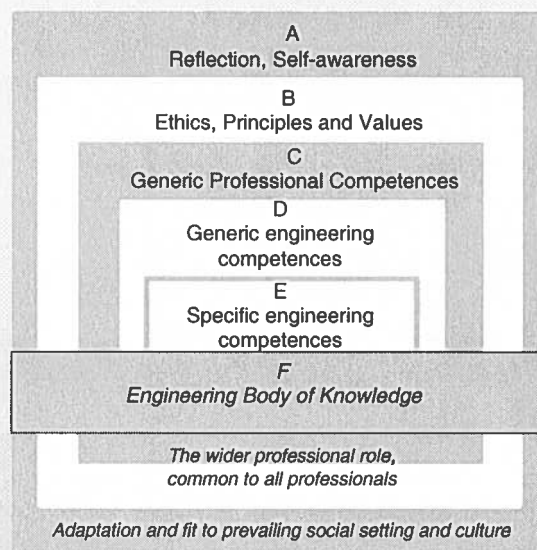


The European Record of Achievement for Professionals in the Engineering Industry



DO YOU WANT HELP WITH MANAGING YOUR CAREER AND YOUR PROFESSIONAL DEVELOPMENT?

As a professional you are ultimately yourself responsible for maintaining and developing your own competence. As technology and the business environment are changing at an increasing pace, this means that continuous learning – both in the workplace and through off-the-job training – is becoming ever more important.

How well equipped are *you* for managing your own learning, to make the most of the time and effort you invest in your professional and personal development?

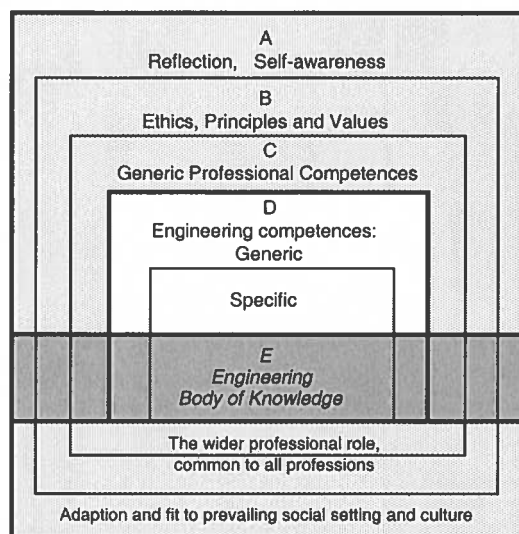
There are many sources of support to help you in your professional development. You can draw on the support of your employer, your union or professional body, and many training providers. However, *you* are the person ultimately responsible. It is to support you in this responsibility that the EuroRecord, the European Professional Record of Achievement in Engineering, has been designed, to help you to satisfy your professional and personal goals.

*Developed with the financial support of the
LEONARDO DA VINCI programme of the European Communities.*

make the most of your professional development

18 October 1998

EURORECORD – EUROPEAN RECORD OF ACHIEVEMENT FOR PROFESSIONALS IN THE ENGINEERING INDUSTRY



A – Reflection, Self-awareness

B – Ethics, Principles and Values

- | | | | |
|----|--|----|--|
| B1 | Follow an accepted code of ethics appropriate to the social and professional context | B3 | Develop and promote environmental principles |
| B2 | Exercise duty of care to clients and the community | B4 | Assume professional responsibility for own actions |

C – Generic Professional Competences

- | | | | |
|----|--|----|---|
| C1 | Maintain and develop own expertise | C5 | Work as a member of and lead a team |
| C2 | Develop new professional knowledge through research and practice | C6 | Communicate and represent in the professional role |
| C3 | Develop and mentor others | C7 | Manage people, resources, projects and business affairs |
| C4 | Apply self management principles | | |

D – Professional Engineering Competences

Generic Engineering Competences:

- D1 Professional engineering practice skills**
- D1.1 Solve engineering problems, adapting to circumstances
 - D1.2 Apply engineering method
 - D1.3 Apply quality management principles
 - D1.4 Utilise appropriate engineering and technological aids
 - D1.5 Conduct testing, measurement and evaluation
- D2 Professional engineering planning, design and documentation**
- D2.1 Clarify and define engineering design requirements
 - D2.2 Prepare concept proposal to meet requirements
 - D2.3 Perform or arrange for design of selected proposal
 - D2.4 Perform design evaluation
 - D2.5 Prepare supporting documentation
 - D2.6 Maintain integrity of design identification documentation
 - D2.7 Present, report on and advocate engineering ideas
 - D2.8 Prepare, comprehend and communicate engineering documents

Engineering Competences Related to Specific Activities:

- D3 Research, development and commercialisation**
- D3.1 Perform research
 - D3.2 Formulate concepts for development
 - D3.3 Identify and seek allocation of resources for development of research outcomes
 - D3.4 Perform market research on research outcomes
 - D3.5 Commercialise research outcomes
- D4 Materials and components**
- D4.1 Define requirements and applications for specific materials or components
 - D4.2 Source raw materials for making engineering materials or components
 - D4.3 Supervise the preparation or manufacture of engineering materials and components
 - D4.4 Assess properties of materials or components
 - D4.5 Select protection against deterioration

D5 Manufacturing and production

- D5.1 Plan the manufacturing or production process
- D5.2 Maintain and supervise a quality assurance programme
- D5.3 Perform process operations, control and optimisation tasks
- D5.4 Perform raw materials management tasks
- D5.5 Measure production performance

D6 Project implementation

- D6.1 Perform construction or installation tasks
- D6.2 Prepare and monitor contracts
- D6.3 Prepare tenders and meet contract requirements
- D6.4 Perform site management tasks and activities

- D6.5 Perform commissioning

D7 Asset management

- D7.1 Perform asset procurement tasks
- D7.2 Perform or supervise maintenance tasks
- D7.3 Perform asset controlling and optimisation tasks
- D7.4 Perform disposal planning

D8 Engineering education and training

- D8.1 Develop engineering education or training plans
- D8.2 Conduct engineering education or training programmes

D9 Other specific activities

E – Engineering Body of Knowledge

E1 Engineering mathematics

- E1.1 Analysis and calculus
- E1.2 Linear algebra
- E1.3 Discrete mathematics
- E1.4 Probability and statistics
- E1.5 Operational analysis, non-linear systems, optimization

E2 Physical and chemical structures, processes and properties

- E2.1 Structures of matter
- E2.2 Physical properties of matter
- E2.3 Chemical properties of matter
- E2.4 Biochemistry
- E2.5 Life sciences and agronomy
- E2.6 Properties of electromagnetic waves
- E2.7 Transducers, sensors and other devices

E3 Engineering mechanics

- E3.1 Applied thermodynamics
- E3.2 Mechanics of fluids
- E3.3 Mechanics of machines

E4 Electrical and electronic engineering

- E4.1 Engineering systems
- E4.2 Electromagnetism
- E4.3 Electrical networks
- E4.4 Electrical energy conversion
- E4.5 Electrical power systems and electrical drives
- E4.6 Electronics
- E4.7 Power electronics
- E4.8 Control and instrumentation
- E4.9 Signal processing

E5 Systems engineering and information technology

- E5.1 Information theory and systems
- E5.2 Integrated circuit technology
- E5.3 Computer architecture
- E5.4 Software engineering
- E5.5 Automation and control engineering
- E5.6 Artificial intelligence and expert systems

E6 Materials and structures

- E6.1 Materials science
- E6.2 Strength of single elements, theory of structures
- E6.3 Rock and soil mechanics

E7 Manufacturing engineering

- E7.1 Mapping, modelling and analysis of manufacturing operations
- E7.2 Transformation processes
- E7.3 Manufacturing technologies
- E7.4 Operations management
- E7.5 Manufacturing system design

E8 Chemical and biological engineering

- E8.1 Chemical engineering
- E8.2 Bioengineering

E9 Environment

- E9.1 Town planning, national and regional development
- E9.2 Environmental systems and management
- E9.3 Environmental protection
- E9.4 Rural engineering

E10 Organisation, people and enterprise

- E10.1 People and organisations
- E10.2 Business and management
- E10.3 Law
- E10.4 Society

E11 Professional language mastery

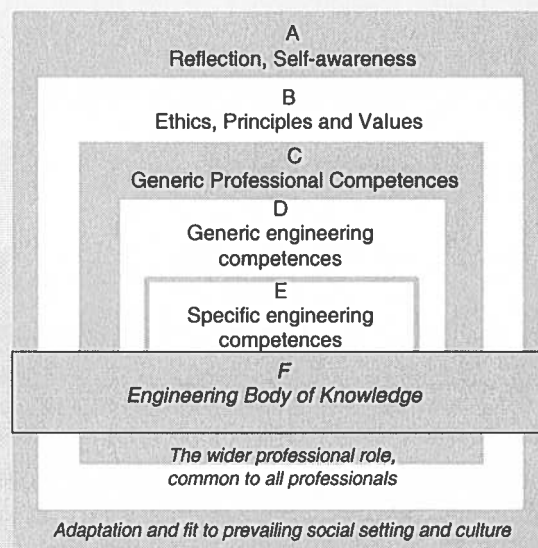
- E11.1 English
- E11.2 Other languages
- E11.3 Scientific and technical professional vocabulary

E12 General citizenship

- E12.1 History of ideas
- E12.2 Politics
- E12.3 Personal interests

The European Record of Achievement for Professionals in the Engineering Industry

COMPETENCE FRAMEWORK



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19 October 1998

*Developed with the financial support of the
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make the most of your professional development

Code	Competence heading	Description
A	REFLECTION AND SELF-AWARENESS	
A1	Understanding the nature of knowledge and competence	<i>Understand the qualities of different kinds of knowing, understanding, know-how, values, skills and competences and how they inter-relate and reinforce each other</i>
A2	Reflection on own action	<i>Reflect upon and evaluate own actions and knowledge; learn from own professional practice, from successes and mistakes</i>
B	ETHICS, PRINCIPLES AND VALUES	
B1	Follow an accepted code of ethics	
B1.1	Consideration of ethical issues and values	<i>Incorporate into judgements consideration of ethical issues, values and the role of the profession in society</i>
B1.2	Commitment to own profession	<i>Act to uphold the honour, integrity and dignity of the profession, demonstrating commitment to positive development of the profession, for the benefit of the wider community</i>
B1.3	Recognition of limits of own competence	<i>Generally perform work independently only in areas of proven competence; when operating in areas of developing competence, or where research is required, be open about the facts, and seek appropriate support</i>
B1.4	Fair competition	<i>Build professional reputation on merit, not compete unfairly</i>
B1.5	Objectiveness and truthfulness	<i>Give evidence, express opinions or make statements in an objective and truthful manner and on the basis of adequate knowledge, particularly when it might be assumed that such statements are made within the professional role</i>
B1.6	Equality	<i>Ensure equitable practice (e.g. non-discrimination)</i>
B1.7	Personal integrity and honesty	<i>Show at all times personal integrity, honesty and respect for others, and consistency between behaviour and expressed attitudes</i>
B1.8	Independence and self-reliance	<i>Show independence and self-reliance</i>
B1.9	Avoiding conflicts of interest	<i>Avoid personal matters affecting professional conduct or judgement</i>
B1.10	Personal sense of purpose and vision	<i>Engage a personal sense of purpose and vision</i>
B1.11	Maintaining personal standards	<i>Maintain self-imposed high standards, excellence and attention to detail, while being able to adjust to real constraints for the achievement of practicable outcomes</i>
B2	Exercise duty of care to clients and the community	
B2.1	Responsibility for public welfare, health, safety	<i>Place responsibility for the welfare, health and safety of the community at all times before responsibility to the profession, to sectional interests (including the client), or to other professionals</i>
B2.2	Professional loyalty and reliability	<i>Apply professional skill in the interests of employer, client, and the wider community acting in professional matters as a faithful agent or trustee</i>
B2.3	Client care and communication	<i>Check that the client's brief, wishes and views are fully understood, taken into account, and responded to, and that the client is kept informed and consulted</i>
B2.4	Confidentiality and personal integrity	<i>Respect confidentiality, and avoid making improper use of privileged information and professional relationships, consistent with retaining the highest standards of personal integrity</i>
B2.5	Trust and confidence	<i>Develop trust and confidence, influencing decisions in the absence of formal authority</i>
B3	Develop and promote environmental principles	
B3.1	Consider environmental impact	<i>Incorporate into judgements consideration of environmental impact</i>
B3.2	Recognition of diversity of ecosystems	<i>Recognise that ecosystem interdependence and diversity form the basis for continued human existence</i>
B3.3	Recognition of finite capacity of the environment	<i>Recognise the finite capacity of the environment to assimilate human-made changes</i>
B3.4	Promote environmental actions in engineering	<i>Promote the actions required in engineering practice to improve, sustain and restore the environment</i>
B3.5	Waste minimisation, recycling, and alternatives	<i>Promote the wise use of non-renewable resources through waste minimisation, recycling and the development of alternatives wherever possible</i>
B3.6	Minimise use of raw materials and energy	<i>Strive to achieve the beneficial objectives of engineering work with the lowest possible consumption of raw materials and energy, the use of low embodied-energy products, and by adopting sustainable management practices</i>
B3.7	Take account of total lifecycle implications	<i>Take account of total life-cycle implications of products and projects in relation to the environment</i>

B3.8	Take account of effects on culture and heritage	<i>Take account of possible effects of engineering work on likely cultural or heritage factors</i>
B4	Assume professional responsibility for own actions	
B4.1	Quality and consequences of own and others' work	<i>Accept responsibility for the quality and consequences of own work and for the work of others for whom accountable</i>
B4.2	Professional risks and liabilities	<i>Take account of potential professional risks and liabilities, and accept responsibility for them</i>
B4.3	Operate safely at all times	<i>Operate safely at all times, including in uncertain and risk-prone circumstances, taking care of others</i>
B4.4	Occupational health and safety requirements	<i>Implement appropriate occupational health and safety requirements</i>
B4.5	Community safety requirements	<i>Investigate community safety requirements and act to solve any incipient safety problems</i>
B4.6	Appropriate precautions in hazardous operations	<i>Take appropriate precautions when dealing with hazardous operations</i>
B4.7	Disaster prevention, mitigation, recovery methods	<i>Take account of disaster prevention, mitigation and recovery methods</i>
C	GENERIC PROFESSIONAL COMPETENCES, common to all professions	
C1	Maintain and develop own expertise	
C1.1	Manage own continuing professional development	<i>Manage and pursue own continuing professional development in relation to professional goals and/or corporate strategic objectives</i>
C1.2	Acquire and maintain broad general education	<i>Acquire and maintain the broad education necessary to understand the impact of engineering solutions in the widest context, and a knowledge of historical and contemporary issues</i>
C1.3	Understand appropriate engineering competences	<i>Have a comprehensive understanding of and acquire the appropriate engineering competences (see Sections D, E and F) and the relevant knowledge, including critical evaluation and relevant know-how covering when and how to apply it</i>
C1.4	Know own limitations and seek external help	<i>Know the limitations of own competence and recognise when, where and how to search for additional information, help or expertise</i>
C1.5	Learn from other people, sources, media	<i>Learn from other people and from a variety of sources and media</i>
C1.6	Maintain career development plan	<i>Work out and maintain a career development plan, mapping out a plan for acquiring learning in the professional as well as the private domains</i>
C1.7	Maintain record of professional development	<i>Maintain record of professional development activities (Record of Achievement), identifying the learning achieved</i>
C2	Develop new professional knowledge	
C2.1	Assess existing knowledge, know-how and competence	<i>Audit and assess existing knowledge, know-how and competence</i>
C2.2	Pursue independent research	<i>Pursue independent research, where knowledge and expertise required is not available: for the resolution of immediate problems, in pursuit of excellence, for own professional development, and for the development of the profession</i>
C3	Develop and mentor others	
C3.1	Know competence of others	<i>Know the areas of competence of others and when to involve them</i>
C3.2	Give constructive feedback	<i>Give a lead and constructive feedback to others</i>
C3.3	Encourage subordinates to advance their expertise	<i>Actively aid and encourage subordinates to advance their knowledge and experience</i>
C3.4	Develop competences of colleagues, subordinates	<i>Consciously develop competences of colleagues, particularly concentrating on subordinates</i>
C3.5	Help colleagues develop their own thinking	<i>Help all colleagues and peers to clarify and develop their own thinking, enabling them to build on each other's ideas</i>
C3.6	Determine training needs and plans for others	<i>Identify and determine training needs and plans for others</i>
C3.7	Review effectiveness of training and development	<i>Review effectiveness of work-place training and development programmes and activities</i>
C4	Self management	
C4.1	Develop teamwork, awareness of self and others	<i>Focus on the development of teamwork skills, self awareness, and awareness of others</i>
C4.2	Suspend action to reflect, maintain self-control	<i>Suspend judgement and action for the sake of reflection and understanding, maintaining self-control</i>
C4.3	Monitor own professional performance and impact	<i>Self-monitor professional performance and impact, employing critical appraisal</i>
C4.4	Produce accurate accounts of own practice	<i>Produce accurate accounts of own professional practice</i>

C4.5	Tolerate ambivalent feelings, motives, uncertainty	<i>Tolerate ambivalent feelings and motives, and uncertainty about the outcomes of a situation</i>
C4.6	Express thoughts and feelings with integrity	<i>Express thoughts and feelings with integrity in a situation, in an authentic and honest manner, while sustaining professional role</i>
C4.7	Awareness of effect of feelings on work situations	<i>Be aware of the effect of own and others' feelings on work situations</i>
C4.8	Time management	<i>Practise effective time management</i>
C5	Team work: work as a member of and lead a team	
C5.1	Collaborate to achieve shared purposes, interests	<i>Engage the collaboration of others in the pursuit of shared purposes or reciprocal interests</i>
C5.2	Listen and contribute in diverse environments	<i>Listen and contribute fully in multi-disciplinary, inter-disciplinary and multi-cultural environments</i>
C5.3	Read social situations and adapt action	<i>Read social situations and adapt action to them</i>
C5.4	Accept feedback	<i>Accept feedback from others, taking account of other points of view</i>
C5.5	Respect others' ideas and divergent views	<i>Allow colleagues freedom to express their own ideas, protecting the expression of divergent views</i>
C6	Communication and representation in the professional role	
C6.1	Effective and relevant communication	<i>Communicate effectively, with relevance, sensitivity to context and audience, with conciseness and focus, using appropriate concepts, conventions and symbols in the spoken, written and drawn media in the language adopted for official and professional usage</i>
C6.2	Effective listening	<i>Listen effectively, providing feedback.</i>
C6.3	Presentation of professional information	<i>Prepare, interpret and present professional information</i>
C6.4	Internal and external networking	<i>Liaise with colleagues and experts within and beyond the organisation</i>
C6.5	Interpretation of engineering instructions	<i>Correctly interpret engineering instructions received</i>
C6.6	Instructing subordinates	<i>Issue clear and accurate instructions to subordinates</i>
C6.7	Select appropriate communication methods	<i>Select appropriate methods of communication</i>
C6.8	Communication in foreign languages	<i>Communicate effectively in professional settings in other relevant foreign languages</i>
C6.9	Negotiating, advising and influencing	<i>Communicate and negotiate with, advise and influence individuals and groups both inside and outside own organisation</i>
C7	Management and business: Manage people, resources, projects and business affairs	
C7.1	Management of tasks, people or resources	<i>Plan, organise, direct and control tasks, people or resources</i>
C7.1.1	Set and implement work objectives and priorities	
C7.1.2	Determine methods of approach	
C7.1.3	Analyse work for resource estimates	<i>Analyse work to be performed to provide the basis for resource estimates</i>
C7.1.4	Make time, resource and cost estimates	
C7.1.5	Organise small work teams	
C7.1.6	Lead technical or other personnel	<i>Exercise leadership of engineers, technical or other personnel where required</i>
C7.1.7	Monitor tasks to ensure planned performance	<i>Monitor tasks to ensure activities performed as planned, and take corrective action as required</i>
C7.2	Finance, law, marketing, business management	<i>Perform economic, financial, legal, marketing and business management</i>
C7.2.1	Economic evaluation of work undertaken	<i>Perform economic evaluation tasks in relation to work undertaken</i>
C7.2.2	Legal implications of work undertaken	<i>Recognise legal implications of work undertaken</i>
C7.2.3	Apply appropriate regulations	<i>Recognise, interpret and apply appropriate regulations</i>
C7.2.4	Marketing	<i>Assess marketing needs, define and implement marketing strategies</i>
C7.2.5	Risk assessment	<i>Carry out risk assessment tasks</i>
C7.2.6	Business management	<i>Recognise business needs of enterprise and act on them in terms of costs, time, and other factors</i>
C7.2.7	Business planning	<i>Assess and prepare business plans</i>
C7.3	Manage human resources	<i>Manage human resources</i>
C7.3.1	Occupational health and safety	<i>Comply with occupational health and safety requirements</i>
C7.3.2	Performance appraisal	<i>Perform performance appraisal of subordinates</i>
C7.3.3	Equal opportunities	<i>Comply with equal opportunity requirements</i>
C7.3.4	Industrial relations	<i>Establishing and maintaining an effective industrial relations environment</i>

C7.4	Apply project management principles	<i>Apply project management principles</i>
C7.4.1	Project monitoring and planning	<i>Undertake project monitoring and planning tasks</i>
C7.4.2	Work breakdown	<i>Develop work breakdown structure</i>
C7.4.3	Critical path analysis, work scheduling	<i>Prepare critical path or work schedules</i>
C7.4.4	Progress monitoring	<i>Monitor progress, investigate departures from schedule and initiate corrective action</i>
D	GENERIC ENGINEERING COMPETENCES, common to all professional engineers	
D1	Professional engineering practice	
D1.1	Solve engineering problems	<i>Solve engineering problems</i>
D1.1.1	Exercise original thought...	<i>Exercise original thought in synthesising satisfactory outcomes to engineering challenges</i>
D1.1.2	Exercise professional judgement...	<i>Exercise professional judgement in making engineering decisions</i>
D1.1.3	Work of a creative and innovative nature...	<i>Undertake work of a creative and innovative nature</i>
D1.1.4	Recognise and solve problems...	<i>Recognise and solve engineering problems</i>
D1.1.5	Interdisciplinarity and multidisciplinary...	<i>Extend knowledge of related disciplines or fields and foster cooperation across discipline boundaries when working in a multidisciplinary environment</i>
D1.1.6	Investigating needs and opportunities...	<i>Investigate needs and exploit opportunities within a particular industry or area of expertise</i>
D1.1.7	Identifying and framing problems...	<i>Identify, frame and reframe problems so that they are amenable to solution</i>
D1.1.8	Generating innovative solutions...	<i>Generate a range of innovative solutions, evaluate them and choose between them</i>
D1.1.9	Sound, practical judgement...	<i>Reach sound, practical judgements even in response to complex, changing, ambiguous and unpredictable situations</i>
D1.1.10	Applying learning to new contexts and situations...	<i>Apply learning to new contexts and new situations; relate experience to general principles; establish links between different kinds of knowledge; formulate theories to explain new observations and use them in a purposeful way</i>
D1.1.11	Effective use of technology...	<i>Use technology effectively, responding appropriately to constraints and limitations</i>
D1.1.12	Initiative, responsiveness, decisiveness...	<i>Take initiative, and show responsiveness, decisiveness and tenacity, focusing on a given objective; recognising at the same time that all professional judgements are open to question, and consequently be adaptable, innovative and flexible, with a capacity to facilitate compromise and evaluate potential outcomes</i>
D1.2	Apply engineering methods	
D1.2.1	Identifying engineering applications...	<i>Identify engineering applications</i>
D1.2.2	Resolution of identified applications...	<i>Propose concepts for resolution of identified engineering applications</i>
D1.2.3	Specification of engineering applications...	<i>Specify selected engineering applications</i>
D1.2.4	Documentation and recording of outcomes...	<i>Control the currency of documentation recording outcomes</i>
D1.2.5	Assessing acceptance and future requirements...	<i>Assess user acceptance and future requirements</i>
D1.3	Apply quality management principles	
D1.3.1	Implementation of quality system...	<i>Implement or contribute to quality system</i>
D1.3.2	Foster the acceptance of quality management...	<i>Foster the acceptance by subordinates and colleagues of quality management principles</i>
D1.3.3	Work to appropriate quality standards...	<i>Perform work to appropriate quality standards</i>
D1.3.4	Quality control and assurance techniques...	<i>Apply quality control and assurance techniques</i>
D1.3.5	Best-practice quality systems...	<i>Create and follow best-practice quality systems, in terms both of quality assurance and quality control, ensuring that work is fit for purpose</i>
D1.4	Use appropriate engineering and technological aids	
D1.4.1	Mathematical analysis, simulations, modelling...	<i>Select and use mathematical analysis, engineering science, computer simulations or other modelling techniques</i>
D1.4.2	Computer systems applications...	<i>Select and utilise computer systems applications</i>
D1.4.3	Software programming and use...	<i>Direct and undertake software programming and utilisation tasks</i>
D1.4.4	Use of technological tools...	<i>Select and use technological aids and monitor their performance</i>

D1.5	Conduct testing, measurement and evaluation	
D1.5.1	Definition of test objectives...	<i>Define test objectives</i>
D1.5.2	Test procedures and schedules...	<i>Devise test procedures and schedules</i>
D1.5.3	Measurement procedures and equipment...	<i>Develop measurement procedures and equipment</i>
D1.5.4	Critical engineering tests and measurements...	<i>Undertake critical engineering tests and measurements</i>
D1.5.5	Non-critical tests and measurements...	<i>Supervise non-critical tests and measurements</i>
D1.5.6	Evaluation of test results...	<i>Evaluate results of tests and measurements</i>
D2	Engineering planning, design and documentation	
D2.1	Definition of engineering design requirements	<i>Clarify and define engineering design requirements</i>
D2.1.1	Negotiation of initial specification or brief...	<i>Negotiate initial specification or brief in terms of client perceptions and engineering realities</i>
D2.1.2	Functional design requirements analysis...	<i>Perform functional design requirements analysis</i>
D2.1.3	Design for performance, reliability, maintenance..	<i>Address design concepts such as performance, reliability, maintainability and ergonomics</i>
D2.1.4	Impact of design factors...	<i>Determine impact on design of factors such as production, construction, installation, commissioning, life cycle implications, logistic support and training of users.</i>
D2.1.5	Design constraints: liability, environment,...	<i>Determine possible constraints, such as product liability legislation, the effect of the external physical environment on the item to be designed, or the effect of that item on the environment, and take appropriate measures as a consequence</i>
D2.1.6	Design standards and specifications...	<i>Use engineering design standards and specifications, and write functional specifications</i>
D2.2	Preparation of concept proposals	<i>Prepare concept proposal to meet requirements</i>
D2.2.1	Creativity and initiative in design...	<i>Exercise creativity and initiative in investigating, analysing and conceptualising possible concepts to meet design objectives</i>
D2.2.2	Analysis of concepts for design, assessing impact..	<i>Analyse promising concepts for final design to assess impacts of factors such as performance, reliability and maintainability</i>
D2.2.3	Identification of problem areas...	<i>Identify possible problem areas and negotiate modifications or adaptations to the design brief if necessary</i>
D2.2.4	Cost-benefit and risk analysis, feasibility, ...	<i>Undertake cost-benefit and risk analyses, feasibility studies and life-cycle costing to produce a workable design</i>
D2.2.5	Proposal preparation and documentation...	<i>Prepare and recommend for implementation a documented proposal to meet client or manufacturing requirements</i>
D2.3	Design work or commissioning	<i>Perform or arrange for design of selected proposal</i>
D2.3.1	Significant design tasks...	<i>Undertake or arrange for significant design tasks</i>
D2.3.2	Analysis for components and materials...	<i>Perform or arrange for analysis to select components and materials</i>
D2.3.3	Engineering specifications of design outcome...	<i>Prepare and check engineering specifications of design outcome</i>
D2.4	Design evaluation	<i>Perform design evaluation</i>
D2.4.1	Physical or computer modelling...	<i>Demonstrate the design by physical or computer models</i>
D2.4.2	Design test scheduling...	<i>Prepare design test schedules for performance and physical environmental testing</i>
D2.4.3	Test result analysis...	<i>Oversee testing, analyse test results and recommend or arrange corrective action to overcome any shortcomings revealed.</i>
D2.4.4	Effect evaluation...	<i>Evaluate effects on external environment</i>
D2.4.5	Consultation on design evaluation...	<i>Participate in consultation with affected parties on design evaluation</i>
D2.5	Supporting documentation	<i>Prepare supporting documentation</i>
D2.5.1	Preparation of documentation...	<i>Prepare supporting documentation for production or construction, installation, operation, maintenance and training</i>
D2.5.2	Editing and checking of documentation...	<i>Edit and check supporting documentation</i>
D2.6	Maintenance of design documentation	<i>Maintain integrity of design documentation</i>
D2.6.1	Identification of designed item by documentation...	<i>Identify designed item by appropriate engineering design documentation and records</i>
D2.6.2	Changes in documentation...	<i>Recommend proposed changes for approval for incorporation in a controlled manner</i>

D2.6.3	Design record maintenance...	<i>Ensure all engineering design records are maintained as a true description of the designed item</i>
D2.7	Present, report on and advocate engineering ideas	<i>Present, report on and advocate engineering ideas</i>
D2.7.1	Professional lectures...	<i>Prepare and present lectures at a professional level</i>
D2.7.2	Publications and papers...	<i>Prepare papers for publication in Professional Engineering journals</i>
D2.7.3	Communication of engineering information...	<i>Communicate engineering information effectively within the engineering work-force, and to others</i>
D2.7.4	Information within the enterprise...	<i>Convey engineering information effectively to any engineering and non-engineering level in the enterprise</i>
D2.7.5	Negotiation, conflict resolution, counselling...	<i>Undertake negotiation, conflict resolution, counselling, exchanging ideas and conveying convictions and attitudes</i>
D2.8	Prepare and communicate engineering documents	<i>Prepare and communicate engineering documents</i>
D2.8.1	Professional engineering reports...	<i>Prepare professional engineering reports</i>
D2.8.2	Specifications, standards, graphics, ...	<i>Prepare documents such as specifications, standards and graphical representations</i>
D2.8.3	Complex documents...	<i>Prepare or contribute to complex documents such as environmental impact statements</i>
D2.8.4	Interpretation of engineering drawings...	<i>Correctly interpret applicable engineering drawings and other graphics, specifications, standards, regulations, codes of practice and environmental impact statements</i>

E SPECIFIC ENGINEERING COMPETENCES

E1	Research, development and commercialisation	
E1.1	Research	<i>Perform research</i>
E1.1.1	Research requirements...	<i>Identify requirements for research</i>
E1.1.2	Literature surveys...	<i>Undertake literature surveys</i>
E1.1.3	Fundamental or applied research...	<i>Undertake fundamental or applied research</i>
E1.1.4	Seeking new knowledge...	<i>Seek new knowledge</i>
E1.1.5	Communication of research results...	<i>Identify and communicate results of research</i>
E1.2	Formulation of development concepts	<i>Formulate concepts for development</i>
E1.2.1	Requirement identification...	<i>Identify new requirements for development</i>
E1.2.2	Concept examination...	<i>Examine promising concepts</i>
E1.2.3	Concepts for further development...	<i>Nominate concepts for further development</i>
E1.3	Resource development of research outcomes	<i>Seek resources for development of research outcomes</i>
E1.3.1	End-user needs definition...	<i>Define ultimate user needs</i>
E1.3.2	Resource proposals...	<i>Prepare proposals seeking resources for development</i>
E1.3.3	Cost estimates...	<i>Prepare cost estimates for development, design, production or construction, and operation</i>
E1.4	Perform market research on research outcomes	
E1.4.1	Product specification...	<i>Determine desirable product properties</i>
E1.4.2	Product pricing...	<i>Gather information and make recommendations for determining product pricing</i>
E1.4.3	Product distribution...	<i>Make recommendations regarding distribution of the product</i>
E1.4.4	Product promotion...	<i>Make recommendations for promotion of the product</i>
E1.5	Commercialise research outcomes	
E1.5.1	Economic evaluation of research outcomes...	<i>Carry out economic evaluation of research outcomes</i>
E1.5.2	Marketing of research outcomes...	<i>Select likely mechanisms for marketing research outcomes</i>
E1.5.3	Demonstration models for proving viability...	<i>Prepare demonstration models for proving technical and commercial viability</i>
E1.5.4	Pilot schemes for proving viability...	<i>Develop pilot schemes for proving technical and commercial viability</i>

E2	Materials and components	
E2.1	Define requirements for materials or components	<i>Define requirements and applications for specific materials or components</i>
E2.1.1	Materials/component property identification...	<i>Identify fundamental properties of a range of specialised materials or components, together with suitable alternatives</i>
E2.1.2	Materials/components suitability assessment...	<i>Assess suitable applications for specialised materials or components</i>
E2.1.3	Understanding of cross-disciplinary relations...	<i>Establish cross-disciplinary relationships to obtain specialist advice</i>
E2.1.4	Recycling...	<i>Take account of opportunities for recycling</i>
E2.1.5	Environmental and or other hazards...	<i>Take account of environmental or other hazards in using or disposing of materials or components</i>
E2.2	Sourcing of raw materials	<i>Source raw materials for making engineering materials or components</i>
E2.2.1	Raw material sources...	<i>Locate suitable sources of raw materials</i>
E2.2.2	Cost-effectiveness of materials, components...	<i>Select cost-effective materials or components</i>
E2.3	Supervision of manufacturing	<i>Supervise the preparation or manufacture of engineering materials and components</i>
E2.3.1	Materials preparation techniques...	<i>Specify materials preparation techniques</i>
E2.3.2	Interactions between materials, components...	<i>Determine interactions between different materials or components</i>
E2.3.3	Process control...	<i>Perform process control activities</i>
E2.4	Assessment of material or component properties	<i>Assess properties of materials or components</i>
E2.4.1	Identification of operating environment...	<i>Identify operating environment</i>
E2.4.2	Requirements for materials/component testing...	<i>Identify requirements for testing materials and components</i>
E2.4.3	Site and laboratory tests...	<i>Perform or supervise, and evaluate site and laboratory tests</i>
E2.4.4	Maintenance and calibration of test facilities...	<i>Direct maintenance and calibration relevant to test facilities</i>
E2.4.5	Test reports...	<i>Prepare, approve and certify test reports</i>
E2.4.6	Recommendation of materials or components...	<i>Recommend materials or components for specific uses</i>
E2.5	Protection against deterioration	<i>Select protection against deterioration</i>
E2.5.1	Causes of deterioration...	<i>Recognise the causes of deterioration such as wear, corrosion, fatigue and ultra-violet radiation</i>
E2.5.2	Minimising deterioration and preventing failure...	<i>Employs techniques for minimising deterioration and preventing premature failure</i>
E2.5.3	Failure detection techniques...	<i>Utilise techniques for detecting indications of potential failure</i>
E2.5.4	Material treatments...	<i>Specify material treatments such as heat treatment or surface treatment</i>
E3	Manufacturing and production	
E3.1	Manufacturing or production process planning	<i>Plan the manufacturing or production process</i>
E3.1.1	Layout and work-flow analysis and optimisation...	<i>Analyse plant or system layout and work-flows and act to optimise flexibility and efficiency</i>
E3.1.2	Management planning techniques...	<i>Employ management planning techniques</i>
E3.1.3	Process operation monitoring...	<i>Monitor process operations and modify them to improve final products</i>
E3.1.4	Critical path analysis, linear programming, ...	<i>Utilise techniques such as critical path analysis, line of balance and linear programming</i>
E3.1.5	Production planning liaison with design team...	<i>Undertake production planning liaison with the product design team</i>
E3.1.6	Manufacturing line/process set-up...	<i>Set up a manufacturing line or process</i>
E3.1.7	Manufacturing process cost analysis...	<i>Perform cost analysis tasks of manufacturing processes</i>
E3.2	Quality assurance	<i>Maintain and supervise a quality assurance programme</i>
E3.2.1	Production processes performance monitoring...	<i>Monitor and regulate the performance of production or manufacturing processes</i>
E3.2.2	Continuous manufacturing process improvement...	<i>Seek and implement changes for continuous improvement of manufacturing processes</i>
E3.2.3	Statistical quality assurance...	<i>Apply statistical quality assurance techniques</i>
E3.2.4	Reject rate & system-down time reduction...	<i>Initiate corrective action to reduce reject rate or system-down time</i>
E3.2.5	Specific procedures collaboration...	<i>Collaborate in specific procedures</i>
E3.2.6	Supplier quality assessment...	<i>Conduct quality assessment of suppliers</i>

E3.3	Process operations, control and optimisation	<i>Perform process operations, control and optimisation tasks</i>
E3.3.1	Process operations and control improvements...	<i>Refine and optimise process operations and control</i>
E3.3.2	Process operations and control...	<i>Perform process operations and control tasks</i>
E3.3.3	Value analysis...	<i>Perform value analysis tasks</i>
E3.3.4	Manufacturing or process problem solving...	<i>Perform tasks to diagnose and resolve manufacturing or process problems</i>
E3.3.5	Flexible manufacturing processes...	<i>Collaborate in flexible manufacturing processes</i>
E3.3.6	Plant economics, plant safety...	<i>Collaborate in plant economics and plant safety</i>
E3.4	Raw materials management	<i>Perform raw materials management tasks</i>
E3.4.1	Materials handling, materials balance procedures...	<i>Develop materials handling and materials balance procedures</i>
E3.4.2	Materials procurement and allocation...	<i>Specify, procure and allocate materials</i>
E3.4.3	Materials reduction...	<i>Perform materials reduction programmes</i>
E3.5	Production performance measurement	<i>Measure production performance</i>
E3.5.1	Manufacturing output measurement...	<i>Measure output of manufacturing process in terms of quantity, quality and cost to assess whether targets have been achieved</i>
E3.5.2	Productivity analysis...	<i>Analyse productivity to determine where improvements can be achieved</i>
E3.5.3	Materials usage analysis...	<i>Analyse usage of materials and expendables for efficiency improvements and supporting procedures</i>
E3.5.4	Procedures analysis...	<i>Analyse procedures for improving efficiency</i>
E4	Project Implementation	
E4.1	Construction and Installation	<i>Perform construction or installation tasks</i>
E4.1.1	Construction/ installation specifications...	<i>Prepare construction or installation specifications and schedules</i>
E4.1.2	Construction/installation phasing...	<i>Contribute to phasing of construction or installation</i>
E4.1.3	Service and facility specification...	<i>Specify services and facilities required</i>
E4.1.4	Construction/installation supervision...	<i>Supervise construction or installation</i>
E4.1.5	Construction/installation certification...	<i>Confirm satisfactory completion of construction or installation for certification</i>
E4.2	Contract preparation and monitoring	<i>Prepare and monitor contracts</i>
E4.2.1	Tender schedule preparation...	<i>Prepare tender schedules</i>
E4.2.2	Tender evaluation...	<i>Carry out tender evaluation</i>
E4.2.3	Contract preparation...	<i>Prepare contracts</i>
E4.2.4	Contractor performance monitoring...	<i>Monitor contractor performance and investigate departures from contract requirements</i>
E4.2.5	Contractor performance investigation...	<i>Investigate contractor performance to recommend certification for payment approval</i>
E4.3	Tender preparation	<i>Prepare tenders and meet contract requirements</i>
E4.3.1	Tender schedule evaluation...	<i>Evaluate tender schedules</i>
E4.3.2	Tender preparation...	<i>Prepare tenders</i>
E4.3.3	Progress monitoring...	<i>Monitor progress and investigate departures from contract requirements</i>
E4.3.4	Progress reporting...	<i>Prepare progress reports for submission to client</i>
E4.4	Site management	<i>Perform site management tasks and activities</i>
E4.4.1	Construction/installation site management...	<i>Undertake construction or installation site management tasks</i>
E4.4.2	Materials ordering...	<i>Perform materials ordering tasks</i>
E4.4.3	Development of site management procedures...	<i>Develop procedures</i>
E4.4.4	Supervision of materials handling...	<i>Supervise on-site materials handling</i>
E4.5	Commissioning	<i>Perform commissioning</i>
E4.5.1	Acceptance programme development...	<i>Perform acceptance programme development tasks</i>
E4.5.2	Commissioning programme execution and supervision...	<i>Undertake commissioning programme execution and supervision tasks</i>
E4.5.3	Certification of completed commissioning...	<i>Confirm satisfactory completion of commissioning for certification</i>

E5	Asset management	
E5.1	Asset procurement	<i>Perform asset procurement tasks</i>
E5.1.1	Asset needs specification...	<i>Investigate requirements for new assets</i>
E5.1.2	Asset procurement specification...	<i>Prepare specification or brief for proposed new asset</i>
E5.1.3	Purchasing...	<i>Carry out purchasing activities</i>
E5.1.4	Acceptance testing...	<i>Perform or supervise acceptance testing on delivery</i>
E5.2	Maintenance	<i>Perform or supervise maintenance tasks</i>
E5.2.1	Maintenance philosophy definition...	<i>Develop maintenance philosophy and asset performance parameters</i>
E5.2.2	Preventive maintenance scheduling...	<i>Prepare preventive maintenance schedules</i>
E5.2.3	Corrective maintenance instructions...	<i>Prepare corrective maintenance instructions</i>
E5.2.4	Specification of maintenance test aids....	<i>Specify, and if required design, maintenance test aids</i>
E5.2.5	Maintenance supervision...	<i>Supervise maintenance tasks</i>
E5.2.6	Spares logistics requirement specification...	<i>Determine spares logistics requirements</i>
E5.2.7	Fault diagnosis...	<i>Undertake fault diagnosis</i>
E5.2.8	Failure mode and effect analysis...	<i>Perform failure mode and effect analysis</i>
E5.3	Asset control and optimisation	<i>Perform asset controlling and optimisation tasks</i>
E5.3.1	Asset performance analysis...	<i>Define asset performance parameters</i>
E5.3.2	Operating instructions and training of operators...	<i>Prepare operating instructions and trains operators</i>
E5.3.3	Condition monitoring...	<i>Plan and perform condition monitoring tasks</i>
E5.3.4	Supervision of asset systems...	<i>Perform tasks in supervising operation of asset systems</i>
E5.3.5	Regulation of asset operation...	<i>Perform tasks in regulating asset operation to maintain service</i>
E5.3.6	Asset life extension studies...	<i>Carry out asset life extension studies</i>
E5.4	Disposal planning	<i>Perform disposal planning</i>
E5.4.1	Economic life analysis...	<i>Carry out studies to determine economic life</i>
E5.4.2	Economic disposal...	<i>Carry out investigations into economic disposal</i>
E5.4.3	Disposal action...	<i>Recommend disposal action</i>
E5.4.4	Site rehabilitation...	<i>Carry out site rehabilitation</i>
E6	Engineering education and training	
E6.1	Education and training – planning	<i>Develop engineering education or training plans</i>
E6.1.1	Education and training needs analysis...	<i>Define education and training needs</i>
E6.1.2	Engineering education or training plans...	<i>Draw up engineering education plans for tertiary education or engineering training plans for training organisations</i>
E6.1.3	Development of practical experience programmes...	<i>Develop practical experience programmes</i>
E6.1.4	Curriculum or syllabus development...	<i>Develop curriculum, syllabus or exercises in engineering</i>
E6.2	Education or training – implementation	<i>Conduct engineering education or training programmes</i>
E6.2.1	Development of teaching plans and materials...	<i>Develop lesson plans and teaching materials for engineering education or training programmes</i>
E6.2.2	Experiential development plans...	<i>Develop experiential development plans</i>
E6.2.3	Management of experiential development programmes..	<i>Manage programmes through which students or trainees gain theoretical and practical engineering experience</i>
E6.2.4	Teaching and facilitation of learning...	<i>Conduct effective teaching, development and learning activities in whatever form is most appropriate to the circumstances</i>
E6.2.5	Use of educational and training technology...	<i>Make effective use of educational and training technology to support teaching, development and learning processes in engineering education or training programmes</i>
E6.2.6	Development of educational content...	<i>Develop the specific content of engineering education and training programmes through research, study, practice or other techniques</i>
E6.2.7	Student or trainee assessment...	<i>Carry out formative and overall assessment of students or trainees engaged in engineering education or training programmes</i>
E6.2.8	Assessment of education/training effectiveness...	<i>Assess the effectiveness of engineering education or training programmes</i>
E6.2.9	Education/training programme review...	<i>Review engineering education or training programmes</i>

PROFESSIONAL RECORD OF ACHIEVEMENT IN ENGINEERING: TOWARDS PORTABLE QUALIFICATIONS

Dr Christopher Padfield & Anders Hagström¹

This paper describes work carried out within a pilot project under the European Union LEONARDO Programme. The EuroRecord project aims to establish a scheme within the engineering industry for

- *drawing up and documenting career development plans and the resulting requirements for learning and for personal and professional development*
- *recording learning achievements and professional development, wherever, and however it occurs, and for accumulating credit towards relevant qualifications, linked to the learning plan.*

The paper describes the competence framework adopted by the project, and reports on the first-hand experiences of the EuroRecord.

Background

Engineers and the engineering profession have been well served, in the main, by the formal system of education, though there are many inconsistencies and rigidities throughout Europe that are slow to adapt to a changing world. Continuing education and training, on the other hand, is still fragmented, opaque and often almost arbitrary, within the greatest opacity in the area of the greatest opportunity for learning: learning on the job, through experience.

A widely recognised constraint in the dialogue between industry and education – especially at international level – is the difficulty of communicating about education and training needs on the one hand, and achievements on the other. Industry, education, the engineering profession as well as government all agree on the need for more transparency.

Individual commitment to lifelong learning is increasingly recognised as a key for improved business performance for employers and career progression for individuals. Continuing education therefore needs to be based on an *individually driven* education system – or rather “learning system” – where individuals have *learning agreements* with a variety of parties, including their employer, their professional body, and different academic and other providers. This requires a common language and currency both to improve communication and coordination between the partners, and to enable individuals to achieve *coherence* in their overall learning plans and activities.

The pursuit and recognition of *qualifications*, both initial qualifications taken as an outcome or extension of early education, and on a continuing basis throughout professional life, is increasingly important for both individuals and employers. However, confusion between academic, vocational and professional qualifications creates difficulties in comparing and using them. An improved language, format and a vehicle based on learning achievements can assist in understanding different qualifications, both within and between countries.

The EuroRecord

The European Professional Record of Achievement in Engineering project (EuroRecord) aims to provide a common language and common structure for recording continuing professional development. The project involves development and testing of the tool, and training of individuals, mentors, counsellors and trainers to make use of it. As Records of Achievement of this kind become widespread, they should facilitate the planning and forecasting of continuing learning on a much wider scale.

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More generally, the project aims to:

- encourage the perception of continuing education as a process owned by the individual rather than a scatter of unrelated short courses and training events
- encourage the presentation of course descriptions to be mutually comprehensible across borders
- develop the linkages between systems of initial and continuing qualification;
- contribute to the transparency of qualifications in Europe, increasing understanding and mutual recognition between different systems.

The EuroRecord will be a workable tool for the planning of individual development needs and for the recording of learning, and on its usefulness to the individual, to employers, to universities and to professional institutions.

Focus on Learning

Considerable research attention is being paid to the nature of different kinds of learning, their interaction and means of acquisition, as knowledge is clearly a major agency in the achievement of competitive advantage. Companies are increasingly developing and making use of methodologies for appraising the “bank” of skills and knowledge present in the company and analysing the skills, technology and other knowledge needed to deliver the company’s strategic aims. Lateral uses of these methodologies allow companies to examine whether their plans to enter new markets require the acquisition of entirely new knowledge sets, whether existing knowledge would allow straightforward adoption of new products, and the like.

Several different methodologies exist for identifying the knowledge and knowhow required of an individual to fulfil the requirements of a particular job. These appear not to be based on an attempt to specify and measure the knowledge needed, but to set up a scale, referenced within the organisation. Used with other indicators (responsibility etc.) such measures allow different jobs to be ranked, for purposes of establishing payment differentials.

Specialists in this field offer a variety of different taxonomies of learning; different jobs and functions require different mixes. Employers are particularly interested in what their employees *can do*, rather than in what certificates they have collected, or what short courses they have attended. A focus on competences is therefore essential in continuing education and professional development, though it is, of course, not the end of the story. Competence-based assessment has been used and developed for several decades in the UK, and has revolutionised attitudes to the importance of work-based learning on the one hand, and established, for the first time in many fields, verifiable standards of performance that are referenced to specific criteria, on the other.

The idea of *key or core skills* is developing in several countries in parallel, and is seen as a set of requirements generic to all workers. Threshold levels of core skills are typically defined in areas such as application of number (numeracy), information technology, communication and language skills, and problem-solving. In France, for example, a system for establishing a person’s *Bilan de Compétences*, a record of personal competences with an associated development plan, has been introduced. Although the use of the *bilan* as a professional development tool has met with some difficulties, the process has established a national network of centres and a growing list of tools for assessing a person’s knowledge, skills and competencies according to a set menu. While the identification of “core skills” may make educationalists cringe, as they grossly trivialise highly sophisticated areas of human capacity (the confounding of language in all its power with “communications skills”, for example), it has a certain utility in setting threshold standards.

The orderliness and transparency of the output-based system is in strong contrast to the *norm-referenced* system typically used in universities. Here the strength of a qualification depends strongly on the reputation of the institution. Universities would be hard put to prove that their

Master's graduates in History in 1996 were performing to the same standard as those in Physics in 1985. They would similarly have great difficulty in benchmarking performance of their graduates in relation to any other university, or even national norms. Work on an open *academic* credit system – not very different from the credit system of the Continuing Education Unit that has been effective in the USA for many years – has taken place within the European Credit Transfer Scheme (ECTS). Like most other educational credit systems, the ECTS adopts a common method of measuring the time and effort *input* to each element of educational achievement.

Input-based credit systems have little to contribute in professional development in the absence of a methodology for measuring learning outputs. It is unlikely that any credit accumulation and transfer system, based on “academic credit” could ever be successfully implemented for lifelong learning across the spectrum of industry and across Europe, given the conflict between input and output measures; the complexity; the pace of change; the number of different actors contributing elements of learning; and the many institutions offering qualifications and assessing learning and competence for their own purposes. As things stand however, the laborious business of assessing an individual's learning and competences has to be repeated nearly from ground zero by any interested party, acting as a severe barrier to mobility and mutual recognition.

The EuroRecord will not create a specific qualification or attempt to introduce any credit rating of continuing education. By employing formats and metrics for the recording of career and development plans and for the recording of learning, it aims to provide a common platform of concepts, language and accessible data that any other party may use as a starting point in assessing the suitability of the individual concerned for a qualification, a job, or for further development.

Recording Learning and Achievement

Perhaps the greatest area of uncertainty in the EuroRecord project has centred around the dilemma:

- should the Record of Achievement aim to set out a menu of skills and elements of knowledge, with specifications of content, indicators of level and standard, and methodologies for assessment?
- or should it be silent on scope and content, leaving such decisions entirely to the discretion of the user, but making suggestions about how the elements of learning should be recorded and evidenced?

We have decided on a course that lies part-way between these two extreme options, perhaps closer to the first, but with the crucial distinction that we are not presuming to prescribe what people should learn. We desire to establish headings under which individuals will analyse and record their learning, but not to prescribe what might be thought of as “required” learning.

There are severe dangers here. Many people appear to draw comfort from a suggestion that the canon of required learning had been “discovered”. Others assume, when they see a list of headings, that it constitutes a syllabus. We would re-emphasise that the headings used in EuroRecord are intended to clarify description, and offer a common taxonomy and language. They do not prescribe what should be learned.

The primary focus in any attempt to develop a Record of Achievement is on what an individual can do, not on

- the abstract knowledge they may embody, or even
- what they have done

though these constitute important evidence of, and are integral to, capacity and competence.

Models of Professional Competence

There are many alternative classifications for elements of learning. What a professional individual can (and, by implication, will be able to) do, is determined by education in breadth, behavioural attributes and values, as well as by training; particularly in a fast-moving world with many uncertainties, where standard answers will not suffice. Competence therefore, for the purposes of this EuroRecord, is taken to encompass, as well as verifiable performance skills, “deep structures of knowledge and understanding, a broad cognitive perspective, reflective and analytical capacity, sensitivity to relevant aspects of social or situational contexts, responsiveness, and, in general, affective as well as cognitive ingredients.”[2] A professional engineer is not an authority figure, but rather someone who combines possession of high-level knowledge and skills, with “*reflective deliberation* about particular circumstances and problem-situations in *dialogue* with the clients being served”[3] to arrive at “good” solutions [4]. The EuroRecord aims not to treat the “moral, evaluative and motivational aspects of education as separable from ... the technical and craft dimensions... in a way that [would] wholly distort the logical, normative and psychological relations between them.”[5]

The EuroRecord therefore does not rely on the maps of competences derived from detailed functional analysis, and familiar in Vocational Qualifications and Occupational Standards in UK and elsewhere. These represent performance specifications, rather than integrated educational goals, and so are relevant to one aspect of recording achievement only: the functional elements. These functional lists can be extremely long, minutely detailed, and very quickly risk becoming out-dated. An individual who wishes to achieve a Vocational Qualification along these lines will be *able* to use the EuroRecord for the purpose, but recording achievement against such standards is not an essential feature of EuroRecord: EuroRecord is compatible with functional competences, but does not require their use.

The EuroRecord Model

A taxonomy has been adopted in this project that is believed to be reasonably descriptive of the key features of professional activity in engineering. EuroRecord employs a professional competence model as a means for ensuring that learning achieved is recorded against (what it is hoped will be) a commonly agreed and logical set of headings. It allows for the recording of events (experiences, courses, episodes, including a record of the time involved) where learning occurred *separately* from the records made of the learning achieved. One-to-many relationships are recorded

- between events and learning achieved: the learning achieved in each event will be deconstructed under a number of separate headings, so that learning achieved in each area can be reviewed synoptically.
- between learning recorded, and the events that contributed to that learning.

(Hyper)links between the entries will remain in evidence, so that reference is possible both ways: from event to knowledge and from learning element to the experience that gave rise to it.

The EuroRecord attempts to establish a **generic** competence model (see Appendix 1) of professional competence that applies across the entire spectrum of engineering; that characterises “expert performance”; and that accommodates that essential feature of high-level professional activity: the transfer of knowledge developed in a restricted set of circumstances for application to very different ones [6], a process facilitated by reflection [7]. The competence model proposed for testing in the second year of the EuroRecord project owes much to CISC [4] and Winter [8]. The work of Cheetham and Chivers [9] has been particularly helpful, as has that of The Institution of Engineers Australia[10].

Two concepts are important, therefore, for the description of learning in the EuroRecord:

Competence: The generic elements of competence used here constitute an aggregate of “skills, information and motivation.”² The elements of competence are divided, purely for the purpose of teasing out the different threads of learning, into a number of separate categories, which will be described below. The separate elements do not stand in any sense alone. Professional practice involves, as was said above in other words, an intimate fusion of “performance, awareness and understanding” where awareness is taken to include emotional (affective), ethical and reflective [11] elements. The broad structure of the Competence Model is illustrated in the figure, and further amplified in the text of an appendix to this paper.

Body of Knowledge: This is a listing of the areas of theoretical knowledge, and the relevant operational and situational knowledge and skills (eg. *knowing about* Laplace transforms (theoretical principles), and also being able both to *decide when to use them*, (informed situational judgements), and in practice *actually to do them* (skills, techniques and technologies)).

A **generic** competence model represents as considerable degree of commonality with other professions, though the fine detail of the relevant “Body of Knowledge” will differ considerably from profession to profession, as will the relative weight of the different kinds of generic competence. The intention is that the model will be applicable across disciplines, the outer layers, having generic application, and the set of inner layers constituting a replaceable plug-in module tuned specifically to the requirements of different sectors. It follows (from the desire to provide a generic framework that will be usable and applicable across the engineering industry, encompassing as much those who work primarily in management functions, as those engaged in design or manufacture), that it will not be appropriate to spell out the fine detail of any Body of Knowledge in the EuroRecord either. It is anyway not the job of a Record of Achievement to *prescribe any canon* of knowledge — but to provide a neutral shell for use by an individual, for his or her own purposes.

The listing of headings to describe a “Body of Knowledge” within the “Generic Competence” model does not imply two *alternative* ways of recording achievement. They allow *complementary* descriptions of learning achieved: the one centred on the total role of the professional; the other focusing more on the detailed knowledge and associated operational actions the individual may be called upon to take. Elements of learning derived from recorded *events*, will be teased out and recorded against *both* classifications.

The model adopted here will doubtless be found to be wanting during the second year of full testing. There are other projects who are following parallel paths, researching empirically the details of engineering generic competences. The EuroRecord model will be revised again at the end of the third year in the light of our own experience, and whatever experience we can glean from others.

Experience in the Pilots

The EuroRecord project, at the time of writing entering its third and final year, has established consensus among the project partners concerning the competence framework, the format and support processes for the Record of Achievement. The design has been pilot tested in small groups in six countries, and will in 1998 enter larger-scale experimentation with European companies. Although several of the pilots are still under way, several tentative conclusions are already possible:

- There is widespread enthusiasm for the EuroRecord as a tool, and for a single version of that tool across Europe, articulated to match the differing needs of the range of professions. How this might be accomplished, has not been satisfactorily resolved.

- There is enthusiasm for the integration of a Competence Framework into the Record of Achievement, though its use requires some considerable sophistication on the part of users and facilitators alike.
- There does not yet seem to be any area that is resistant to the seductive charms of the EuroRecord to offer a connecting bridge between so many activities and processes that were previously free-standing and isolated (job evaluation, training needs analysis, career counselling, transparency and portability of qualifications, and many more). By areas we mean no country (in Europe, at least, among those involved to date), no profession and no sector of society (Trades Unions, Professional Institutions, Companies, Universities, etc.)
- The software-version of EuroRecord is eagerly awaited. The multiple links across different dimensions can appear immediate in hyperspace, but incomprehensibly complex on paper. A software version of the EuroRecord will also provide users with the benefit of being able to produce outputs in various formats, for different purposes.
- We are currently engaged in having the full text of EuroRecord, with all its explanatory materials, rewritten by a professional communications consultancy, to ensure that the language and the diagrams used are as simple and user-friendly as possible.
- We are having EuroRecord reviewed by an industrial psychologist, with a view to ensuring that the concepts and processes used draw as firmly as possible on the wealth of experience gained to date in psychometric profiling. The EuroRecord will, it is hoped, plug an important gap in the armoury of the industrial psychologist, who has been unable up to date to record competences very precisely.
- Finally after the above-mentioned reviews and redraftings have been completed we will have EuroRecord translated into the principal languages of Europe, and have the materials professionally printed and presented.

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- Professional reflection = reflecting on experience, reflecting on the subject's own role, reflecting on experience and linking it to theoretical frameworks