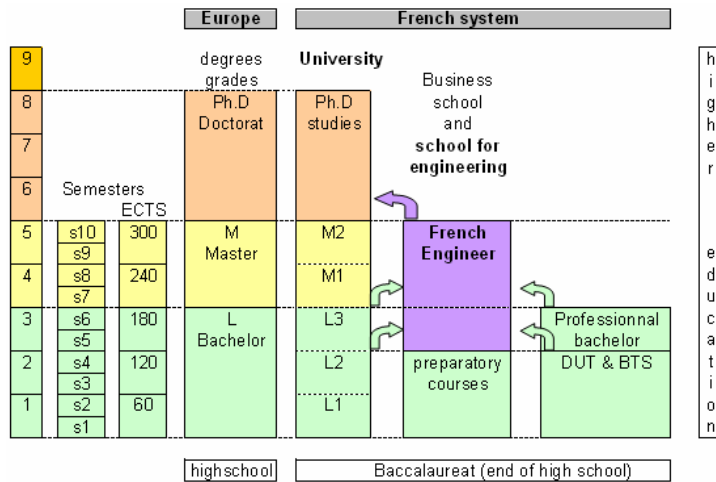


Figure 1: French higher education system satisfying the European grades. Accredited diploma leads to better employee hiring.



Two realities that contrast and complement. Two functioning which are inseparable and interdependent.

Figure 2: Principles of the WIL training model to access the diploma

Each year 15% of the 350 graduates from Polytech’Lille are Work Based Learners. Our first promotion passed the degree in 1995 and today 228 IESP Engineers work in the industry (41 apprentices). Already employees of the company during their training, they improve their position once graduate or change from company in the run. They are efficient upon any mission covering production needs: manufacturing quality, maintenance, safety procedures, logistics, environment, project management, etc. Table 1 gives some examples of the weight of their previous formative work situations for company goals. Until today we have worked with more than 70 different companies including strong partnership with Renault, EDF, Safran, Rio Tinto and Danone.

Field	Company	Task
Metallurgy	Aluminium Pechiney Aluval	Implementation of TPM Foundry
Energy	Bugey Nuclear Plant (EDF)	Implementation of conditional maintenance alternators
Energy	Gravelines Nuclear Plant (EDF)	Project High Ground Control define a new job
Energy	EDF GEH Garonne	Quality organization design: ISO 9001, ISO 14001
Energy	EDF LONS LE SAUNIER	Inspection and maintenance of hydroelectric
Energy	EDF-GDF Corse	Controlling Explosive Atmospheres in thermal Corsican
Transport	KEOLIS Métro de Rennes	Consolidation (update of the design an planning) of work cycle
Automotive	RENAULT Sandouville	Forward and build new production lines
Automotive	RENAULT Technical centre	Define and deploy the logistics to the international
Transport	SNCF Tech. Centre Hellemmes	Prepare the workshop production of axles competition
Aeronautics	SNECMA Services	Physical flows optimization (incoming/outgoing) for all activities
Manufacturer	SNECMA Engines	Industrialization of a new computer for fighter aircraft
Aeronautics	THALES	Industrial Project Airbus-Thales
Manufacturer	TOSHIBA Neuville les Dieppe	E.O.L. end of life - reverse logistics
Food industry	DUYCK Brewery	Optimization of production (+30%)
Food industry	METAROM	Optimization of production
Manufacturer	DECATHLON	Opening a new subcontractor in foreign country (Italy)
Transport	ALSTOM	Transport Renovation of the subway of the Caire (Egypt)
Telecom	ALCATEL Cables	Industrialization of a new submarine cable

Table 1: examples of formative work situations integrated to IESP training

Work Based Learning education allows the same level of knowledge than for any Polytech Engineers who have followed the conventional educational path but it adds competencies that can be directly mobilized (employability improvement). Such a solution gives place to transfer and allow individual skills to remain in the company: work is recognized as a process of learning

(Costley, 2000; Armsby, 2006; Chatelet, 2006; Dewblam, 2006). For our department and team the strong partnership allows us to keep in touch with the industrial reality and keep on updating our competencies. Development of Lifelong learning process and legal possibilities for the accreditation of competences will help the social modernization (French Government, 2002). Today the required formative situation will introduce professional and vocational periods abroad. Innovation was already included in the missions through the engagement letter. Academic curriculum includes some courses or conferences in English to help learners to cover both writing, listening and reading capability (advanced independent user). All our actions tend to support such prospects. Table 2 gives the key figures that characterize the training process and organization.

Actions	IESP Key Figures (2009-2010) taking into account all individual spent time
Graduates	228 : 187 CVT since 1995 (upon which 24 VAE*) + 41 IVT since 2007
Realized training hours	65600 h (academic) : 21200 h for CVT + 44400 h for IVT 128100 h (company) : 39300 h for CVT + 88800 h for IVT
Realized hours for assessment	1050 h : 371 h for CVT + 518 h for IVT + 161 h for jury (include joint assessment)
Brainstorming hour on pedagogy including workgroups and management meetings	1070 h 1 joint management board of the IESP (4 meetings a year) – 208h 3 IESP workgroups with one day feedback for results – 640h 4 workgroups and management board of ITII partnership (national and regional) whose results are presented during the annual ITII convention - 132h 4 workgroups for apprenticeship (Formasup-APEA) with feedback day and management board meetings (regional) - 90h
Administrative team (since 2010)	2 secretaries (1 full-time, 1 half-time) 5 teacher-searchers doing a management mission (no full time job)
Pedagogic team (since 2008)	50-80 lecturers upon which 30% are stakeholders from the industry, 40% are teacher-researcher (belong to laboratory)
Partnership for training actions (since 2008)	2 for Value management and quality (1 international: Utrecht in Netherland) 3 for Safety and Health at Work (AINF, ARACT, Fullmark) 1 for Innovation (CRITM2A) 2 training seminars abroad for lecturer benchmarking (i.e. 10 days)
Communication (since 2006)	9 international communications (upon which 2 within regional collaboration and 1 with international collaboration)

Table 3: key figures for IESP training including realization, benchmarking, best practice feedback and transfer, evolution and international training influence. (VAE*: Validation of Acquired Experience; graduate without following the training thanks to their professional background)).

In the following, first a general view of our unique quality WIL training model is given. Second the quality criteria for accreditation taking into account European framework are stressed: the compliance of our model is proved, further developed in a third part precisising the main steps of the training model and tools. Finally the conclusion is made dealing with our process based and value management consistent with international quality requirements for Work Integrated Learning and Work based experience ability acquisition.

2. General view of our unique quality WIL training model

Curriculum is based on a professional profile of abilities for the production field (process engineer) dealing with 2 fields of application: **human** and **technical**. It was developed by our partners (7 industrial groups from energy sector, metallurgy, food industry, automotive sector and chemical engineering as well as aeronautics) in partnership with the professional unions (metallurgy and chemical). The training includes **sandwich courses** and work based experience through **formative situation in the company**. The only difference between both ways of access to the diploma (CVT and IVT) is the public origin (age, professional background experience required or not) that leads to different duration of academic courses. Work contract and training fees financing also differ but they all got a salary (see Table 3). Curriculum includes in the same proportion (33% each) of courses: Sciences and Technics, Methods and tools for engineering, Engineer professional background including seminars, conferences and English (Nuninger et al., 2009, 2011).

Training	Lifelong learning (CVT)	Vocational learning (IVT)
Core of the IESP Training	IESP Professional profile (production field, technics and human ability) - Relocated Seminars Partnership with professional union - Sandwich courses – Inductive pedagogy Work experience based on a formative situation - Dual tutoring (school tutor, company mentor)	
Grade required	BAC+2 (Grade L 2) as a minimum	
Grade reached	Chartered Engineer (BAC+5, Master's degree in Engineering) from Polytech'Lille	
Public	- average age of 35 year - employees (technicians, supervisors...) - professional experience longer than 3 years with personal evolution potential detected by the company	- young adults (less than 26 years' old) - no professional experience required - motivation detected within interview at school and in the company for recruitment
Legal condition	Work contract by the company (salary) Training convention with the department	Work contract for apprenticeship with the company (salary). Transport is refunded by Formasup (Crequis, 2009)
Training fees	Training fees are paid by companies through the professional training plan (legal obligation in France), human resource policy or financial aids from professional union and state. Learner may have a personal participation.	Free registration fees for the apprentice. Training financing comes from legal tax for apprenticeship paid by the companies and regional aids.
Duration	Professional Qualification + 5 semesters	6 semesters
Frequency	1 week per month at school (average)	1 week at school for 3 weeks in the company
At school	1200 h (academic curriculum)	1 800 h (academic curriculum)
In the company	1800 h (formative situation)	3 600 h (formative situation)
Personal workload	2100 h (estimation based on polls)	900 h (estimation based on polls)

Table 3: Unique Quality Training Design (IESP, 2010)

The partnership with the professional union is a way to guarantee the quality of the training process. This link with industrial partners takes shape within the joint management board meetings rhythmic by the training life. Table 4 summarized the 3 initial expectations for the training design; further formalised in the ITII charter in 2006 (ITII, 2006). This concept guides the development of the process respecting each actor goals and framework with a mutual enrichment; a requirement for this kind of training in France (Crequis et al., 2010). Periodic audits are made by the Commission des Titres d'Ingénieur (CTI) for accreditation of higher education institutions in the fields of engineering: our training was renewed for 6 years which is a proof of quality. Audits consider all the aspects of the training: curriculum design, learners' employability, training realization, school management and organization, link with research and industrial partnership, international actions and development (see Table 5). Note that CTI is a full member of ENQA (European Association for Quality Assurance in Higher Education). With respect to the European framework our Quality WIL training model is also compliant with the Tuning Dynamic Quality development Circle for Educational Structure in Europe (Tuning Project, 2007). Indeed, as shown in Figure 3, the model design process respects all the requirements and expectations of our partners and evaluators and can also be compared with other trainings.

Training close to the industry	Training with sandwich courses	Value management
- strong partnership with industry - professional profile - project management ability - sciences and technology skills - equilibrium between courses for sciences, engineer tools and professional background - both validation of academic courses and work experience in the company - focus on knowledge, know how, soft skills and ability acquisition through work experience	- sandwich courses - inductive pedagogy - problem based learning - teachers and tutors should taking into account the industrial reality - duration of training (1800 h for IVT, 1200 h for CVT) - formative situation in the company - work contract for learners - contract for apprenticeship	-individualisation of training with respect to learner history and evolution -cooperative assessment of ability -assessment of the training process by the learners -participation of the training centre (school) to the managing groups and improving discussion group of partners (ITII) -management by quality -feedback

Table 5: Training requirements from the ITII charter (ITII, 2006)

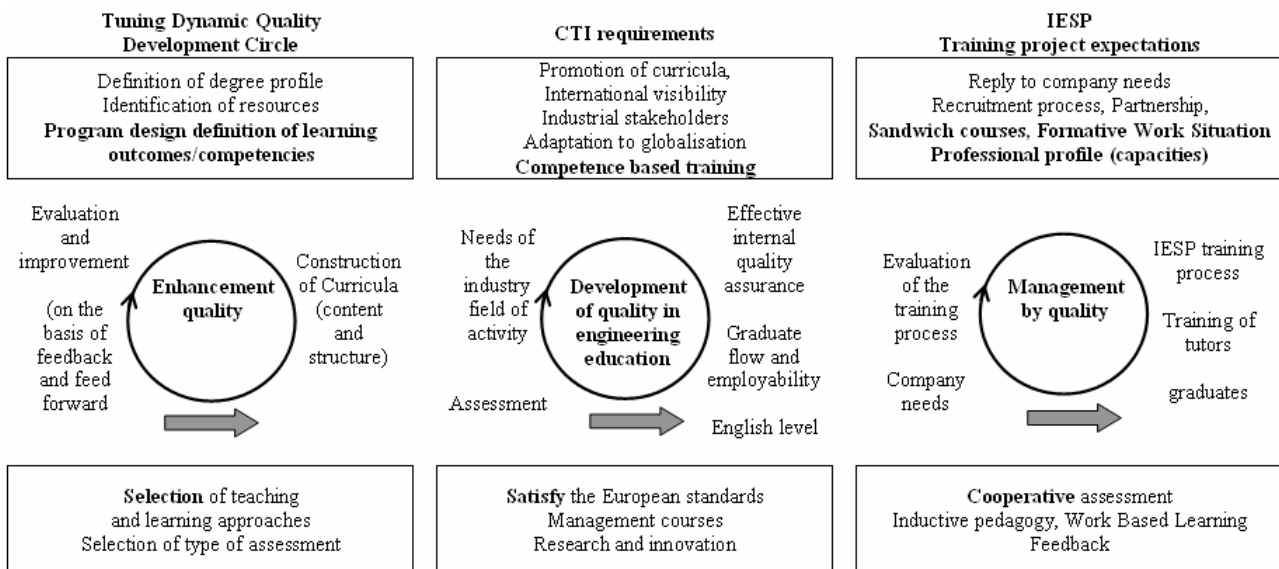


Figure 3: short functional analysis to help comparison between quality model design processes (ITII, 2006; Tuning Project, 2007; CTI, 2010). For each, thanks to management, a Plan Do Check Act process based on entry leads to a training design taking into account best practices, requirements and management decisions.

Goals of CTI	Main requirements	Indicators for accreditation
<ul style="list-style-type: none"> - development of quality in engineering education - promotion of engineering curricula and careers in France and abroad - adaptation of engineering training to globalisation of economy and to the ever-growing international higher education area 	<ul style="list-style-type: none"> - implementation of effective internal quality assurance - competence-based engineering education - satisfy the European standards, international visibility 	<ul style="list-style-type: none"> - graduate flow and employability - match the needs of the industry field of activity - partnership, industrial participant (stakeholders) - management courses - English level (independent and proficient user) - grade of trainer - learners mobility - research and innovation - training assessment - organisation (evolution, curriculum improvement)

Table 5: CTI accreditation requirements (CTI, 2010)

3. Main good practice steps of our work integrated model of training

Success of each learner training course relies on several steps of our process. To perform and achieve these steps, tools and pedagogical methodology are developed and used taking into account a good practice policy (see Figure 3 and Table 6). All the system focuses on the learner or the apprentice's needs to develop his skills, abilities, personal potential of evolution. His work experience is the basis of the training within the formative situation to allow ability acquisition in a real framework: the company. The following Table 6 shortly describes these main steps. Figure 4 completes the definition of our guide for the development of our process: a virtual circle respecting each actors and sustainable development within a target that remains technical and human transfer of ability and values. First of all the **recruitment process** takes into account the candidate backgrounds (grade, professional and academic history) and his motivation but also the involvement of his company with respect to the learner personal and professional project (support and finance of the project of the actual (CVT) or future (IVT) employee). For any demand, a specific contact or visit to the company is made by members of the department IESP to present our process, inform about the training requirement and mostly the ones of the formative situation of engineer level (that includes both company goals and ability acquisition goals to be validated; efficient role of mentoring and tutoring, right position of the learner in the company). Secondly, a **training of the company mentor and school tutors** is performed: aim is to help the definition of the mission, the identification of each one role (it is not doing and resolving it for the learner, but coaching and guiding him on the path of personal evolution, self analysis, behaviours, acquisition of skills and abilities).

	Step	Tools	Goal
1	Recruitment process	Interview with candidate, visit to the company, explanation about training process and formative requirement	Detection of potential Ensuring the involvement of the company in the process and candidate project
2	Mentoring	Tutors training, participation to final assessment jury, learner interview during the process, one visit per year in the company (CVT) and one per semester (IVT)	Explanation of each one role (coach), understanding of IESP professional profile, ensure involvement of mentor for guiding and cooperative evaluation, help the mission definition and further identification of improving points of learner, feedback, benchmarking
3	Definition of formative mission	Formative situation with both company results and ability acquisition goal with respect to the IESP professional profile	Ensure ability acquisition with right position in the company within work based experience and personal evolution, a way to improve personal and professional evolution
4	Academic curriculum	Inductive pedagogy, WBL, English courses and seminars, conferences. Curriculum is based on professional profile of ability	Adapted to the public with real needs, benchmarking, ability to analyse problems, independent user of English, knowledge of other industrial sectors.
5	Feed back	Proofreading experience, e-portfolio, apprentice booklet, interviews with tutors, personal enrichment activities	Reflexive attitude, behaviour evolution, personal evolution, transfer of ability, network, improvement
6	Cooperative assessment	Ability assessment through interview and questions, courses assessments, remedial activities	Proof of ability acquisition (human & technical fields), both ability and knowledge evaluation, personal evolution

Table 6: main tools of our work integrated model of training linked to the goal

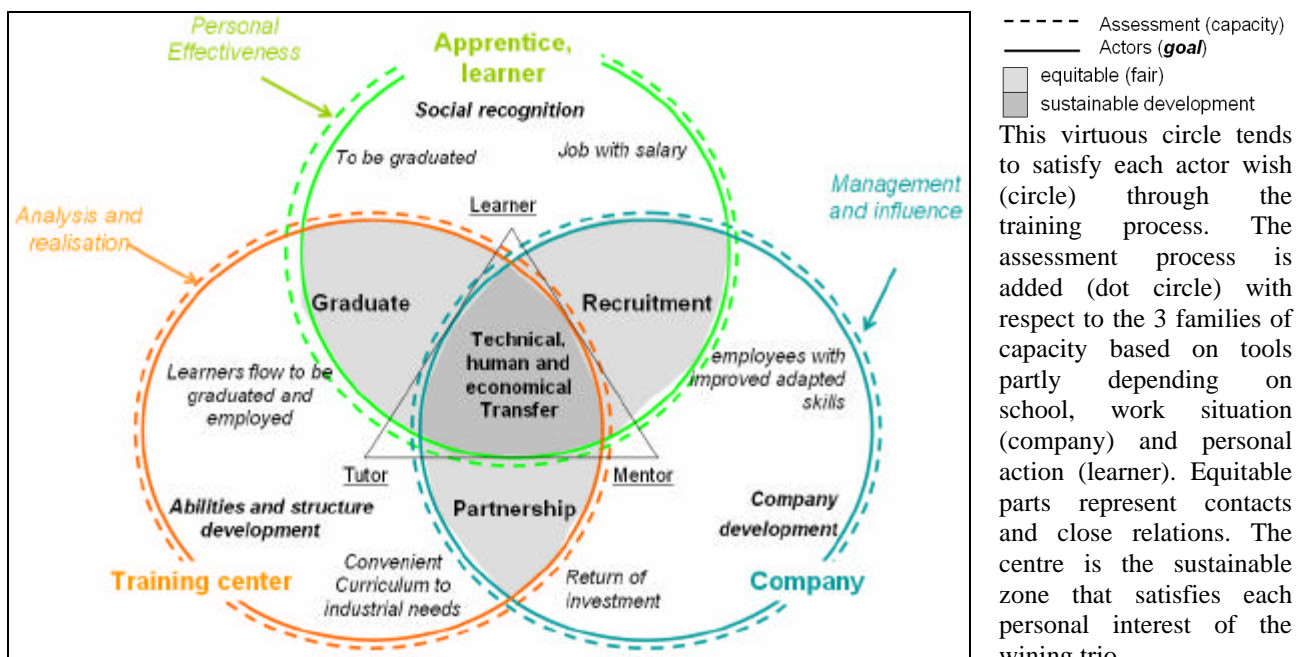


Figure 4: sustainable development policy for cooperative transfer of human and technological abilities and values in a competitive and global world. Actors form the winning-trio. (Krupp, 1984; Houssaye, 2000; Nuninger, 2011;)

The engagement letter with respect to academic curriculum and professional profile has to be jointly validated by the company and the school: it is the core of the curriculum. The learner is the centre of the process leading to a **winning trio** between actors. Respect of **inductive pedagogy** (Michel, 2005) and **project based learning** during academic courses (Kolb learning cycle, (Kolb, 1984)) is the right process: starting with real examples that might lead to theory and solutions. It requires times and efficient planning of schedule. In case of failure, **remedial activities** are decided. Including relocated seminars that improve group cohesion and **experience transfer** through proofreading experience. Seminar topics are (see Figures 5 and 6); (1) communication and personal development, (2) value management (HSQE) and (3) language seminar (realised abroad). Finally, the **cooperative assessment** (by the industry mentor and the school tutor) is a way to alert the

learners along the process when there is a risk of failing, to help him to identify the improvement axes and to urge the personal evolution thanks to questioning, exchange, feedback, proofreading experience, **enrichment activities**. Future engineers should develop the ability to industrial project management. Our network of partners and graduates maintain development and consistency of training. The point of consistency of each actor goal is obviously part of the sustainable development: satisfying it has an impact on social (recognition) and economic (existence) fields. Transfer of ability is the sustainable goal (see figure 4). Table 6 makes the link between these aspects and the IESP professional profile of competencies.

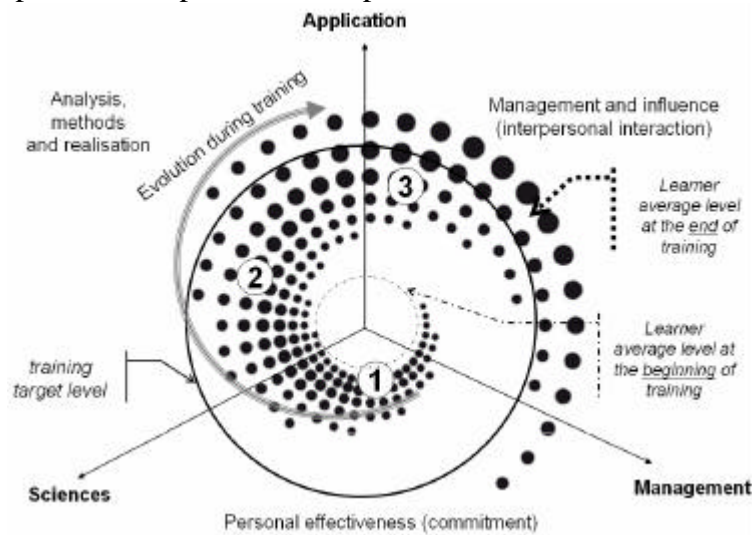


Figure 5: Variability of personal evolution during training process (dot plant) with respect to initial level of recruitment (dash circle) and training final target. Each axis defines capacity groups (plan) between scientific knowledge, application and management. The personal posture will change from technician to chartered engineer.

In the end, each learner and apprentice will have a personal evolution during the training that in general exceeds expectation, i.e. the target level of the training and the company expectations. A proof is that the final position of the graduate is in general a higher position than the one expected within strategic workforce planning (GPEC). This evolution of learner during training is illustrated by figures 5 and 6. Respecting these concepts is a tool for managing such training process and leads to quality (see figure 6).

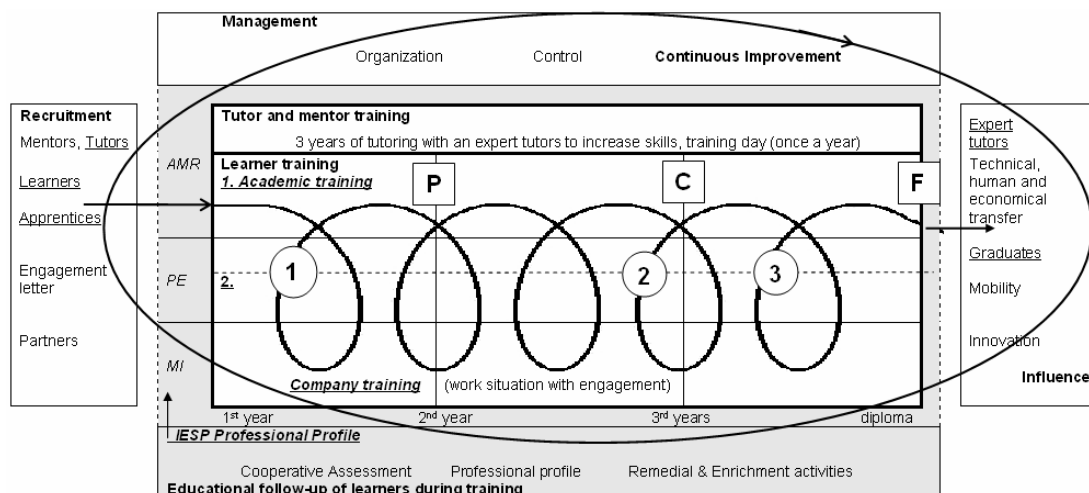


Figure 6: Training included in the Quality management System of the IESP Department.

Recruitment process acts on inputs. Outputs will impact the Influence process. Training process depends on abilities described by the IESP professional profile (AMR: Analysis and Realization; PE : Personal Effectiveness; MI: Management and Influence). It is rhythmic by assessments (P: technical project; C: prospective analysis for action as a reply to the accepted mission; F: final proof of ability acquisition with joint assessment). Relocated seminars all along the training help the learner personal evolution (1: personal development; 2: value management; 3: language (abroad)).

In figure 6 the process is presented as full part of the quality management system of the IESP Department. In both figures, the main steps (seminars, assessments) of the training are indicated as they are the clues of posture change (evolution from technician ability to engineer competencies). The training satisfies three points of view within a virtuous circle:

- the personal effectiveness improvement through knowledge (academic curriculum, sciences; “savoir”), expertise (within projects; “savoir faire”) and interpersonal skills (within work based learning; “savoir être”)
- the professional improvement through the management of the mission (work situation)
- the collective improvement through team working and international mobility (application)

Therefore, the three key moments of the trainings are the three seminars correctly planned during the training cycle:

- “driving the change” (personal development management) that improves individual skills
- “management by quality and value” that improves analysing and solving ability
- “international mobility” (language) leading to a better influence capacity

Conclusion

Today, innovation, mobility and sustainable development are obvious requirements for engineers. Quality of training process, Quality of tutoring and mentoring action, Quality of cooperative assessments and Quality of partnership exchange are the ways to achieve the goals: integration of innovation in the formative situation; foreign professional experience at a lower cost for the training centre respecting each other interests and framework to achieve the mutual efficient enrichment (transfer of skills, expertise, technical knowledge, economical development). However the training was first created in 1992 as a reply to French industrial needs for engineers with technical knowledge and management abilities, the professional profile and the process of realization are still up to date. The main reason is that at the beginning continuous improvement through evaluation was already taken into account. Therefore quality, security, profitability and reactivity criteria are always considered in order to follow action and prove performances. These strong requirements are included in the ITII Charter such as; industrial partnership, consistency of curriculum with company needs, training process dedicated to ability acquisition, equilibrium between Sciences, Engineer tools and professional background including, professional profile with both management and technical skills, cooperative assessments of both academic courses and work experience, adapted inductive pedagogy focusing on WBL, value management of the training and the organization of it. Our model is fully compliant with CTI expectations and with the Tuning Dynamic Quality development Circle for Educational Structure in Europe (Tuning Project, 2007): it allows a better mobility of graduates and it can be compared to other training models. Within the process, the learner’s skills are developed and positive thinking and analysis are enhanced. As a consequence employability is improved for apprentices due to a better self knowledge and learners (CVT) can pretend to higher position in the company.

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