



HAL
open science

Engineering In Torment: Anomy or the Emergence of a Model

Guy Minguet, Florence Osty

► **To cite this version:**

Guy Minguet, Florence Osty. Engineering In Torment: Anomy or the Emergence of a Model. Christophe Midler; Guy Minguet; Monique Vervaeke. Working on innovation, Routledge, pp.107-128, 2009, 9780203872833. hal-01016646

HAL Id: hal-01016646

<https://hal.science/hal-01016646v1>

Submitted on 6 Jul 2021

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

Engineering in Torment

Anomy, or the Emergence of a Model

Guy Minguet, Florence Osty

INTRODUCTION

Identity for Design Professionals: A Delicate Question, A Critical Process

Since the beginning of the 1980s, a 'design revolution' has been disrupting the time frameworks for markets, organizations, and R&D activities. Profound changes have been taking place on several levels: The actual work involved in design has been confronted with various forms of activity on projects at different stages, with the self-regulation of the process within project groups and between different professions as well as a progressive but rapid curtailment of the design phase. Organization, at the institutional level, calls for redistribution in forms such as restructuring, change of stockholders, and the broadening of the R&D network. *Matrix organization*¹ and multisite configuration have considerably modified the modes of cooperation, the creation of collective belonging, and the planning of one's professional future.

These companies are governed, in a domineering fashion, by the urgency of innovation and the rhetoric of adaptation to the point that these modernizing organizations falter when it comes to planning their continuity and envisaging their future. Pushed to its limits, this process puts individuals' capabilities to the test in dealing with new forms of uncertainty concerning what they produce and their work procedures, along with their professional sociability and their means of identity-building.

Intensively innovative environments form a tormented landscape where multifaceted modernization does not unfold according to a known and reproducible scenario but rather one that is more complex and original. How can one be sure that, in this shifting context of disseminating sources of *prescription* (Hatchuel 1996) and destabilized time and space frameworks in production, one can simultaneously preserve the ability to learn, the transmission of the fundamentals in professions, and the regeneration of technological imagination?

Comprehending technical work also requires documentation that links work activities, roles, and identities to industrial organization (both functional and projectized structures). The social organization of innovative

design project work is an especially fruitful arena, ripe for sociological exploration.

More broadly, what permanent fixtures allow one to weather this identity crisis, this risk of dilution in sociability and tactical and incidental behaviour? What today are the driving forces and the processes of identity-building in a context where work interactions cannot be summed up by the simple relations of functional cooperation and authority, where the benefits for identity are rooted in the work situation and uncertain in terms of one's career?

This problem of the identity-building experience in one's work with professionals² in advanced technological environments will serve as the unifying thread on two R&D sites. Design identity characterizes itself by a strong identification with one's profession and one's company as an area for the development of professional career paths. Associated with strong sociability at work, this design identity paves the way for harmonious cooperation, the critical point in *matrix* structures, and the source of durable integration. The identity-building aspect constitutes a particularly precious factor for regulation in the torment of perpetual movement in organizations.

THE DIMENSIONS OF THE IDENTITY-BUILDING EXPERIENCE IN ORGANIZATIONS WRAPPED IN RADICAL UNCERTAINTY³

Today, the question of identity has forcefully resurfaced at the very moment it has been brushed aside and become a problem. The wavering in the modes of defining oneself constitutes an indication of a crisis, inseparable from the rise of an individualistic society (Dubar 2000). The crisis in the social link and the collective categories of identification create tension in the process of identity-building. The individual emerges as an atom in modern societies, emancipated from the traditional frameworks that forged him. Socialization, dreaded as a process of acculturation, has today given way to an interpretation of socialization processes constituting the lion's share of experience (Dubet 1994) as the driving force for subjective experience.

If life experience at work indeed constitutes the melting pot for socialization (Sainsaulieu 1977) and for the production of collective belonging, the identity-building forms (Dubar 1991) have profoundly changed and illustrate the possibilities of access to more restrictive recognition. Substantive and stabilized identities in work relations give way to identity-building scenarios that are less signposted and more uncertain.

A Crisis in the Transmission of Work Activities

Companies involved in intensive innovation encounter the following paradox: They combine their ability to produce innovation in the form of new uses or functionalities for highly technological products. A high level of

professionalism is required to gain a firm grasp on the window of opportunity, which compensates those who arrive first in a given market. However, project management relegates the time needed for the social production of these high-tech skills and their adjustments to the background by only recognizing their immediate availability.

What the sociology of work activities *and craftsmanship* clearly reveals to us (Osty 2003) is that the social dynamics in a work activity are part of a long process, since the performance in a work activity is measured using its mechanisms of circulation and its regeneration of practical knowledge. Stated otherwise, it is important to consider professional socialisation as the result of the effectiveness of highly qualified knowledge. Actually, the skills required for design cannot be directly mobilized in the marketplace, as they are supposed to be socialized; in other words, they are acquired and developed at the heart of work interactions. The perfection of an art represents the aim of assembling people from a work activity, as was the case in bygone corporations (Sewell 1980). That shows how much know-how contributes to a feeling of community by putting the accent on the transmission of knowledge, standards, and values between generations. This constant reference when learning a work activity, its practice, and its transmission is still essential to journeymen who strictly go by the book and consider their initiation to its 'secret' the foundation of their belonging to the community.

In constant contact with these references, professionals form an identifiable group through work that permanently reinterprets the foundation of their knowledge, given present-day enigmas. Limited knowledge gives way to experiential knowledge, which updates itself through the events encountered (Zarifian 1995). Even so, the dynamics of learning a craft remain fundamentally rooted in the practices of journeymen and the modes of cooperation among peers.

It is within this dimension of professional dynamics that areas of tension appear in connection with the modernising of management practices. Contemporary organisations are more and more rarely firms with an institutional or corporate memory or ones that draw upon any previously established model. The disturbances resulting from instability (Alter 2000) produce situations that sometimes go as far as a state of political and organisational panic (with structural transformations that are successive and close together in time, with strategic aboutfaces, with pressure towards the acceleration of time and pace) jeopardizing the conditions of an identity-building experience in a work activity. The major time frameworks that set the pace in the life of contemporary companies seem to have been erased under the attacks of 'short-term goals', which are more and more present. In this way—and the paradox is only apparent as cognitive and technological abilities for innovation progress—their representations falter. They lose ground due to the illegibility of their structures, their permanent adaptation, and the correlative opaqueness of the future.

Work activities and craftsmanship here are presented in a defensive form ready to combat the whirlwind of organizational and managerial changes to production structures. *Craftsmanship* attempts to preserve areas for professional socialization in a secret way sometimes, when managerial indicators reduce work activities to simple exploitable resources. What remains to be understood is the way in which these seasoned and expert practitioners manage to inject their work situations full of the aspirations and ideal of the profession that underlie their commitment. What is the nature of this work experience that leads the individual to build his own standardized universe, to reinforce his relationship with the traditions of the work activity to which he identifies himself?

It is in this way precisely that professional identities, stabilized around work activities (whether they be communities of practitioners or functional identities in organisations), can no longer be designated as inherited or transmitted identities even if one admits that they can be reworked. They take form through concrete work experience and are updated according to one's interpersonal exchanges.

Identity-Building Scenarios

Through work experience, individuals build their own socio-professional identities using the diverse symbolic resources available. Belonging to a work activity or a category, events, which nourish shared memory, codes, rituals, and symbolic markers, constitute as many influences on one's identification to work. Professional identity can be analyzed as a scenario that takes place in a given space and over a long period of time, and that equally involves what makes up the substance of the professional world: standards, shared beliefs, representations of work.

Part of identity feeds on the experience of work relations (Sainsaulieu 1977). The way one acts within the constraints of a situation reflects the possibility of affirming oneself as an individual in work relations. Mechanisms of identification and differentiation play themselves out in the heart of the workplace as a basis for collective belonging, tracing the contours of real work subcultures through linguistic and behavioral norms. The permanence of collective identities is a result of mechanisms of cultural transmission which anchor the identity-building process in the stability of the collective undertakings in the workplace. Actually, the spectre of identification models (Osty, Sainsaulieu and Uhalde 2007) broadens with the transformation of work situations, revealing new cultural models (concerning entrepreneurship, mobility, and public service) that are added to the models for growth years (concerning the bureaucracy, the profession, and the community).

In the end, professional identity is becoming a major phenomenon and is divided into several distinct modes referring to life at work as allowing one to take on a more meaningful role and gain more subjective experience (Heckscher and Adler 2006).

However, greater affirmation of identity at work than in the past causes the collapse of traditional sectors of identification, making the quest for identity less certain and the modes of access for recognition more critical. The crisis of collective identities conveys a feeling of profound uneasiness and loss of meaning. The clash between the circumstances of the action and the cultural model of reference brings to light a faulty identity-building process and a fuzzy future on the horizon. The cultural dynamics of companies are thus based on the ability to bring to life a multiplicity of collective identities as well as offering sufficiently legitimate models for identification to allow for the recognition of commitment to work, which is asked of employees more and more (Sainsaulieu 1997).

Moreover, the diversity of identity-building forms according to the criteria for gaining recognition and biographical continuity (Dubar 1991) emphasize the importance of taking into consideration one's relationship to the institution and the relationship to one's biographical career path as other guidelines to understanding the modes of identity-building. The identity-building scenario feeds on three major stages of commitment: one's relationship at work as a potential area for subjective experience, the relationship with one's peers as an area of belonging, and the relationship with the company as an area for institutional recognition (Osty 2003). One's identity is a product of the intersection of two main transactions: an intrapsychic transaction where the question of discontinuities in one's career path meets tension in terms of continuity or biographical rupture. Observed in the analysis of work-study programs in the '90s, this biographical process updates itself according to functional, geographic, professional, or company mobility. Being less linear than in the past, the programs put social situations to the test as a stabilized area of belonging.

The second transaction creates interplay between the individual and the management system in its ability to offer some sort of institutional recognition. Putting the emphasis on the symbolic dimension in the methods for mobilizing labour highlights the fact that access to recognition is not open to nor acquired by everyone. The company is therefore a stage for the production of statutory and symbolic attributes that act as recognition markers. The crisis in the collective categories of identification (Dubar 2000) defers part of the identity-building process to narrative and reflexive forms, thus disqualifying themselves from being seen as substantive and stabilized identities.

Being able to grasp the identity-building process using movement supposes creating order in the variety of identity-building scenarios or in the places where these scenarios take place (Barley and Kunda 2004). When confronted with less attributed, more progressive and unique identities, it is advisable to have analysis charts to be able to identify the types of trajectories and the methods for identification as unforeseeable re-organisations, accelerated or distended time-frames, or where the lessening of available spaces occur.

The question surrounding the construction of professional identities in the world of intensive innovation is without doubt in the nature of identity-building scenarios. This chapter aims to shed light on the process of construction of work identities emphasizing the point that identification with a conceptual activity results in a process of subjective experience at work. We will then show that professional socialization necessitates the edification of networking links, and a sociability of various intensities.

Two Worlds of Conception Hit by Movement

The results presented are excerpts from a research program on the acceleration processes of industrial time and their social effects on conceptual activities and the work of professionals (Minguet and Osty 2008). These two design sites are involved in an intensive and repeated innovation strategy concerning either the supply of dedicated microcircuit functionalities (IXEL), or the supply of digital telephone exchange software for home and office phone lines and the transmission of broadband data in addition to internet access technologies (MARTEL) for the development of new strategy segments (products, customers, markets). The two fields have inherited a highly technological, professional, and established organisation and have been subjected to an aggressive policy promoting exchanges within the organisation, the coupling of work activities and projects, the skills and commitment of professionals, and increasing flexibility in the workplace.

The IXEL site is part of one of the world's leading groups in the design, manufacturing, and marketing of advanced semiconductors (10,000 employees) with headquarters in Silicon Valley in California. It is particularly active in markets for communication systems, automobile systems, data processing systems, secure transactions, and in the field of aerospace. For the group, this site represents the state-of-the-art for its skills in dedicated microcontrollers and its expertise and production in specific technologies. This Business Centre is made up of 300 people, of whom 80 percent are engineers and technicians.

Local technological skills encompass four fundamental elements in the product range: analogic integrated circuits, nonvolatile memory, microcontrollers and microprocessors, standard and dedicated logical circuits. The understanding of what a product is at a certain stage of advanced design has proven difficult, particularly since the professionals themselves only describe one of its dimensions in the form of their expert contribution in the development process. The virtual and hybrid character of a product, which reconciles the characteristics of the material (silicon here) or the assembled supports (circuits, memory) and the characteristics of software and therefore languages, make it difficult to comprehend.

In this sector, innovation is characterized by the *high velocity* in the complexification and the miniaturisation of products as well as by the rapid

arrival in the marketplace of new products. Moreover, more and more markets, especially the applied ones, are only equipped with one 'system' chip covering the totality of its functionalities. The lowering in the cost of functions through the increase in integration density (the possibility to concentrate more and more possibilities on an ever smaller surface), constitutes a factor of technological innovation.

The second site, MARTEL, is part of a world group for parts manufacturing in telecommunications in the fields of telephony and data communications. The site is devoted to the development of new digital telephone exchange software for telephony and the transmission of broadband data as well as Internet access technologies. The site accommodates 670 people (of whom 80 percent are engineers and technicians). This R&D function is organized around product lines (home and office telephony) and common skills. Present on this site are the five Competence Centres supporting the following poles: (a) architecture and systems specifications, (b) material and software development, (c) testing, (d) product engineering, (e) after-sales service or maintenance support, (f) support for marketing offers.

The supply of telephone equipment software is a productive activity whose aim is to play a part in one of the main server's functions. This function is included within a package so as to respond reliably to applications and to customer uses. A project has been elaborated to respond to developments in the server itself. Function development is written into a succession of functional levels; one example is the 'intelligent terminal' function. The conception of a function refers to multiple developments in which their final assembly constitutes a release.

The development activity is structured by the dual logic of processes (projects) and the areas of expertise (work activities). The five basic work activities functionally find their places in the accommodation structures made up of the service centres. The established methodology organizes conception and development by subdividing them into several industrializable and reusable subsystems. This has brought about a time reduction for development cycles and a rationalization in an unfriendly environment. Concurrent project phases aim at reducing costs and the time for each cycle.

IDENTIFICATION WITH THE ACTIVITY OF DESIGN

In this incessant ballet of organisational transformations, aboutfaces in strategy, product metamorphoses, volatile markets, and work activities become both reference points and symbolic investments. The basis for this professional identity is made up of technique. A vector for innovation, structuring work as regards work protocols as well as a rallying language, technique is also a source of Promethean imagination. It is endowed with positive qualities since it is inseparable from the innovation that it produces.

An Asserted Identification With Work Activities

In speeches, pushing a project is seen as a source of movement and disruption. Work activities are considered as ‘the temple guardians’ and constitute anchors that are particularly important since individuals feel they are tossed about in projects. A project is the source of a career opportunity in terms of the perilous adventure that it infers for project managers. It does not entail any significance in terms of identification and takes on a purely instrumental character in the identity-building strategies developed. On the other hand, the work activity ideal is counterproductive to cooperation, nourishes career projections, builds up affinities, and serves as a reference despite the incessant organisational changes.

The Work Activity Ideal: the Figure of the Architect

Whatever function one occupies, one finds an unequivocal conception of the work activity ideal that refers to the figure of the architect.

The work activity ideal serves as a shared scale of comparison with which one measures one’s work situation and the symbolic hierarchy in one’s work activity. Work mobilization of architecture refers to mastered techniques to be ordered in an original configuration (Boudon 2004). It is in this way that work takes on a life of its own through a process of creation, of translation into technical language, of testing the functionalities of one’s work given the materials used (their resistance, their compatibility), and of materialisation. Here the creative team has recourse to technological grammar for programming languages as a material basis to translate specifications into software to be able to handle new functions. In this respect, the way the different phases are arranged is crucial and the necessity to take into account the context of implementation indispensable. Design takes on an aesthetic attribute when its experts possess it in its highest form, the fruit of a long apprenticeship resulting in a much enhanced final object. Other cases have been reported: In an important comparative study on automobile, aircraft, computer, and aluminum manufacturers, the result obtained was that the aesthetics of the process and of the metamorphosis of objects were part and parcel of the company’s strategy (Thomas 1994).

The architect, as a work ideal, refers to a desire for mastery which is revealed in two complimentary facets: the representation of assembling the various components that make up a telephone exchange feeds a shared fantasy, which is particularly strong since the complexification and the developments in a product cancel out any inclination towards knowing a product in its entirety.

Surrounding the server, the various software fits together like pieces in a Lego game, but their overlapping and systemic effects, notably through the specter of server regression, highlights the complexity of the interfaces between the whole and its components. The concern for mastery includes

the memory of the product's development in order to create appropriate technical responses to ensure the compatibility of functions and software from different generations.

Creating a technological legacy and ensuring its longevity represents the reverse side of this imaginary absolute power. Besides, some evoke a time when it was still possible to know a product and the history of its development through methods used in programming.

Today, a product taken as a complex technical system and as technological history is disproportionately large for, although it remains the result of human endeavour, it is no longer on a human scale. Having become 'monstrous' in the mythological sense, a product fascinates and defies its creators to gain control over it and submit it to their will. By partially escaping the control of its creators, it takes on a mind of its own through the uncertainties generated by changes in behaviour occasioned by eventual additions of new functionalities. This in turn transforms each function into a separate entity, which equally escapes being counted as part of the accumulated body of knowledge.

Technological complexity feeds an imaginary challenge where one tries to go beyond a partial understanding of a product and a work activity so as to extract the underlying ideas as well as a subtle understanding of the details. The frustration refers to powerlessness and values those who get close to this ideal of control.

Product Identification

The product represents the culmination of a collective project, giving meaning to each player's individual contribution by offering them a context for identification. But even more so, it incorporates a technical dimension that constitutes the means by which innovative work is carried out step by step. The omnipresence of technical language in interactions translates a shared acculturation of the field's conventions, and gives structure to relational behavior as well as the work activity itself. At each stage of its development, the product exists only in the form of specifications, computer programs, and test results before taking on a perceptible existence such as a microcircuit mask.

The product, if it comprises a generic dimension referring to the end of a project, comes into being differently for each of the people interviewed. Some say it is a question of the *processor core*, a shared legacy with the IXEL group. This core therefore has various forms depending on the type of market and the nature of the demand, but it is one's core that is the object of value insofar as it is associated with a technological asset, a source of competitiveness. In this sense, it protects and it must be protected as a strategic asset because it has a relatively long life expectancy compared with the products it equips. The 'core' reference becomes a source of identification by its vital and central nature for the developments to come.

Finally, the rapport with the product can take on another form: that of its ultimate use. The product is referred to according to its function in a

given technological context. Examples of products that control all the connection cables in an automobile or in MP3 technology are in this respect representative of the imagination mobilized in the activity of design. Here it is the functionality that gives life to the product, and identification takes place through the end-user to whom the project is destined. The focus on its use erases the complexity of the project's progression and gives it visibility through the product's usefulness.

A Passion for Technique as Incentive to Action

The technical challenge is emphasized by designers as an incentive to go beyond one's apparent abilities. Basically, even if only part of one's work provokes a confrontation with one's own limits concerning the design of a product, it suffices to give meaning to the work activity as a whole.

Research is, in part, an adventure that pushes back the limits of what is possible through miniaturization or the complexity of integrated circuits. Astuteness, curiosity, and the diversity of experience are the expressions most commonly used to designate this form of clever intelligence, identified by the ancient Greeks through the notion of *Metis*.⁴

The most interesting thing for me is to take a specification, discuss it and starting there, make something new. A good project is a project with high numeric added value in which one must make lots of improvements and which presents lots of technical problems. If it is a foregone conclusion, one is more relaxed and less stressed but it is less interesting. I love starting with something which, at the beginning, is almost impossible to do, an attribute which does not yet exist (IXEL Advanced Design).

On the other hand, others emphasize the mastery of an art, possessing some sort of specific expertise that confers upon its holder an attribute that is particularly positive since it is rare. Enrichment in a field of expertise is, in that way, preferable to ingenious tinkering. The challenge of this position is more a question of a step-by-step exploration of a limited field where a discovery leads to ever greater refinement. The tech watch dimension is particularly in a growth period because it designates an advanced sector of knowledge.

For some, this penchant for technique has its roots more deeply embedded in a traditional vocation. As a matter of fact, the fascination with technique results from a rapport with oneself and the world, which transforms itself into a passion.

The Work Activity as an Area for Identification Re-activation

The identity-building process feeds on the identification with one's work, which pre-supposes a personal commitment to work. But this commitment

finds conditions in the concrete experience of work to put this work activity ideal into practice. Knowledge of the field is now added to the qualities inherent in the activity of design. The sub-division into various professional figures follows from a more refined appreciation of the different work activities making up the design process. This subdivision reveals forms of the work activity ideal that are more or less degraded depending on the constraints of the activity.

The Skills Required for Design Work

Technical skills are prerequisites to '*master one's subject*'. At MARTEL, these skills concern knowledge of the system, a technical speciality, and also incorporate accumulated experiential know-how to which is added the construction of a memory of the various developments in the product. These qualities are supported by a two-fold skill: the analysis and breakdown of problems in order to choose an appropriate solution and the capacity for synthesis in order to incorporate the development sequence within the whole. This coming and going between detailed analysis and putting it into perspective with other parameters constitutes the daily routine in the field of design.

Discipline is the core of a methodical approach that is combined with intuition so as to anticipate the hazards, as well as track down and correct the defects. The combination of these two apparently contradictory qualities necessitates a certain situational flexibility, being grounded in reality, and a consistent appreciation of the relevance of either one of these skills. Discipline in the mobilization of expertise is equally emphasized as an essential quality at IXEL. Mastering technical knowledge and its mobilization allows one to apply one's work, but only if the framework within which the skills are being applied to is an innovative process.

A second skill involved in the design activity concerns *ingenuity*. Indeed, curiosity is coupled with the qualities of discipline and scientific method, resourcefulness, adaptability and intuition, all mobilized in the process of invention. Curiosity is held up as a quality that forms the basis of crafty intelligence, a sideways glance at the system, allowing one to outwit the powerlessness of thorough knowledge.

On a cognitive level, the people interviewed demonstrate a certain degree of flexibility in the situations they encounter, leading them to favour either their disciplinary side or their inventive side, depending on the phase of work they are involved in. Obviously, the positions they occupy call upon these skills in different ways, but they outline a certain technical professionalism within a context without boundaries formed by the knowledge of what action to take. In this respect, the life of a project retraces this alternation between tinkering and the rigorous application of a work protocol.

Technical analysis, tracking defects, and changing projects demand active learning, putting the acquired knowledge to the test in uncharted territory, under pressure and in a situation of interdependence. Within

this framework of constraints, various styles prove themselves in the way of carrying out a given task so as to reveal an aesthetic dimension, an elaborate subdivision of quality work (Thomas 1994).

Mastering a technical specialization for experts in the field or organizing the phases for those involved in the interface, act as a resource when faced with the disproportion of system-products. However, abandoning this fantasy of subjecting oneself to technique finds a solution in a dual attitude of humility and a willingness to confront the risks. Acting quickly, having an astute eye, being intuitive, having flair and a method, and diagnosing problems constitute the daily work of experienced professionals. Actually, work implies a combination of attention to detail and being able to see the big picture, attention and reactivity, diagnosis and action. The mobilization of technical knowledge is inseparable from other less standardized qualities but is just as important.

Another quality required in design work is that of *endurance to stress* when faced with project pressure. It is at the end of a project, in the testing stage, that all the unsolved problems come together. These tests constitute the ultimate filter before industrialization, the time to instill qualities in the product (still in virtual form) before it is transformed into a perceptible product. On the one hand, the designers, hurried along by other projects, are looking to push the project towards its final stages, at the risk of discovering developmental defects that, once again, lead to more design work. On the other hand, the customer is waiting to launch his product and is pushing the deadlines. It is not surprising that the most stressful period is found in the last stage before industrialization. The ability to resist, to keep one's critical distance, to negotiate, to react promptly, and to add a little oil to the works are all part of the know-how for the various players in this field. It is thus hardly surprising that they provide a large number of managers in current projects, being exposed themselves to time pressures. Actually, this emergency functioning becomes for some a 'drug that one gets used to'.

Finally, *networking* skills represent a reservoir of cooperation resources when faced with an emergency and pressure. This relational knowledge is built up throughout various interactional experiences. This system of interpersonal links distinguishes stabilized zones of cooperation from zones of exploration.

These various qualities mobilized in the design activity co-exist at varying degrees for all professionals working in design, and they can be combined without negating each other. The surprising alliance between discipline and astuteness, personal endurance and opening up to a network translates the fluidity between sequences, mobilizing one or more of these qualities, organizational positions, and the nature of the project.

A Variety of Mobilized Figures

Work experience combines the controlled and orderly acquisition of technological fundamentals and qualities resulting from work experience:

ingenuity, expertise, networking, stress endurance. In this way, we see an outlined panorama that combines these various components and refer to four professional ideal-typic figures.

The combination of expertise and network mobilization refer explicitly to the figure of the expert, registered in a community of peers. This figure is very present in skill areas since it is within the context of the work activity in which professional socialization operates.

Allied with stress endurance, the figure of the researcher emerges since the setting for his work is in a system of time constraints, which are particularly demanding in the field of fundamental research. Expertise leans on perseverance so that the inclusion of advanced design takes place in the best of conditions. Here this position is lessened by a framework of applied research but it is actually expertise that is mobilized as a primary resource to develop a product within a given timeframe.

As far as astuteness, ingenuity, the tricks of the trade are concerned, two figures come into play. The first is the inventor, who combines resourcefulness with network mobilization to promote his finding. The second refers to the symbolic figure of the fireman who, when faced with a given situation (particularly in unexpected and fast-paced situations), must react as quickly as possible by combining different types of knowledge so as to find an appropriate response.

If some of these attitudes are more present than others in certain departments, it seems that they are all mobilized in the act of innovative design and that they presuppose reliable working relationships. The process of recognition starts in the very heart of the workplace where the efficiency of each professional act serves as a yardstick to assess the professional's skills and one's peers in terms of the required qualities mentioned above.

Customer-tested and Project-tested Work Identification

Work identification comes into focus in the concrete work experience of design and is troubled by the sudden arrival of the customer in the process, and the subordination of work activities to projects. Design work blends customers' demands and confronts the unfolding of projects with resistance. As a matter of fact, work identity is forced into making certain concessions in accomplishing professional ideals.

A work ideal turned toward innovation and perfection does not blend well with other contingencies, especially those related to deadlines. At IXEL, the Business Center structure and projectized organization have set up a dynamic tension between customer demands and those of product development. The marketplace places its demands on certain projects as a key factor, even if the guarantee of the product's technical reliability must be relegated to a secondary consideration. Renouncing technical perfection is not simple, and certain designers point out to what extent time factors intervene and limit their work by placing a ceiling on their contribution.

Incorporating the customer's demands is relayed by hybrid actors coordinating manufacturing, certain semiconductor designers, and marketing. Let us take note that younger workers are more sensitive to this customer contingency, which can even become a source of added value and a challenge. Giving up on optimum quality for a product results in added value for the work done by the customer.

In actual fact, if the center of gravity for development remains part of the semiconductor design process, the improvement in sales and marketing counteracts the symbolic influence of design. Concerning the Application Laboratory, although they share with design a technical identification, a synthesis of identity is sparked by the interactive experience with the customer, either upstream (specifications) or downstream (After Sales Services). Symbolically, the customer is in fact very much 'an actor' within the context of the Business Center, and the learning process in this contingency becomes standardized since seeking customer satisfaction forces its way into projects given the ambivalence of this satisfaction and the variety of customer demands according to the products/market.

On the other hand, at the MARTEL site, the work ideal for telecommunication software design is blackened by a progressive degradation of the conditions in which it is experienced. Rooted in an expert and technical dimension of the activity, it is disturbed by the project steamroller, embodying another representation of what it is to be a professional. The logic of the demand causes an inversion of perspectives, since the intention is to provide specific responses springing from organized technological know-how and to multiply the number of business transactions undertaken so as to increase profitability. This strategy pushes one to make use of existing assets by reducing the dedicated solutions in places where technological innovations allowed one to improve products in a relationship with a single client.

With the setting up of a management system per project, the ideal for expertise is taken the wrong way round because the rationalization of products is carried out by mastering a technique instead of organizing it. Subordinated by the double logic of profitability and standardization, the degradation of this identifying figure manifests itself through frustration as it necessitates that one forego the quality work ideal.

The conditions for focusing on the work ideal in concrete work situations are no longer all available at one time and give rise to statements that counter the qualities associated with design work. The work experience in the project mode no longer allows one to reach this ideal work figure. Moreover, it does not allow learning with the aim to construct a hybrid figure between the technical expert and the project entrepreneur to take place. If the deadlines norm is generally accepted, it is due more to the inescapable constraint of the internalization of customer logic. Respecting deadlines not only activates games of cooperation but also games of diversion and recourse to letting off steam, although this only remains acceptable to a limited degree.

Shortening the development cycle subjects professionals to considerable time constraints, which results in easing up on professional demands for quality. Furthermore, it is this abandonment of perfection in one's work that qualifies work as 'dirty' and irrespective of tradition.

Identity Classification on a Scale Measuring Improvement

The work situation presents itself as a test that necessitates an identity-building transaction between the work ideal and the reality of the work experience. Not all design activities take the same form given that each person identifies differently with his work. There exists a limit of some sort that cannot be exceeded between the work ideal and the possibilities of putting the Promethean imagination at the heart of the work experience. The arrival of a market logic and management on a per-project basis represent degradation factors in work identity. But the position in the cycle equally influences the conditions of a successful identity-building transaction. In fact, there exists within the same community of values a scale of prestige that inconsistently classifies work activities depending on the prestige ranking.

The Lords of Design

The various activities in the field of product design do not offer the same opportunities to develop a work ideal and are linked to a symbolic and hierarchical scale of work activities. At the top of this prestige scale, one finds the work activities that take place at the initial stages in the process. These activities are closer to the figure of the architect. At MARTEL, the 'lords' of design are found in the center of the 'systems' department. They concentrate on the global vision of the product and create the guidelines for its transformation within a limited technological context. Their advantageous situation is reinforced by an upstream position in the V cycle in which there is less pressure and more room for maneuver.

Within the 'development' entity, specification professionals are close to those working on systems in that they subdivide systems analyses into specifications.

The field of development nevertheless gets its renown and its added value from this work activity's history. Detailed analysis marks the beginning of the production phase itself. The customized work of writing up the development principles is the handiwork of these professionals and places the author's stamp on it. Development constitutes the core of design work since it is responsible for transforming the detailed analyses of the product into programming language and dividing the system into developmental building blocks. Development is categorized along with other construction activities and so gives birth to the figure of the builder. Development is the basis for enhanced collective identification in the very place where secondary identifications find their subdivisions according to the work activities involved.

At IXEL, the *Advanced Design* department incorporates the historical memory of the design core as well, and, step by step, follows the traces of technological ruptures such as those involved in the rise of volatile markets. It is the department most put to the test in spotting developments and sources of added value in terms of business; it is also the most in demand concerning knowledge capitalization. It is in charge of the Dominant Design model (Hatchuel, Le Masson, and Weil 2004), the guardian of the company's technological assets.

Two skills predominate. The Advanced Design unit's aim is to further future product designs and IP developments, that is, available data blocks for a specification that are optimized, testable, and transferable in the application's environment (microprocessors and memory). Their objective aims to obtain a standard product while at the same time offering ad hoc functionalities. The application laboratory pursues a three-part task of description stemming from the specifications (linked to marketing and thereby controlling the technical-sales relationship with the customer), from validation (in terms of integration coherence), and from a tech-watch standpoint (linked to design).

These two entities are the best placed on the work ideal identification scale because they come into play at the very early stages in the V development cycle in all projects.

Design Piece-workers

In complete contrast with the nobler departments, we find *Testing*, which takes charge of incorporating the parts developed and detecting anomalies. Unitary coding and testing represent the least prestigious departments. The extreme specialization of tasks and the assignment of teams to projects lead to a depreciation of the activity and references to workers who 'plod along'. This work activity concentrates the most constraints linked to the lower area in the V cycle as well as the threat that outsourcing presents (especially at MARTEL, where a great deal of its testing activities have been outsourced to Rumania). Their position must also take into account the threat to workers (Osty, Sainsaulieu, and Uhalde 2007). The terms 'peon' and 'assignable resources' indicate the gap between the ideal aimed at and the reality of a crumbling job over which they have no control. Without being able to develop a more global vision, testers are reduced to being in a frustrating position between the ideal of discovery and reality.

Between these two fields is found a continuum on which is positioned the various development activities. The work activity undertaken by the Industrialization department represents an intermediary position at MARTEL. It is spared piecework and a partial vision of the product by being the guardian of the server's memory. Its global, and even more so its cumulative vision, gives it some footing in recognition modes when compared with the company's other work activities. On the other hand, the dire need for

it by customers and project managers propel it to the forefront of problems concerning following up on errors, support deficiencies, and conflicting demands from those it deals with everyday. Tossed about among diverse constraints, it attempts to overcome this sensation of dissipation and the fear of being overwhelmed in an interminable race towards deadlines, standardization, and dependability.

Concerning the interdisciplinary work carried out by *Tools and Supports*, we enter into a different scenario. Offering support to a company's other work activities, it draws its powerful resources from its crossroads position but does not represent a unified work activity to which one can identify. It concentrates numerous constraints demanding real reactivity and has to cope with the outsourcing of certain activities. Its virtual lack of autonomy, coupled with a rough definition of its scope of action, makes it difficult for an enhancement process. It is an identity in the shadows where its technical side gives it its identity-building support.

At IXEL, *Product Engineering* is a recent department, squeezed in between Advanced Design and Manufacturing. This department positioned downstream from the design flow is in charge of validating the circuit and its *industrialization* so as to stabilize a given circuit and prepare its access to the manufacturing stage. It does not contribute to the design process in that it does not add anything to the microcontroller (it only tests and validates it) and yet its influence in the project is analogous to the master control room. It suffers from being the last link in a serial chain of dependence. It inherits unresolved problems from the other entities and must cope with any errors resulting from the product's critical passage from virtual to concrete in addition to any errors in development left pending. Product Engineering, to some extent, functions like the R&D departments of old in the automobile industry. It handles a local function of integration, which organizes the interfacing between design and manufacturing. This intermediary position places it in an eternal quest to enhance its contribution.

In the end, a major finding can be elucidated in this first part: The work ideal, learned during one's training, is updated through work experience, particularly when there is homology between the work situation and working values. But even in less similar cases, this work reference acts as an enhancement by default (e.g., in testing) or by compensation. The identity of design professionals is not a virtual identity or one to be read between the lines as it truly reveals a solid foundation that takes on meaning in the workplace.

Behind this shared identification appears the specter of a symbolic scale that classifies the various professional areas by comparing them to each other. The scale is not a source of division or independence for the various professional areas to find their own identity; they are linked to each other by the invisible thread of belonging to the design ideal. This specter functions like an *efficient* operator for a widespread representation of the process. It is not unreasonable to think that it acts as a source of renewal for workers' strategic and learning abilities. Management by project is an excessive consumer of

resources and it is neither concerned with the recognition of its members—only work activity and peer hierarchies have a say in this—nor the ability to renew itself, which is the contribution of work activities.

VARIOUS EXPERIMENTS WITH PROFESSIONAL SOCIALIZATION

The mechanisms through which work identity is constructed call for an understanding of socialization modes and therefore the results of recognition through the mediation of the social link to work. This is everyone's predominant experience in producing this link. It can take diverse forms: the development of an attributive process for others and a process for articulating one's own demands (Dubar 1991, 2000), the two-fold movement by which a company acquires both employees who are able to help it enter a market and subjects that allow employees to work autonomously (Dubet 1994), learning to be oneself (Sainsaulieu 1977), and the recognition process—an identification whose aim is reciprocity (Ricoeur 2004). Professional identities are supported by forms of varying degrees of sociability. This could be in the form of services, a network in the case of projects, or close relations among peers. The two fields differentiate themselves through the intensity of professional sociability. Highly valued, and forming the bedrock of belonging to a community at IXEL, it is diluted within the links created through affinity and choice at MARTEL. The weight of the relational dimension in work identity-building differs considerably, constituting the point of divergence between the two identity-building dynamics.

A department constitutes the limit for privileged socialization for individuals. It is within that area that the dynamics of skills development as well as convivial links take root.

The Circulation of Knowledge: the Foundation for Team Spirit

The socializing dimension of work takes place within work groups made up of several individuals or entire company departments. The creation of team spirit manifests itself mostly through a convivial atmosphere and an ability to help each other out at IXEL. Through these exchanges, one learns to feel comfortable with each other's brand of professionalism and style, which are, in fact, linked to one's previous work experience.

Symbiosis is thought to be preferable to competition among experts since it is always better to limit the risks one is exposed to. Helping each other out is both a way for peers to cooperate and a way for skills to circulate. Within this sphere of solidarity, one puts professional sociability fully to use. This sociability is the basis for collective learning mechanisms that ensure the updating of skills within an entire company department.

The circulation of knowledge in an informal way is prolonged in certain cases by institutionalized meetings on a regular basis (every week). These meetings personify the collectivity and structure it through a space–time dimension devoted to exchanges and arbitration concerning the allocation of resources. This is an interdisciplinary moment in various projects on which teams are working, and so it is within this context that knowledge and experience are shared.

The hierarchy ('work activity manager') plays an important role in the activation of this socialization. The exercise of hierarchical authority finds its expression in principles that are delegable, listening to others, the art of creating teams according to levels of expertise and the various personalities, following up on aspects of a given work activity or, in a nutshell, through the ability to manage a work group. The work activity manager plays the role of buffer between the pressures in projects, the desires of one's teams to work on an exciting project and the fine-tuning of work, and the equal repartition of the workload. Playing a protective role, the work activity manager will negotiate his team's interests with other work activity and project representatives when it is faced with external pressures, notably in terms of deadlines. Part of his role is to incite this same team to maintain a high level of performance, notably in terms of results.

One must add that these work sectors counterbalance the overpowering aspect of projects. The sudden arrival of production through projects is also present in customers' logic at the heart of the design activity. By relying on work activities through the ad hoc mobilization of resources to aid the project, project managers measure their degree of dependence on these work activities. If the work activity represents a central identification pole, it is because it is centered on positions of power. As a matter of fact, the repartition of resources among and within projects represents massive stakes for which department heads rally together. At the point where this confrontation between production through projects and production centered on work activities finds a resolution in terms of arbitration methods at IXEL, at MARTEL there is an invigorating and segmented process. Decision areas, within a context of interdependence, allow on the one hand a dynamic and nonparalyzing tension between two contradictory approaches to be maintained, and on the other, backtracking dilemmas along hierarchical lines lose their way by meandering through little identified decision-making bodies and activate safety nets in the form of budgetary extensions or time extensions when the pressure becomes too great.

Whatever the scenario, the work activity provides the basis for a relevant identity-building anchor and ensures positions for resistance to counter the steamroller effect of projects. By putting those who act as an interface in an awkward position, it allows others to find continuity in the identity-building trajectory of their work activity.

A Seldom-ritualized, Affinitive Link to Work

For all that, the intensity of cooperative links is quite variable between the two monographs. At MARTEL, the weakness of speeches related to sociability allows one to catch a glimpse of a relatively well-kept social link to work. If the experience of one's rapport to work is a component of one's work identity, its relational dimension seems to have been reduced to maintaining civil relations. A 'good atmosphere' in work teams is characterized by little relational commitment and maintaining enough distance so as to avoid controversial subjects. This good atmosphere provides a necessary counterbalance to pressures experienced at work and even provides a work condition to help one get through the roughest parts of projects. It reminds us of 'Harmony and Compromise' (Sainsaulieu 1977)⁵. Seniority then becomes a factor for keeping relations tolerable over time.

The absence of any ritualizing in work groups leads to a civilized atmosphere where the workers do not think of the workplace as a community area for people with a shared destiny. Individuals assert their needs as individuals and working relationships do not form according to affinities that usually provide the framework for a network of cooperation.

In any case, the instrumental character of the social link makes it a weak one despite the fact that one shares the same design work ideal. These elective relations do not provide the bedrock either for the construction of 'communities of practices' (Brown and Duguid 2005) that would come and substitute network links for those within work teams to provide an area for the circulation of knowledge and the regeneration of expertise. If the relations can be deemed 'good', they are not entrusted with the support of a community link but reduced to a functional role where everyone can see the need for exchanges.

Different layers of networking links can be distinguished and refer to experiences with work transfers. The 'peers' area is built up around a time-frame adjusted to professional trajectories, and goes beyond the work-colleague framework. This network link becomes particularly efficient in the critical pathways in the design process, notably when it involves several departments.

It is constructed at the heart of daily work interactions because it is supported by trusting relationships. When faced with the pressure of projects, solidarity plays a role within a perimeter limited by relational proximity. The act of getting to know each other is the result of concrete interactions, which are then adjusted according to the degree of trust granted to other people. In reality, cooperative situations serve as a testing ground for the reliability of adjustment skills, and allow one to identify those one can count on in a critical situation.

The fluidity in cooperation modes is in fact the product of work sociability. When work interactions are transformed into a community link such as the one at IXEL, work identification is reactivated in daily work

relations, contributing to making the site seem like the most efficient one in the group. Rooted in a company mode, selective and seldom-ritualized affinities diminish the reliability of adjustment mechanisms conditioned by more explicit mixed interests. However, the intensity of sociability does not have any repercussions on work identification, which, in both cases, is bound to the work activity. Work as an area of subjective experience finds here a particularly rich illustration in that it diminishes the work relation factor as a key dimension of collective identity.

CONCLUSION

We can learn several lessons from the exploration of identity-building mechanisms in the world of design. First of all, the commitment in the endless innovation cycles for products, services, and organizational transformations necessitate stability in the mobilization modes of high-level skills. Paradoxically, the greater the intensity of movement, the more continuously social regulation modes are in demand. Sustainable integration represents a condition for the building of interpersonal relations and for the circulation of skills. It also supports the updating of high-tech knowledge by offering a stable horizon for projection. It is at this precise moment that career management policies come into play as a factor in the stabilization of in-house job availability. By betting on long-term development of resources for professionals by broadening development channels and improving functional mobility, interpersonal relations will ensure the longevity of a reservoir of expertise that represents the main driving force for competitiveness.

As a matter of fact, the dependability of cooperative relations through the use of networking links represents a particularly effective resource for reactivity in the critical development of projects. It outlines more economical means of adjustment than functional coordination modes because it has been proven over time.

The setting up of management modes for professional channels then represents a factor for harnessing structural and organizational changes. It acts as a counter measure within an industrial context by adjusting itself according to new and for the most part unpredictable ways and by functioning in a high velocity and unstable mode. In other words, professional socialization modes, by ensuring creativity, integration, and mobilization, constitute an appropriate response in situations of radical incertitude. They supply the necessary continuity to support the whirlwind of projects and the illegibility of structures. By outlining an area for professional projection and career management, companies present themselves in the form of mini-corporations (Mallet 1975), manifesting themselves in the form of a closed job market. Moreover, the socialization process in the world of design reveals two conceptions for the social link to work.

In the case of MARTEL, sustainable identification in the field of telecommunications and development support the building of individual trajectories. The dilution of sociability pushes the identity-building process right back to the narrow perimeter of work experience. Identity is rooted in the individual, connected to the company through an impersonal link and incorporating little need for group activities. The company nature of the social link illustrates the way in which a design professional finds, in his two-fold identification to work and the company, the driving force for personal accomplishment. The passion for technique represents the incentive for work mobilization whereas the institution represents a cocoon guaranteeing one a job and career development.

The IXEL site reveals a community version for work where integration takes place on three levels: one's work, one's group, and the institution. One can defend the proposition of real social regulation in the workplace at the heart of project management and matrix organizational structures. Work groups are endowed, as a means of shaping them, with an education in work. Intersubjectivity, backed up by the circulation of practical knowledge, supports an edification process of shared reference points for action and shared values. The social link to work finds its roots in daily interactions and the conditions for its legitimacy in the management policies for professional career paths. The congruency between the two spheres of identification creates harmony in hierarchical relations where authority derives the basis for its legitimacy from the expertise and the exemplary nature of one's career path. The recent identification to groups simply symbolizes the three-fold integration in its ability to offer symbolic and institutional recognition for work.

To finish our study, it seems to us that these contributions give credence to the thesis of a design identity but in various forms of integration. The rise to power of a knowledge economy founded on innovative design makes recognizing the contribution of professionals a real stake. Along with the development of management tools for professional channels and individual projections, there exists a variety of professional models for success such as management, expertise, and appropriate ways for carrying out projects. However, depending on whether an identity-building opportunity is offered (IXEL) or not (MARTEL), the consequences are considerable concerning the congruence between management modes and the social dynamics of work. The dynamic management of careers acts as a reinforcement vector for one's commitment to design work by offering a plurality of professional development prospects. Access to recognition for design work is based on the elaboration of new forms of social compromise where the stability of professionals combines with mobile career paths that are likely to reinforce the effectiveness of networking links. In the end, the modes of mobilization and integration for professionals in design act as a variable that is as fundamental as the organization in the contexts of intensive innovation.

NOTES

1. This organizational type assigns each worker two bosses in two different hierarchies. One hierarchy is 'functional' and assures that each type of expert in the organization is well trained and supervised by a boss who is a super-expert in the same field. The other hierarchy is 'executive' and tries to get projects completed using the experts. Projects might be organized by region, customer types, or some other scheme. Matrix management combines the aspects of a functional organization with those of a projectized organization.
2. The term professional is used here to define employees with high qualifications, as is the case with engineers and technicians.
3. The expression radical uncertainty refers to situations in which the actors have no certified knowledge of what the possibilities, categories, circumstances, or results of their action could be. This incertitude is the fruit of the interaction among several factors, including the need to incorporate the latest advances in applied science, to globalise the supply of products and services, and to simultaneously make the most of economies of scale and the *customizing* of solutions for niche markets. Reducing incertitude is only possible after the fact, once the effects of one's actions are known.
4. In Greek Mythology, Metis ('wisdom' or 'wise counsel') was a Titaness who was Zeus' first great spouse, indeed his equal and the mother of Athena. Metis was the goddess of wisdom, cunning, craftiness, and deep thought.
5. 'Collectively committed to the experiment, these professionals having the same rank, seniority, and skills must accept each other's individualities. Possibilities for promotion or transfer are lessened. The Harmony and Compromise style then develops in an organization turned towards peaceful coexistence among rivals each of whom [is] capable of individual strategies'. Sainsaulieu, 1977, p. 170.

BIBLIOGRAPHY

- Alter, N. *L'innovation ordinaire*. Paris: PUF, 2000.
- Barley, S. and Kunda, G. *Gurus, Hired Guns and Warm Bodies: Itinerant Experts in a Knowledge Economy*. Princeton: Princeton University Press, 2004.
- Boudon, P. *Conception*. Paris: Editions de la Villette, 2004.
- Brown, J. S. and Duguid, P. 'The Art of Knowing: Social and Tacit Dimensions of Knowledge and the Limits of the Community of Practice'. *Information Society* 21, no. 2 (2005): 109–118.
- Dubar, C. *La socialisation. Construction des identités sociales et Professionnelles*. Paris: A. Colin, 1991.
- . *La crise des identités*. Paris: PUF, 2000.
- Dubet, F. *Sociologie de l'expérience*. Paris: Seuil, 1994.
- Hatchuel, A. 'Coopération et conception collective; variété et crises des rapports de prescription'. In *Coopération et Conception*, edited by G. De Terssac and E. Friedberg, 101–121. Toulouse: Octares, 1996.
- Hatchuel, A., Le Masson, P., and Weil, B. 'Activité de conception, organisation de l'entreprise et innovation'. In *Travail, Entreprise et Société. Manuel de sociologie pour des ingénieurs et des scientifiques*, edited by G. Minguet and C. Thuderoz. Paris: PUF, 2004.
- Hecksher, C. and Adler, P. *The Firm as a Collaborative Community. Reconstructing Trust in the Knowledge Economy*. Oxford: Oxford University Press, 2006.

- Mallet, S. *The New Working Class*. New York: Bertrand Russell Peace Foundation, 1975.
- Minguet, G. and Osty, F. *En quête d'innovation, Du projet au produit de haute Technologie*. London: Hermès Science; Paris: Lavoisier, 2008.
- Osty, F. *Le désir de métier en entreprise. Engagement, identité et reconnaissance au travail*. Rennes: Presses Universitaires de Rennes, 2003.
- Osty, F., Sainsaulieu, R., and Uhalde, M. *Les Mondes sociaux de l'entreprise: penser le développement des organisations*. Paris: La Découverte, 2007.
- Ricoeur, P. *Parcours de la reconnaissance*. Paris: Stock, 2004.
- Sainsaulieu, R. *L'identité au travail. Les effets culturels de l'organisation*. Paris: Fondation Nationale des Sciences Politiques, 1977.
- . *Sociologie de l'entreprise. Organisation, culture et Développement*. Paris: Presses de Sciences Politiques et Dalloz, 1997.
- Sewell, W. H. *Work and Revolution in France: The Language of Labor from the Old Regime to 1848*. London: Cambridge University Press, 1980.
- Thomas, Robert J. *What Machines Can't Do. Politics and Technology in the Industrial Enterprise*. Berkeley: University of California Press, 1994.
- Zarifian, P. *Le travail et l'événement*. Paris: l'Harmattan, 1995.