

TRAINING & EMPLOYMENT

FRENCH DIMENSIONS

A NEWSLETTER FROM CEREO
AND ITS ASSOCIATED CENTRES

Changing Skills in Metalworking Industries: A Review of Research

Transformations in the French **metalworking** industries have given rise to numerous studies on **employment and job content** in metallurgy over **the past decade**. The following review of that research is based on a more extensive survey recently carried out in the context of a forecasting study commissioned by the government **and** the employers organisations in the metal working industries [1]. A number of the studies deal with the transformations themselves, while others attempt to shed light on the problems encountered in recent years in two critical sectors by comparing conditions in France and Japan.

THE POLARISATION OF SKILLS

THE first of these **studies** [Bouchut et al. 1980] relates technical transformations to changes in the skills content of certain categories of workers. The fact that **machines** are **increasingly** fed and operated automatically has led to regrouping the feeding maneuvers with the **previous stage** of the mechanised labour carried out by machine operators. By **contrast**, maintenance work tends to be broken up into very **simplified, standard** operations on the one hand and **sophisticated** ones on the other. This

[1.] J. Merchiers, *Travail et emploi dans la Métallurgie*. CEREO Document de Travail n° 57 (June 1990).

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process of "skills redefinition" also **affects** programming technicians, whose work is divided into simple coding operations and complicated new tasks of programming and optimisation involving new categories of workers such as computer technicians.

In this **context**, the automation of work results in the elimination of certain know-how belonging to an earlier phase of technical development. In the operation of numerically controlled (CNC) machines, for **example**, the work of preparing the programmes becomes crucial, while the skilled operative's knowledge is no longer necessary. In the iron and steel **industry**, the development of mechanisation and early forms of automation has led to the disappearance of a certain concrete professional knowledge rooted in **artisanal** practices; **this** has been

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transformed into another type of knowledge **which** functions **algorithmically** and can be integrated **into** current scientific and technical **expertise**.

Since 1983, **however**, the orientation has begun to **shift**. The necessary forms of knowledge are subject to more precise **definitions**, and the analysis of **robotisation** is no longer reduced to a simple robot-operator substitution because **it is** recognised that the robot can never be a perfect substitute for the human operator [Bouchut et al. 1983]. On the economic **level**, these new analyses bring out the **inappropriateness** of **investment** choices in robotics which do not take into account various production-cost factors such as waiting periods, delays, stocking, retouching, or wastes of energy and raw **materials**. Relations between general economic conditions and automation are likewise held to be too rigid, since these economic conditions clearly permit several forms of automation, yet these do not all have the same impact on the **organisation** of human labour and the kinds of knowledge required [Barcet and Mercier 1983].

NEW TECHNOLOGIES AND LABOUR

A SECOND series of studies carried out by CEREO and the Laboratory for the Economics and Sociology of Labour (LEST) in Aix-en-Provence between 1980 and 1984 attempts to take into consideration the role of the firms' economic situation in technological and organisational **decision-making**.

The most representative example of skilled industrial labour is undoubtedly metal machining. Over the past ten years, with the **spread** of numerical control, this work has been modified considerably. Like all forms of automation, numerical control is based on the separation between the elaboration and transmission of instructions to the machine on the one hand and the machine's carrying out of the material **operations** on the other. As a **result**, numerical control tends to accentuate the polarisation of functions between preparation and manufacture and thus threatens the qualification of the **operator**, who does not participate in programming.

In-depth investigations into the work of these operators carried out in the early 1980s [Bertrand 1984; Cavestro 1984] show, however, that preparatory work always allows the operator a certain autonomy. Indeed, it is **impossible** to **eliminate** all the unknowns, and these can only increase when the **series** are small and the parts **complex**. The traditional machining competencies do not tend to disappear automatically, but the new programming **competencies** fall **into different** occupational categories than those of skilled operatives. The inquiries conducted at LEST when numerical control was first being introduced [Maurice et al. 1986] also bring out the **crucial** nature of the implementation of the programming function. The process pits the planning and programming **personnel** against those of the **shop**, and in many firms, it is most often the setters, planners, programmers, or, in certain cases, shop technicians who see their work upgraded. In other words, **in-shop** programming was not practised in any of the firms investigated. The comparative **studies** between France and Japan will provide the beginnings of an **explanation** for this situation.

In contrast to numerical **control**, robotics or techniques of control by programmable automation or microprocessor generally lend themselves to repetitive work carried out under strong time constraints, such as on the assembly **line**. The **difficulties** encountered in automating **this kind**

of work are dealt with in several studies which bring out aspects sometimes neglected by those **responsible** for conceptualising automated equipment. Thus, unskilled work is often **represented** as **repetitive** and **continuous** in the **sense** that it endlessly repeats the same **operations**. But in fact, this **repetitiveness** and continuity only exist in the absence of technical incidents, variations in the size of the labour **force**, fluctuations in the nature of the material **being** worked, and so forth [Chave et al. 1978]. As the **ergonomists** point out, real work is never identical to the **operations** assigned to unskilled workers, whether this involves the assembly **line** or the operation of mechanised equipment [Daniellou et al. 1983].

In addition, unskilled labour entails other kinds of labour around it, notably the supervision, **retouching**, **setting** or repairing of mechanised equipment. Thus automation can affect all or part of these **activities** but still leave open the **possibility** of **assigning** the rest to different **categories** of workers.'

Surveys conducted in the early 1980s [Merchiers 1984] bring out certain constants: the emergence at the production **stage** of operator-supervisors who carry out part of the maintenance and **setting** work; a related trend toward the disappearance of the setters, who often constitute an **intermediate** category between maintenance and production; multiplication of levels of upkeep, and the growing importance of technicians, especially in the programming of **control** systems. The functional Integration of the production-supervision-maintenance model runs up against the limitations of automation, however.

If, as is sometimes said, **automation** gives **rise** to the "breakdown society", this is undoubtedly because the **traditional** causes of dysfunction have not disappeared (irregularities in the raw materials, defects in the functioning of the equipment), and the introduction of new technologies often leads to hybrid ensembles mixing old and new **elements**. The result is what **ergonomists** call "**downgraded operation**." To deal with this **situation**, the operators have to seek out the necessary information themselves, in other words, to anticipate the **course** of the operations; this capacity would seem to depend on vocational experience but also on training. [Rosenvallon and Troussier 1987].

The development of maintenance [Denis 1985] also comes under the general goals of productivity and **profitability**, which translate into greater demand for continuity in the production process. The conception of the breakdown as an "accident" with no particular significance gives way to that of the **interrelationship** between the **breakdown**, the nature of the **equipment**, and the cost of maintenance. The breakdown rate is taken to reflect the dependability of the equipment. The spread of **industrial** computer technology also contributes to the planning and structuring of maintenance through the development of **mechanisms** for auto-command, for signalling breakdowns, for assisting in **diagnosis** and repair. Finally, better relations between departments tend to challenge the existing separations and to reduce antagonisms between maintenance and **production**. However, these inquiries into the engineering and process **industries** do not confirm the **general thesis** of the polarisation of maintenance skills. Rather, they suggest that **continuous, complementary interventions** take place, within the maintenance **departments** and between the agents of these departments and the **production operators**, who are responsible for providing **initial** indications about equipment performance, i.e., for carrying out the most basic tasks of maintenance and repair.

THE UPGRADING OF THE SHOP

A FINAL series of studies carried out in 1986-1987 by several teams coordinated by CEREO [Bercot et al. 1988, 1989] was aimed at redefining the role of the operative and technician categories in situations of industrial change; at the same time it identified the practical knowledge that they entail in order to provide information for training policy-makers. One of the main results of this research relates to the "upgrading" of the role of the shop, which is now recognised as the place where production requirements are brought together. These new requirements concern the dependability of technical equipment (for maximum avoidance of breakdowns and unknowns), the quality of the final product (which presupposes auto-command during manufacturing itself), and flexibility of organisation (to ensure compatibility between the delivery of orders "just in time" and optimal use of production capacities).

The role of the shop is also being upgraded on the level of practical knowledge, because it is there that concrete expertise about the functioning and correction of installations is formed, and this kind of knowledge is particularly valued by departments responsible for conception and innovation [Zarifian 1988]. The distinction between operatives and technicians thus becomes more flexible: technicians take charge of production by shift, and operatives participate in the elaboration of technical changes. On the level of practical knowledge and training, this research shows that, with the upgrading of the shop, the operatives' knowledge of production processes, far from diminishing, becomes richer. The operative, now an "operative-technician," is also the expert on what takes place at his work station.

AUTOMATION IN THE AUTOMOBILE INDUSTRY AND THE FUTURE OF TAYLORISM

B ETWEEN 1983 and 1987, automobile construction was second only to the iron and steel industry as the sector most affected by employment cutbacks, especially for unskilled labour. To some extent, however, technical functions were less affected than those of sales and administration [Choffel and Kramarz 1988]. It is thus reasonable to ask whether the Taylorist model of mass production has not broken down [Kern and Schumann 1984].

The first wave of automation, launched in the automobile industry in the 1950s, essentially involved machining, which was partly carried out by machine transfers. The second wave, however, put technical means at the disposal of the current imperatives of flexibility and profitability, thus making the mechanisation of previously manual operations both possible and profitable [Freysenet et al. 1985]. From these developments there emerged a new job profile: that of the operator, who combines the supervision of equipment — a manufacturing activity — with the first level of maintenance, and thus collaborates with technician-level maintenance personnel. The imperatives of flexibility and profitability also contribute to modifying the overall production system, as shown by a comparative study of the automobile industries in France and Japan [Jacot et al. 1990].

The specificity of the Japanese style of production and management is best seen in the "Toyota system." This basically consists of measures aimed at simplifying the organisation and economising on resources through a system of so-called manufacturing kanbans. This system permits "just-in-time" production through the use of labels (*kanban* means "label" or "card," in this case attached to a container of parts) to transmit the manufacturing order from one work station to another situated upstream. Thus the second station only receives manufacturing orders corresponding to the needs of the first when these needs become apparent. The Toyota production system, which also incorporates many other measures of standardisation, machine layout and quality control, is aimed at simplifying and improving the manufacturing process by bringing management down to the production level. It is here, for example, that the *kanban's* organising function comes into play, since the virtual disappearance of buffer stocks reveals problems of machine dependability, of labour skills, of the quality of the raw materials, and so forth. The "just-in-time" principle thus serves as a powerful means of rationalisation.

In France, although there are methods of the *kanban* type, manufacturers seem prefer investing in state-of-the-art technology such as industrial automation or computerisation. Production management is most often organised around MRP (Management Resources Planning) procedures, which are based on statistical assessments of necessary production resources taking into account random fluctuations in demand. This trend can be explained on the one hand by widespread computerisation of the firms' management apparatus and on the other, by the fact that such an approach is better suited to the hierarchical, centralised organisation inspired by Taylorism.

OCCUPATIONAL CATEGORIES AND COMPETITIVENESS: THE CASE OF THE MACHINE TOOL

THE machine-tool sector occupies a central position in the metalworking industry because of its role in the creation and diffusion of new production norms. While France has never been one of the major machine-tool producers, the situation declined sharply from 1974 on. The fact that the government's recovery plan of 1981 is the ninth to be instituted since the Second World War demonstrates the industry's structural problems.

This most recent plan is intended to permit major changes in the nature of the product by encouraging the manufacture of CNC machines and machining centres [Hillaire and Podevin 1985]. A certain improvement was noted in 1988, but on the world scale, the sector has dropped from fifth to eighth or ninth place, and with increasing mergers, the two hundred existing firms may well dwindle to fifty or even twenty in the coming years.

Such a situation stands in marked contrast to Japan's resounding success. A comparative study [Maurice et al. 1988] sheds light on the Japanese experience in the field, which they call "mechatronics" to underscore the fusion of innovative technologies from engineering and electronics alike. This capacity to integrate new technologies is combined with a certain prudence where automation is concerned, and the resulting search for alternatives to total automation avoids the violent kinds of technological disruptions that have been encountered in France. It also relies on increasing the competencies of the personnel,

which **permits** the transformation of existing machines and even the creation of new ones.

The **main** explanation for this flexibility **is** to be found in the **different** nature of occupational categories in France and Japan. In **France**, the notion of the "**cadre**" plays an important role, but the institutional definitions of **this** category vary. According to the collective **conventions**, membership **in** the category is determined by status in the firm. Supervisors and **technicians** are excluded [Groux 1983] and are thus clearly distinguished from engineers, who are always classified as *cadres*. In **Japan**, by contrast, not **all** engineers have the status of *cadre*: a significant proportion of them are classified as employees **along with** the technicians, at least during the first part of their careers. In other words, the technician category includes a part of the beginning engineers, who can be assigned to tasks of workers as well as those of "technicians" in the French sense of the term, before moving on to tasks that require technical expertise or the assuming of a supervisory function. The other technicians fall **into** a kind of Intermediate category between skilled **operatives** and engineers because they have not acquired the necessary competencies, through initial training or career experience, to assume engineering tasks.

The consequences of these **differences** are clearly visible in the way that Japanese shop personnel acquire competencies. The operators working on CNC machines learn programming through courses organised by the engineers and through **on-the-job training** with the programmers. As the operators master programming, the engineers can devote **increasing time** to the technical

improvement of the machines or the optimisation of certain complicated programmes. Such a form of knowledge transfer reflects the relations of reciprocity found in most **Japanese groups** and a kind of organisation that favors overlapping of functions or **tasks** through the flexible definition of assignments. As a result, the authors of **this** study argue, the **question** often raised in France about bringing the shop and its **support** units closer together does not even exist in Japan.

CONCLUSION

In light of the Japanese experience, it can be seen that the importance given to the technician category in French firms is **characteristic** of the French solution to the problem of relations between the shop and its support units. The progressive establishment of this occupational track in the educational system is also particular to France, as **is** shown in a still-timely report commissioned by UNESCO in 1981 [French 1981]. This category replaces the promotion of skilled operatives, who previously attained the status of technicians **in** the support units. But it also allows the maintenance of a certain **relationship** between workers and operators **in** the shop and engineers by bridging somewhat the occupational and social distances that **separate** these two very different categories •

Article written by Jacques **Merchiers**
(Translation by Mirlam Rosen)

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Associated with the University of Strasbourg, CEREO also belongs to an international network of research centres, namely European Network on the Dynamics of Technological and Institutional Change.

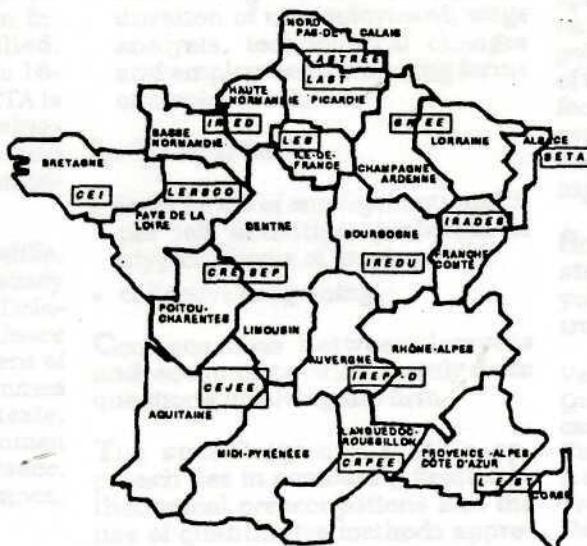
A network of associated centres operating **within** university research units throughout France not only permits CEREO to enlarge its field of study but also to play an active role **in** regional life. The mission of the associated centres is threefold:

- to encourage the **utilisation** and updating of CEREO's observation tools;
- to contribute to regional debate on the training-employment relationship;
- to participate **in** the implementation of CEREO's programme of **activities**.

Use of CEREO's Observation Tools

THE goal here is both to **diversify** and to intensify the use of information and methods developed by the **various** CEREO research groups (e.g., the Observatory on Entry into Working Life, micro-macro inquiries on the firms' training **policies**), notably by encouraging the preparation of reports and theses. The two priority subjects for 1991 are the wages of young labour-market entrants and occupational **mobility**.

UPDATING these tools can also mobilise researchers in the associated centre's host **laboratory**, notably through maximum use of French and international research experience, **in** terms of results and



methods **alike**. The organisation of the programme on occupational mobility will provide a privileged framework for this, as will the creation of an observatory on the supply of continuing training.

THE associated centres also participate **in** or organise workshops devoted to certain occupations

(such as health) or local systems of training and employment.

Regional Debate on the Employment-Training Relationship

THE associated centres provide advice and ensure the transfer of **methods**, notably through the mastery of CEREO's basic research tools. In **addition**, certain centres are actively engaged **in** the **organisation** and maintenance of regional **observatories** on employment and training established by the national government and the regional councils.

Participation in CEREO's Research Programme

ALL of the centres participate **in** the **regional** and Inter-regional analysis of the training-employment relationship.

AMONG the many other examples of Joint research efforts are the studies on recruitment of vocational **bacca-laureat-holders** and on the place of training in skills **acquisition** contracts (**contrats de qualification**).

THE following profiles of **six** associated centres will illustrate the scope of the CEREO network:

BETA (ALSACE)

Bureau d'économie théorique et appliquée [Bureau of Applied and Theoretical Economics]

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UFR de sciences économiques et de gestion

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AFFILIATED WITH the University of Strasbourg, BETA also belongs to an International network of research centres, Eunetic (European Network on the Economics of Technological and Institutional Change). Its work is oriented toward the training-employment relationship, with emphasis on:

- disadvantaged populations;
- the engineering, chemical and food-products sectors;
- regional analysis.

ONE of BETA'S main fields of investigation is the entry of unskilled youth into the labour market. In this context, the centre is presently collaborating on a new government measure, the Individualised Training Credit (Crédit de Formation Individuel, or CFI) for unskilled, unemployed young people (ages 16-25). Within this framework, BETA is conducting research on the evaluation (bilan) that will be used to help young people in developing their Individualised training projects.

IN the regional context, meanwhile, BETA recently carried out a study commissioned by the Regional Delegation for Women's Rights in Alsace and the Lower Rhine Department of Labour and Employment: "Femmes et mécanique en Alsace: contexte, opportunités, résistances" [Women and Engineering Industry in Alsace: Context, Opportunities, Resistance, August 1990.]

As the study shows, no job in this sector is objectively inaccessible to women. Rather, the problem lies with the attitudes of male workers, who are strongly opposed to accepting women in skilled jobs. Therefore, it could be harmful to encourage women to enter training programmes in such sectors. Before orienting women toward such unconventional careers, it is of the utmost importance to obtain guarantees of their future employment.

CEJEE (MIDI-PYRÉNÉES et UTAINE-LIMOUSIN)

Centre d'études Juridiques et économiques de l'emploi [Centre for Legal and Economic Studies on Employment]

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CEJEE, a research unit of the University of Social Sciences in Toulouse, is also affiliated with the National Centre for Scientific Research (CNRS). The main elements of its research programme include:

IN the field of economics:

- economics of education: analysis of the educational system, vocational entry, education-wage relations and the financial return on education;
- utilisation of manpower in the firms: Industrial changes and the organisation of work, management forecasting of manpower (private and public);
- functioning of the labour market: duration of unemployment, wage analysis, technological changes and employment, changing forms of employment.

IN the legal field:

- legal forms of employment: multiple job activities, problems of atypical forms of employment;
- collective bargaining.

COLLABORATIONS between lawyers and economists arise mainly from questions involving the firm.

THE specificity of CEJEE's approach lies in combining fieldwork, theoretical preoccupations and the use of quantitative methods appropriate to labour economics.

IRED-GEFSI (BASSE-NORMANDIE HAUTE-NORMANDIE)

Institut de recherches et de documentation en sciences sociales
Groupe de recherche emploi-formation-système industriel
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Employment-Training-Industrial Systems Research Group]

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IKED, a laboratory of the University of Haute-Normandie, has a double mission:

- to provide a common research site for academics and non-academics in order to encourage the integration of economics and social science research in the regional context and to promote multi-disciplinary research;
- to provide a centre of documentation on and for the region.

THE centre's activities include research, training and, more sporadically, followup on governmental training programmes.

With regard to research, those studies which have been completed or are underway deal with the vocational entry of disadvantaged populations and of degree-holders (tourism and environment), the competencies of personnel responsible for the training and vocational entry of low-skilled populations, as well as evaluations of training institutions (e.g., a centre for the training of apprentices) and evaluations of training areas in the context of the Individualised Training Credit.

SINCE 1986, systematic follow-up studies have been carried out on young people exiting vocational training:

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IREDU (BOURGOGNE)

Institut de recherche sur l'économie de l'éducation [Institute for Research on the Economics of Education]

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AFFILIATED with the National Centre for Scientific Research (CNRS). IREDU is devoted to theoretical, methodological and applied research in three main areas: the costs and financing of educational systems; the evaluation of educational institutions; and the external efficiency of educational systems (effects of education on careers, earnings, etc.). The scope of this research is both national and international, with particular emphasis on developing countries.

IREDU is associated with doctoral programmes in the Faculties of Economics and Education at the University of Bourgogne. It publishes a biennial scientific report which may be obtained from the Documentation Service.

OTHER recent publications by its staff include:

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IREP-D belongs to the University of Social Sciences at Grenoble. Its two main areas of research are: sectoral and spatial aspects of development and production systems on the one hand, and technical change, production engineering and work on the other.

ITS research themes include:

- **industrialisation** and development;
- development and territory;
- competition and European integration;
- **industrial**, scientific and technical policies in the firms;
- employment and training policies and Industrial dynamics (How do young people find jobs on leaving the educational system? What variables influence the evolution of the educational system? How do firms adjust their training programmes to labour and production systems and local realities? How do these policies fulfill management objectives concerning the various aspects of qualifications, innovation strategies, etc.?)
- labour and production systems (the precise analysis of work as an essential condition for understanding and mastering the changes currently affecting production systems: new technologies, work forms and production engineering models; focus on wage policies, high-performance automated systems, SME strategies);
- new forms of production and productive efficiency.

IN addition to its ongoing publications in French, IREP-D publishes a newsletter in English, 4 Pages. A catalogue of publications is available on request.

LEST-CNRS (PROVENCE-ALPES CÔTE D'AZUR-CORSE)

Laboratoire d'économie et de sociologie du travail [Laboratory for the Economics and Sociology of Labour]

Université d'Aix-Marseille II

**35 avenue Jules Ferry
13626 Aix-en-Provence cedex
Tel (33) 42 37 85 00**

CREATED in 1969, LEST involves some twenty French researchers, a dozen engineers, administrative technicians, and foreign researchers.

IT brings together economists and sociologists for common research on:

- the evolution of the firm and the dynamics of its actors;
- the organisation of the labour market;
- employment and skills;
- life on and off the job;
- industrial relationships and the place of labour law.

ITS research method involves:

- a multidisciplinary approach;
- International comparisons;
- Intensive on-site investigations;
- cooperation with the social actors.

LEST attempts to bring out the specific features of the French social system, while limiting technical and economic determinism through the use of the comparative method, notably by undertaking comparisons with Germany and Japan.

SINCE the mid-1980s, LEST has re-oriented its analyses toward the transformations generated by the crisis: changes in the types of wage remuneration and the ways it is administered; the reorganisation of occupational structures, training, and labour markets: the growing complexity of social relations within the firm.

A list of publications is available upon request.



Profiles of CERÉQ's other associated centres will be presented in a future issue of this newsletter.

CEREQ's Associated Centres

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ALSACE

GREE

CHAMPAGNE-ARDENNE LORRAINE

LASTREE LAST

NORD-PAS-DE-CALAIS PICARDIE

I RED

BASSE-NORMANDIE HAUTE-NORMANDIE

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Groupe emploi-formation-système industriel
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IRADES

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LERSCO

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CEJEE

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Formation Emploi: Special Issue on Continuing Training

To mark the twentieth anniversary of the Vocational Training Act of 1971, CEREQ has published a special Issue of **Formation Emploi** reviewing the French experience over the past two decades and discussing the problems that confront the development of continuing training today. The Issue features contributions by the act's original sponsors (notably Jacques Delors), along with analyses of innovative experiments and difficulties encountered, particularly the chronic disadvantages faced by SMEs and low-skilled workers.

Formation Emploi

Available from:

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62 francs.

La Documentation Française

124 rue Henri Barbusse

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