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# THE IMPACT OF OFFICE AUTOMATION ON ORGANIZATIONS AND JOBS: STATE OF THE ART

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# INTRODUCTION

The purpose of this review of the literature is to formulate an overview of theoretical projections and the results of empirical research in the area of evaluating the impact of new technologies on work and its organization.

To this end, a number of data banks were consulted, yielding 80 individual titles published between 1980 and 1987. This body of literature was first separated into works dealing specifically with the question we were studying and those of a more general nature or covering other aspects than those we had selected. A list of these general works will be found in the references. We then divided the specific publications into four categories, corresponding to our research interests:

1. The impact of new technologies on organizational structures.

2. The impact of new technologies on the nature of tasks.

3. The impact of new technologies on job evaluation.

4. The impact of new technologies on staffing and recruitment criteria.

These four categories certainly do not cover the entire problem of the organizational impact of new technologies. In general, the four dimensions are examined in terms of specific areas of study: work organizations, working conditions and job qualifications, or characteristics of work. Occasionally, these three broad themes may be interchangeable in covering the four specific dimensions described above.

In an attempt to provide the reader with a better understanding of our point of view, we will begin this synthesis by defining our research approaches and the specific dimensions we have chosen to examine (organizational structures, nature of tasks, etc.).

The second part of this study contains the results of our synthesis. For each dimension selected, we will examine, in order:

1. The research strategies prevalent in a given dimension (problem, hypothesis, method).

2. The sector of activity in which a problem has most often been examined.

3. The job categories in these sectors which were most often observed in studying the dimension in question.

4. Preliminary conclusions regarding the behaviour of the four dimensions selected.

In the third and final section, we compare our observations with those contained in reviews published in 1982, 1983, 1984 and 1986. This will enable us to bring to light recurrent conclusions and thus confirm what is now known, with varying degrees of certitude, about the impact of new technologies on the organization of work in general.

## 1.0 PART I: RESEARCH THEMES AND DIMENSIONS

The purpose of this first part is to provide a simple, succinct presentation of the concepts, dimensions and organizational variables that characterize research in the area of work organization.

New information and communication technologies are presumed to have an impact on the organization of work. The following presentation will enable us to clarify what is to be understood by the impact of new technologies on work organization. It will also enable us to see to what extent the dimensions we have selected for our examination are linked with the general research themes of organizational and human variables.

### 1.1 Contingency approach

In one of the major reviews of the literature on organizations, Mintzberg (1987) suggests that organizations be seen in terms of their organizational structure. In his view, two dimensions characterize an organizational structure: division of labour and coordination.

Work organization refers to a specific combination of the structural elements of an organization related to division of labour and coordination and even perhaps to the means by which power and authority are exercised within the organization.

Assuming an internal coherence of structural elements and a significant external coherence on the strategic level between the structure and context of the organization (size, technical system, environment, etc.), Mintzberg arrives at five ideal types of work organization or structural configurations, each characterized by a base element and a dominant coordination mechanism.

Division of labour leads us back to job definitions. These are characterized by a degree of work specialization, a degree of formalization of behaviour with respect to task performance and also by a certain level of education and training. We will have occasion to come back to this aspect of job definition in greater detail under the theme of research on the impact of office automation on the nature and content of tasks.

Coordination is an important dimension to consider when discussing a certain approach in analysing the impact of office automation on organizational structures. For the moment, suffice it to say that coordination is more specifically linked to designing the superstructure (as opposed to the infrastructure, represented here by the division of labour). This superstructure depends on the bases and criteria for grouping jobs, the number of jobs making up units, the type of control and planning used for standardization of products, and is also determined by the type of liaison mechanism chosen.

These seven factors are related systemically or reciprocally, but do not constitute all the elements that determine the nature of a structure. Exercise of power over decisions is another important determining factor, on which is based the centralization or decentralization of the organizational structure.

### 1.1.1 Implications of workplace automation

In this framework, we can establish the theoretical principles relevant to the study or evaluation of the impacts of work automation. The impact on work organization refers to a difference between how the work is divided and coordinated before and after automation. This difference should be due to the introduction of technology into the organization.

It should be possible to describe this work organization in a general manner in terms of the dominance of a coordination mechanism and a base element

(strategic summit, technostructure, line of hierarchy, logistics or operational centre). As well, more specific changes can be assessed in terms of work division and coordination, two conceptual dimensions of organizational structure. As regards division of labour, automation may have an impact on: 1) job specialization, 2) degree of formalization of job, 3) training required for the job.

### 1.1.2 Definition of concepts and variables

The following definitions are derived from Mintzberg (1982):

- Coordination mechanisms: These are the channel of communication and means of control implemented to synchronize work. There are five of these: mutual adjustment, direct supervision, and standardization of processes, products or skills.

- Basic organizational elements: These are the various groups making up the personnel of an organization. There are five of these as well: operators, i.e. individuals directly concerned with production, the technostructure, the middle (hierarchical) line and logistic support functions (formerly supervisory personnel), who are all at the intermediate level, and the strategic apex (formerly senior management).

- Work specialization: This refers to the number of tasks comprising a job (breadth of scope) and the control an employee may have over his or her work (depth of work). Work is divided or specialized in two ways: 1) horizontally, where the employee works repetitively at a narrowly defined task, and 2) vertically, where the employee, while performing a narrowly defined task, has no say in how that task should be performed. Often a job that is horizontally specialized is also vertically specialized.

. Horizontal job enlargement: This refers to horizontal despecializing of work. A number of different tasks are assigned to one employee rather than only one specialized task.

. Vertical job enlargement: This is job enrichment, whereby the employee not only performs a number of different tasks but is also given more control over the work.

. Training: Process of teaching the knowledge and skills related to the work.

. Socialization: Process by which employees learn the standards of the organization.

. Grouping into units: This is aimed at "establishing a system of common supervision between positions and units" under the responsibility of one person. Division may be by specialty (surgery, radiology), by function (marketing, accounting, etc.), by product, by customer, etc.

. Size of units: This refers to the number of positions or work units in a base unit.

. Planning and control systems: These are the means used to standardize products, either by predetermining product characteristics or by setting criteria for evaluating activities.

. Liaison mechanisms: The means, from formal to informal, used by the organization to encourage mutual adaptation; a good example would be committees.

. Decentralization: This is the degree to which decision-making power is dispersed to members of an organization. This may be done at the bottom of the chain of authority (vertical decentralization: we would then speak of delegation of authority) and may be done at the level of control

of the decision-making process, i.e. the authority responsible for indicating 1) what can be done to solve a problem (information), 2) what should be done (advice), 3) what is planned (choice), 4) what is authorized (authorization), 5) what is done (execution). These decision-making processes may be transmitted to persons other than the strategic summit and supervisory personnel, and this would then constitute horizontal decentralization. When decisions of different types are made at different locations within the organization, we may speak of selective decentralization, and when these different types of decision are made at the same level in the structure, we would then speak of overall decentralization.

## 1.2 Behavioural approach to work organization

The behavioural approach is actually a contingency approach to designing jobs, or more generally to the organization of work. According to this approach, there is no single valid way of organizing work; everything depends on the coherence between the structure of jobs and their contexts from the standpoint of behaviours as opposed to attitudes.

In this approach, imperative decisions on simplification, specialization and all-out standardization of jobs are the root cause of dissatisfaction, absenteeism and high employee turnover. While this applies to scientific management prescriptions, the school of human relations and resources also comes in for some criticism.

The behavioural approach also refutes the claims of the previous approach, according to which there are, in reality, "normal people" (the majority) who have the same needs for autonomy, control, variety and responsibility. It also denies the fact that these needs may exist independently of group or organizational constraints.

The behavioural approach described here is derived from that of Van de Ven and Ferry (1980), which in turn draws on a number of other studies conducted by the Center for Effective Organization in Michigan, among them the Job Diagnostic Survey (JDS) of Hackman and Oldham (1975).

The behavioural approach proposes four contextual factors and five other factors that describe, in the same way, two dimensions of job design: the position (the individual) and the organization unit (the group). The contextual factors of a job are: 1) task difficulty, 2) task variability, 3) level in the hierarchy, 4) tenure in the organization. It might be noted here that some of these contextual factors also come into play in the rate of use of new technologies (and thus in the potential for impact). This is the case, for example, with the employee's level in the hierarchy.

Job-related factors are: 1) job specialization, 2) employee competence, 3) job standardization, 4) margin of freedom enjoyed by employee, 5) performance incentives. These factors will be examined in the chapters that follow when discussing the impact of work automation on the nature of tasks and also on the selection and recruiting of employees.

At the outset, we can make two observations. First, jobs may be analysed in terms of employee attitudes as in the sociotechnical approach, or in terms of the concrete behaviours they imply, as is the case here. Second, some authors speak of division of labour, structure of the task or job to explain that efficiency of organizational structure or job satisfaction in no way offset the fact that we are dealing with a cognitive or behavioural relationship between the individual employee and his or her work activity.

Factors linked to the work unit, as described in the next paragraph, are the counterpart of the factors that go to make up the job. These factors in fact make up what we would have to call the structure of the work unit. They thus become important when, as is the case here, we are dealing with the impact of new technologies on organizational structures.

The factors that come into play in the work unit are: 1) specialization of the work unit, 2) personnel making up the unit, 3) standardization of operations within the unit, 4) centralization, again in terms of decision-making, and 5) incentives to perform and conform.

### 1.2.1 Implications of workplace automation

The current debate surrounding task enlargement or enrichment (here the nuances of the contingency approach are absent is part of this approach as regards the measurable properties of a job. An enlarged or enriched job is thus characterized by: stimulating work with low or high specialization, a high or medium level of competence, low or moderate standardization, considerable feedback from the work itself and from other employees, high expectations for rewards for work well done and sanctions for poor work.

### 1.2.2 Definition of terms

- Specialization: Refers to the number of different tasks an employee must perform as part of his duties. This variable is normally measured by considering as specialization any task at which the employee works five or more hours in a typical week. As regards the structure of the work unit, specialization refers to the number of different job titles included in the unit.

- Expertise: Refers to the employee's level of professionalism. Where measurable, it covers level of education and time and duration of training and orientation.

- Standardization: Refers to the clarity and detail used to describe roles and tasks in a job description, as well as how much detail is used in defining the rules and procedures to be followed. With respect to the structure of the work unit, we speak of the degree of automation of work

methods as well as the number and complexity of the rules and procedures involved.

. Discretion: Refers to three variables, in the following order of importance: amount of authority linked to the employee's position, pressure of work load and degree of accountability.

The **authority** variable is, in practice, the degree of latitude the employee has to decide what tasks and projects to do, to decide how these are to be done in terms of procedures and rules, to decide on how to manage problem cases and exceptions, and to decide what performance criteria apply. These variables thus form an index that measures the latitude employees enjoy in their work.

The **pressure** variable is, in practice, the degree of control that the employee has over production deadlines, the extent to which the employee is restricted by quality standards to be met and the lead time normally allowed between the time one job is finished and another starts.

After the **pressure** index comes the **accountability** index. Accountability is measured by only one element, the extent to which the employee must answer for his acts and is responsible for decisions he makes respecting his work.

. Incentive: Refers to the amount of feedback the employee receives from observation of his work or from contacts with superiors and peers. The incentive nature of a job also has to do with the employee's expectations regarding rewards or sanctions, both formal and informal, for work that does or does not satisfy performance criteria.

## 1.3 The sociotechnical approach to work organization

The sociotechnical approach sees work organization as a system of complementarity between persons and work methods and machines. Such a system is efficient insofar as the social system (i.e. people and their psychological and sociological needs) is coherent with the technical system (i.e. the functional characteristics of machines and tasks). The reverse should, of course, also be true.

In concrete terms, an efficient work system is one that is conducive to job satisfaction. This satisfaction depends on the coherence between employees' needs and expectations regarding their work and the work requirements laid down by the organization. It is the employees' experience that reveals the degree of coherence of the system.

In this perspective, the impact of new communication and information technologies on work organization in general should, if positive (i.e. resulting in greater job satisfaction) lead to a better fit between expectations and requirements. According to Mumford, when automating work, we can make adjustments in the coherence of the five dimensions of work organization and thus positively affect employee satisfaction. The preferred dimension for this type of intervention depends on the previous degree of "fit" between employee needs and expectations and employee job experience. When this "fit" is very low or even negative for a given dimension, this dimension should be adjusted.

The five dimensions are: 1) coherence between work and the knowledge the employee wishes to contribute, 2) coherence between the work experience and the psychology or motivation of the employee, 3) coherence between the employee's work experience and perception of efficiency, 4) coherence between the employee's work experience and the task structure that interests him, 5) coherence between actual experience in the job and the employee's values.

### 1.3.1 Implications of work automation

We can imagine that, within this framework, work automation might aggravate or emphasize incoherences in work organization, particularly when nothing is done to prevent them before the actual implementation of computers or automated office equipment. We might then speak of a negative impact of work automation on employee aptitudes and knowledge, meaning that they are under-used and under-developed in view of the tasks assigned. We will come back to this particular aspect of work organization when dealing with the criteria for selecting and recruiting employees.

Employee opinion may also prove negative if work automation does not work in favour of their personal motivations. When these motivations are linked to task structure, work automation may have a negative impact in that the new conception of jobs may not meet employee needs. We will look at this problem again later, in the section on the impact of work automation on the content or nature of tasks in terms of enlargement or enrichment.

### 1.3.2 Definition of terms

- Coherence with knowledge: The extent to which employees think their aptitudes and knowledge are used and developed in their work.

- Coherence with psychology: The extent to which employees think their personal motivations are served or satisfied in their work. Examples of motivation are: need for recognition, responsibility, advancement, social interaction, etc.

- Coherence with efficiency requirements: The extent to which employees think the salary, control or autonomy and operative support they receive are commensurate with the effort required of them.

. Coherence with task structure: The relation with work organization is easier to see here. This term refers to the extent to which certain elements of a task (number of skills required, number of tasks with an objective, feedback mechanisms, identity, degree of autonomy and control) correspond to employee expectations. When the employee's responsibilities include an addition to the number of tasks assigned to a given level in the hierarchy (variety), we would speak of enlargement. While enlargement in a job definition leads to more variety and less monotony, job enrichment brings opportunities in terms of using different abilities and more autonomy. When the employee's responsibilities include an addition to the number of tasks related to a higher level in the hierarchy, we would speak of job enrichment.

## 1.4 Conclusion: a reading of the dimensions of the synthesis

The reason we made this analytical presentation of the three approaches to work organization is because it provides what we believe is a good summary of the implicit approaches used in the research covered by this overview, i.e. the impact of new communication and information technologies on work organization in general and, in particular, on the nature of tasks, job evaluation and selection.

We have not presented any of the traditional approaches here, because these are covered in Mintzberg's overview of the contingency approach. Similarly, we have not included the motivational approaches of Herzberg or Hackman and Oldham, since they are covered in the sociotechnical approach and the behavioural approach respectively. Readers interested in learning more about these approaches are advised to consult the excellent overview by Paquin (1986).

The approaches described in Section 1 of this first part have helped to place the research we will summarize further on in its proper context. We have seen that the impact of new technologies on work in an organization may be looked at: 1) from the overall viewpoint of division of labour, 2) from

the point of view of task structure and the knowledge involved, and 3) from the point of view of job characteristics.

As regards the four research themes described earlier, we can see that some of the dimensions and variables of the approaches selected take on considerable importance.

On the theme of structural organization and the debate on the centralizing or decentralizing impact of new technologies, the contingency approach (see 1.1) provides us with an interesting guide. We can see that centralization and decentralization are complex dimensions that cannot be assessed without looking at all details if we wish to avoid confusion in interpreting the results of research.

Also under the contingency approach, we can see that the debate on upgrading due to work automation sometimes introduces nuances regarding meaning we prefer to give to these two dimensions. Is deskilling linked to the job, the task structure or simply the employee's experience of it?

The behavioural approach indicates that job enrichment is not simply a question of the number of tasks to be done in a given time unit, but that there are important qualitative aspects that must be considered.

The sociotechnical approach emphasizes the important role of employees' personal motivations in the evaluation of impacts. These motivations have a tremendous influence on respondents' perceptions, and when they are not taken into consideration, the research results in more questions than answers (e.g. why would certain categories of employees using automated office equipment five to eight hours a day be satisfied with their jobs?)

We now move on to the second part of this status report, which consists in a detailed examination of empirical research dealing with the dimensions described in the beginning of this report.

## 2.0 PART II

This part of our review is aimed at examining the results of empirical research related to our four research themes (see Introduction).

This examination covers three main points: 1) research strategies, i.e. problems studied, hypotheses where applicable and the methods used in the research; 2) sector of activities and job categories most commonly observed in a given sector; 3) preliminary conclusions of these studies.

### 2.1 Organizational structures

Research conducted on the impact of new technologies on the structure of organizations, although rare, naturally focusses on the change/no change dichotomy.

Authors who claim to have observed a change in the formal structure (see 1.1 and 1.2) or the organization consider that automation improved the use or arrangement of personnel and budgets (rationalization). Those, on the other hand, who saw no change in structure consider that work automation mainly served to reinforce existing arrangements by enabling key elements in the organization, i.e. the most influential group, to establish and protect its power. Four studies were examined here, published in 1981, 1984, 1985 and 1987 respectively.

The first study asks what impact computerization had on centralization of decision-making and inter-departmental coordination. The second asks if automation actually had an impact on the overall organizational structure, i.e. in the sense developed in the contingency approach. This study is fairly significant in that it actually tests hypotheses on decentralization

of decision-making, number of jobs, number of service-related jobs and the enlargement and/or enrichment of employees' work.

The third study is just as significant as the second, of course because of its stated objective of testing hypotheses. The question raised here is whether we can consider work automation responsible for changes in the structure of a work unit (centralization, complexity, formalization), or whether a given structure is not simply due to the nature of the task (routine or non-routine).

The fourth and last study on structure also examines whether automation (as the degree to which micro-computers are used in performing certain tasks) might be the cause of structural changes.

### 2.1.1 Research strategies

Research strategies, to be effective, must be adapted to the problems they are supposed to tackle. The first study formulated no hypothesis on the relation between automation and centralization, nor between automation and coordination. It thus proceeded by case study on a sampling of eight organizations scattered throughout the world (England, Sweden, U.S., etc.).

The fourth study, as well, proposed no hypothesis on the relation between work automation and structural change. The objective in any case was only to determine the status of this relation in forthcoming publications, up to the end of 1986. In this sense, the strategy is one of document analysis. Testable hypotheses were only advanced by the second and third studies.

The study by Leiffer and McDonough (1985) predicted that automated work units would be structured differently from those which were not automated and that automated units would have different structures depending on their degree of efficiency. This difference in efficiency should also explain

differences in the structure of non-automated units. The authors also advance the hypothesis that efficient work units would have different structures depending on whether or nor they were automated.

The strategy of this study was thus to monitor the automation and efficiency variables to observe the effects of their variations on the structure of work units, having ensured that the nature of tasks (routine, non-routine) was the same in all units. The sample consisted of 21 work units of 6 employees each from two different organizations.

Study, by Carter (1984) also proposed two correlational hypotheses. Regarding centralization, this study predicted that the more common automation became in various departments (increased use of applications using new technologies in work procedures), the more the organization would tend to decentralize. Looking at division of labour, this study predicted that as the use of applications by departments increased, the organization would see an increase in the number of jobs (functional differentiation), the number of jobs in work units (functional diversification) and the specialization of jobs. This study also undertook to explore the effect of organizational size on these two hypothetical correlations.

Quite naturally, this type of study could only be done on a random sample of organizations; however, recording the size effect on these correlations necessitated a strategy allowing the sample to first be stratified by size.

We may conclude this section by stating that, with the same research theme and sometimes even with relatively similar questions, this research was carried out using several strategies covering multiple case studies, meta-synthesis, near-experimentation and a survey with a stratified sample.

### 2.1.2 Sector of activities and employee category

Two sectors of activity are represented in these studies on the impact of work automation on organizational structures, the service sector and, to a more limited extent, the manufacturing sector.

Carter (1984) attempted to validate her hypotheses on press organizations, while Leiffer and McDonough (1985) studied twelve work units in a manufacturing organization and nine in an insurance company. The multiple case studies by Robey (1981) dealt with two manufacturing concerns: the production control department of an electronic component manufacturer and the sales and marketing departments of a glass manufacturer. This study also covered six service-sector organizations: the admission and test analysis departments of a hospital; the exchange and internal administration departments of a bank; the inventory control, billing and forecasts departments of a wholesale sales operation, the purchasing and order processing departments of a mail-order company, the scheduling department of an airline, and the production-control department of a restaurant supply business.

Regarding distinctions between the public and private sectors, it was seen that these studies made no mention of research on public organizations. We might therefore suggest some caution be used in extending the more easily generalized aspects of the preliminary conclusions in the next section.

### 2.1.3 Preliminary conclusions

Robey (1981) draws four conclusions regarding the impact of work automation on centralization:

- More often than not, work automation brings no change in organizational structure. When, exceptionally, this does occur, automation reinforces the control of upper levels in the hierarchy. This increased control results in greater formalization of rules and unit work procedures.

Whether or not there is change, the author feels that the increased control makes it possible to derive more benefit from the improved performance than automation has the potential to provide (Robey, 1981:681).

- When there is no change in decentralization of decision, there is a reinforcement of structures, in particular that of centralization of decision-making.

- Automation permits: a) increased control through standardization of information used in decision-making, b) faster information processing and more complete files. Even when decisions are made at lower levels, control is augmented by the fact that data on decision-making performance is more easily accessible to higher levels (Robey, 1981:684).

- In the end, automation does not result in greater employee participation in decision-making. The author sees no more necessary change in the case of coordination. Automation may formalize coordination by formalizing the nature of data and distributing it equally to all parties involved in coordination, thus eliminating any need for informal contact between departments.

  In other cases, informal procedures may remain important. As the author notes, it all depends on the organization's work and objective (Robey, 1981:686).

The conclusions of Carter (1984) are also of a contingent nature. In general, the impact of automation on the locus of decision, decentralization and centralization, and division of labour is directly linked to the specific nature of the task for which the computer is used. This relation is in turn affected by the size of the organization (Carter, 1984:266).

Depending on size, more extensive automation improves the chances for greater centralization of decision, in particular in smaller organizations. Certain decisions, for example those related to hiring personnel, may be decentralized in small and medium-sized organizations, but this will not interfere with the distribution of control over the decision in question.

The correlation between increased use of technology and added jobs (functional diversification) is confirmed regardless of the size of the organization, although it tends to be more pronounced in large organizations (Carter, 1984:264). Increased use of technology is even positively correlated to the increase in new jobs (functional differentiation), particularly in smaller organizations; however, most of these new jobs are related to technical manipulation of computers (Carter, 1984:265).

Leiffer and McDonough (1985) conclude that, in general, the impact of work automation may be independent of the nature of the task. When this is the case, the impact tends to bureaucratize structure, that is, centralize and reinforce control over decisions and the tendency to consider the environment as less uncertain (Leiffer and McDonough, 1985:245). It should be noted that, according to the authors, impact on work units has nothing to do with the degree of repetition of tasks, and automation apparently has no impact on the repetitive nature of tasks.

The broad overview by Er (1987) concludes, after examining significant research on the impact of automation on organizations, that this tends to reinforce the organizational structure in place at the time of implementation. When there is a change, it is normal routine decisions that are delegated, and there is thus no loss of control by supervisory and top management personnel.

## 2.2 Nature of tasks

The impact of new communication and information technologies on employees' work is the most prevalent theme in research on impacts.

What is at stake, according to this research, is whether introducing office automation (necessarily) leads to enrichment and enlargement of employees' work or, conversely, to employee specialization or deskilling.

Although they represent a crucial problem in the introduction of office automation, most of the results are related to a compilation of employee opinions and perceptions about their work (an exception is Benoît, 1985). This type of research strategy is more open to criticism when it comes to giving concrete proof in support of employee claims.

The following is a summary of the questions underlying the empirical research examined in our sample:

- What impact does word processing equipment have on the content and context of the task?
- Are tasks likely to be further divided with the implementation of office automation?
- What determines the positive or negative impact of office automation?
- Does office automation call for new skills or competence requirements?
- Does the impact of office automation on the nature or content of tasks vary with the category of employees?

### 2.2.1 Research strategies

Dealing with the impact of new information technologies on work, some authors, e.g. Bernier and Cailloux-Tieger (1985) distinguish pessimistic theses (deskilling) from optimistic (improved qualifications) on the basis of the research strategies adopted. In particular, the use of quantitative

methods is associated with the thesis according to which the impact of new technologies is to increase individual qualifications, while the use of qualitative methods is associated with the opposing thesis of deskilling of work.

This distinction is in fact more related to differences in the level of work analysis. It is hard to imagine a macrosociological study of impacts mainly using interviews and observation to analyse jobs in a given economic sector. Similarly, as regards analysis of employees' jobs, quantitative methods using sampling and survey techniques would be inconsistent with the focus of the examination, which is to study the case of a specific employee.

The research selected here consists of case studies that examine the impact of new information technologies on work units or organizations. More often than not, (relatively simple) qualitative and quantitative data are collected and combined in order to make "inferences" about job structure or work characteristics in a group or on the division of labour in the organization.

These "inferences" are easily distinguished from questions on the impact of new technologies on productivity, unemployment, employment or the mobility of employees in a given economic sector (see Menzies, 1984; Friedricks, 1982; Ontario Task Force on Employment and New Technologies, 1985; Globerman, 1981, etc.).

In these cases, the research strategies adopted allow results to be validly generalized to entire economic sectors (sampling, representativity, testing hypotheses, etc.). Almost all the case studies assembled here are, in fact, characterized by an absence of working hypotheses and systematic sampling, a tendency to describe, and flexible use of interviews and questionnaires.

In all, the theme of the nature of tasks covers ten empirical studies of varying size. The study by Benoît (1985; 1984), begun in 1983, covered 112 organizations in various economic sectors in the Montreal area. Even though the units observed were made up of word processor operators, it was

those responsible for the word processing units who responded to the survey. The survey dealt with several organizational dimensions, including the impact of introducing word processing equipment on the organization itself and on working conditions (including remuneration).

The survey by Roy (1983) on a large public-sector organization was addressed directly to 316 employees assigned to word processing. It also attempted to compare user attitudes and perceptions before and after implementation on several organizational dimensions similar to those in the above study by Benoît (1985). The C.S.P. (Communications Studies and Planning Limited, 1980) survey funded by the Equal Opportunities Commission in Britain, also dealt with the impact of using word processing in ten organizations. The respondent group here was made up of the managers of the word processing units.

The Pinard and Rousseau (1985) study on three insurance companies was not confined to word processing. Managers nevertheless responded, even if they did not alone form observation units. APEX (1984) also studies word processing and, even though no specific details are given on respondents, it seems likely that they were once again the supervisors of word processing units.

Like the Pinard and Rousseau (1985) study, the research by Billette and Cantin (1986) on nine general insurance head offices and three brokerage firms did not deal specifically with word processing. On the contrary, the objective was rather to make a comparative evaluation of different systems (including office automation and interactive remote processing) on a number of organizational dimensions. Using questionnaires and structured interviews, like most of the studies covered here, the Task Force on Employment and New Technologies (1984) surveyed a large number of federal and provincial organizations. Statistics on employment, supplemented by the opinions of experts and managers, were used to evaluate the impact of work automation.

The Diebold (1984) study was also a fairly broad study. Like any survey of this type, and given the unspecified nature of the technology, it also used managers to collect its data, despite the fact that the results were not confined only to executives.

The surveys by the "Groupe de recherche sur l'innovation sociale (1987)" looked at categories of employees in various provincial public organizations.

### 2.2.2 Sector of activities and employee category

Most of the studies on the nature of tasks were done at the operating level of private and public service-sector organizations (insurance companies, banks, etc.). Thus secretaries, stenographers, data-entry clerks and all those whose work was assumed to consist mainly in systematically coding data were often the object of studies on the impacts of new information technologies on work. There are very few studies dealing with computerized work by supervisors and middle and upper management (see Université Laval, 1987 and Diebold, 1984 for exceptions). There were two reasons for this.

The first is linked to the tendency of those developing programs and applications to focus their efforts on systematizing procedural or routine work. Naturally, most of this work is included in the duties of office or operating personnel.

This means that office workers form the ideal category of users. The second reason, related to the first, thus has to do with neglect or failure to develop systems aimed at professionals and executives that would satisfy their true needs. It might also be noted here that the actual users are not always the individuals mainly questioned in impact surveys.

The empirical research we selected for this section dealt mainly with the nature of tasks performed by operating personnel and occasionally with the

nature of professional and managerial work. A rapid look at the categories of user personnel for which we want to describe the impact on tasks and duties reveals that there is no exclusive focussing on the duties of professionals and executives. In the sector we are concerned with, Benoît (1985) studied secretarial employees in various organizations (typists, secretaries, stenographers, clerk-typists). The study by Roy (1983) also dealt with secretarial workers in a public organization (stenographer-secretaries and secretaries). The "Groupe d'Étude et de Planification de la Communication (1980)" also looked at secretaries and typists. Pinard and Rousseau (1985) studied subordinate employees in three insurance companies. Subordinate employees, particularly secretaries and typists, also formed the sample used in the APEX study (1984).

Of the studies which dealt with the nature of tasks but did not confine their analysis to operating personnel, we chose four. These were the Billette & Cantin (1986) study on twelve insurance and brokerage firms; the Ontario Task Force on Employment and New Technology (1985) survey of 29 federal, provincial and municipal government organizations and nine union organizations; the report by the Diebold Group (1984) on nearly a half-million large American and Canadian organizations, and the large-scale study carried out by the GRIS group (Université Laval, 1987) which dealt with members of all employee categories in the Quebec public service.

### 2.2.3 Preliminary conclusions

The impact of work automation on the nature or content of tasks raises, as we noted at the beginning of this chapter, various types of questions.

This section will trace the link between these questions and the results of empirical research dealing specifically with them.

2.2.3.1 Word processing and tasks content

Contrary to the generally accepted image of mind-destroying technology, word processing in general (and this might be replaced by other types of software packages) does not necessarily make jobs less challenging; this is rather the result of overspecialization or excessive fragmentation of work.

Without speculating at this stage about the organization of work or the structure underlying these tasks, nor about the implementation and use methods which might have had a positive effect on these results, we may already observe that, as opposed to the almost non-existent impact of computerization on organizational structure (in the desirable sense of decentralization) the impact on the nature of tasks is recognized.

For Benoît (1985) and Benoît, Cardillo and Cossette (1984), word processing tends to make for less diversity or variety in the jobs of users organized into work groups when we examine the time spent entering text and the proportion of employees assigned to this activity alone. However, given the possible variety of typing jobs, the study observes that the majority of respondents considered working on a word processor to be more diversified than working on a typewriter.

This report also notes that due to the requirements of understanding and assimilating the operation of a word processor and the high degree of responsibility (logic, initiative, judgment) inherent in the instrument, respondents considered operating a word processor more complicated than a typewriter.

Roy (1983), comparing fears expressed by two respondent groups (future and present users of word processing) agrees with the above results on certain points. The author observes that fears expressed before implementation regarding the potential for loss of autonomy and the loss of some of the "interesting nature" of the work were not confirmed after implementation. Most respondents said they perceived no decrease in autonomy and interest.

Other fears were, however, confirmed, for example job losses caused by the steady demand for word processing in organizations and the increased volumes that can be produced with these machines (C.S.P. Ltd., 1980; Benoît, 1985).

2.2.3.2 Fragmentation of tasks and office automation

Tasks fragmentation leads to job specialization and deskilling. This image often associated with industrial automation does not appear, based on recent empirical research, to reflect experience in the current phase of work automation.

The current trend appears to be towards integration into a given job of tasks that were formerly fragmented. Instead of deterioration, it would thus seem that we should be speaking of job enlargement.

Studying banks and insurance companies, Pinard and Rousseau (1985) observed that implementation of office automation coincides with the despecialization of office work and duties formerly simplified and fragmented. They note that the growing versatility due to enlargement of jobs and greater autonomy of workers is opposed to the thesis that work automation leads to deskilling of office jobs. They point out that qualifications depend on recognition.

In their research on the insurance field, Billette and Cantin (1986), observing the disappearance of groups doing fragmented, specialized work, confirmed the trend towards versatility in jobs. Where formerly coding, data entry, typing, batch processing, checking and archiving of insurance policies were performed in central units or by groups of workers doing specific tasks, office automation enabled these specialized jobs to be integrated into the departments that originated the information.

Billette and Cantin (1986) also note that this observation may be generalized to all cases of work automation based on remote processing (termi-

nals or personal computers giving direct access to computerized files for processing or consultation).

Looking at several aspects of the impact of automation on 500 organizations, Diebold Group (1984) showed that implementing office automation in large and medium-sized organizations tended, for 80% of respondents, to enlarge operating employees' work and give them more variety and satisfaction.

Thus when the potential of office automation is realized, we see, without speculating on possible job loss or creation, that tasks formerly specialized and centralized in distinct functions are giving way to a shorter work flow. We might describe this flow as enlarged jobs the holders of which themselves perform tasks that were traditionally done by other departments. ments. This also explains the opinion of respondents to the Diebold (1984) and Roy (1983) studies regarding the level of interest and satisfaction they found in their work after implementation.

One remark might, however, be made regarding interest and satisfaction. These two variables should not necessarily be seen as varying with successful implementation of office automation, because they might equally well be explained by the job structure or the organizational climate that reigned during the entire computerization process. They are also frequently due to employee expectations prior to implementation (Comtois and Conrath, 1987).

#### 2.2.3.3 Impact as a conditioned situation

Increases in the variety, autonomy and enlargement of tasks seem to depend on certain factors linked to implementation and to the organization as it is perceived by employees during the automation process. Even though the research we examined showed a positive effect, the impact on these variables is not necessary positive or negative when office automation is implemented.

Many authors advance the hypothesis that the (positive) impact of work automation is based on the type of technology (Carter, 1984) or the advanced phase of technology development (Billette and Cantin, 1986). From this viewpoint, the operating characteristics of office automation stand out and enable us to distinguish it from the logic of large computer systems.

The need for centralization to control the proliferation of applications even appears, according to Leiffer and McDonough (1985), to be a more determining factor in the impact of office automation on work than the very use of the technology or the formerly routine nature of the work, which as we know depends on the stable or unstable character of the work environment of the employee or work group. The smaller the size of the unit, the more powerful the impact of computerization, thus making the work more complete.

The impact of office automation on work in general thus depends on the type of technology, the intended use (e.g. reduce costs or improve the work of professionals) (Diebold, 1984), the overall attitude of management (e.g. autocratic style as opposed to a democratic or participatory style), and contextual variables such as organizational size and environment.

Even if, in the final analysis, no one of these factors appears to truly explain the variations in impact, it is certain that this impact (when it is identified) is not the direct result of installing automated office equipment. It is rather, as might be assumed from what we have said, amplified or else lessened and restricted by the action of management habits, motivations preceding the implementation project and the context of the organization or the work unit being computerized.

#### 2.2.3.4 Office automation and employee abilities

It is clear that office automation, at least in the perception and opinion of employees, requires new skills from those who spend much of their working time using automated office applications.

Looking at three Ontario municipalities, the study sponsored by the Ontario Department of Labour (Wilkins, 1982) notes that new requirements for competence or skills arise in two ways: when job vacancies occur or during training.

Jobs that became vacant, particularly through natural attrition, were redefined to include requirements for abilities, analysis and interpretation. The position thus redefined became a new, more highly qualified job directly linked to the use of microcomputers. Jobs for word processor operators, since they were filled by employees from typing pools, called for training which, once completed was considered by management as upgrading.

Two other large-scale surveys confirm this increase in requirements for qualifications. The Diebold study (1984) observed that 66% of their respondents recognized that they had seen an increase in skilled jobs while 42% of the same respondents said they had seen a significant decrease in unskilled jobs. The Ontario Task Force on Employment and New Technology study (1985) on government departments observed that work automation tended, in all departments, to create a requirement for more skills from all categories of employees. In a situation less easy to generalize, 97% of respondents to the survey by Roy (1983) felt they had acquired additional qualifications following the implementation and use of word processing machines.

We can see from this research that automated office tools are likely to (and actually do) make work more complex, and consequently force users to take more training which, once assimilated, forms new skills. We should, however, note two points in connection with recognition and compensation.

When learning through training is minimized and taken lightly, as is often the case, recognition of the new skills that might be acquired is reduced and sometimes non-existent. But these new skills, as noted by Pinard and Rousseau (1985), exist only if they are recognized. As well, recognition

does not necessarily appear to mean increased pay. We will come back to the latter point in the next chapter.

2.2.3.5 Office automation and the nature of tasks

Most of the studies dealing with the impact of work automation on the nature of tasks have focussed almost exclusively on operating personnel. This is a major shortcoming, which should point to job categories for future research on this theme. There are nevertheless a few studies dealing with this question, and these found that the impact of office automation on the nature of jobs does in fact vary with employee category, each of which obviously have very different tasks contents.

The Diebold study (1984) on office workers, professionals and executives shows that office automation has a more positive impact among professionals than for any other category. Since they experienced no loss of autonomy or responsibilities, at least 90% of respondents felt that their professional work was greatly facilitated by the saving in time, access to information and shortening of delays in receiving information. For office workers, on the other hand, less than 50% of respondents said they had more responsibility and autonomy, and the impact of office automation on executive work appears nearly non-existent.

Using a slightly different personnel classification (officers, professionals, middle management and senior management) the GRIS (Université Laval, 1987) study, which covered the whole Quebec public service, observed that the employees as a whole were either in favour or very much in favour of office automation, even if all personnel categories did not seem to have perceived a significant impact on organizational structures and procedures (communication, decision-making, etc.). Of the four groups, however, it was senior executives who, in 67% of cases, felt they recognized an improvement in their work motivation, followed by middle management, professionals and operating workers. The same order holds true with respect to job enrich-

ment. Thus, contrary to the previous study, here the impact on actual work (enrichment, satisfaction, autonomy) seems to be linked to rank. Instead of professionals, it was senior and middle management personnel who seemed to be most satisfied as a result of office automation.

## 2.3 Job evaluation and compensation

This section tackles the practical, but thorny, problem of the effect of office automation on employee compensation following changes in their level of classification. The question is: should we automatically reclassify the job and/or increase the salary of users of automated office equipment?

A number of surveys have been done among employees with a view to determining whether office automation actually does lead to increased requirements in terms of skills and qualifications. In general, it was seen that not only did the majority of employees (mainly operating personnel) feel they were using new skills in their work, they thought their work load seemed to have increased. However, according to these studies, only a small minority of employees benefited monetarily from this change in work level.

The few reasons suggested for this difference appeared to be linked to non-recognition of training and learning (acquiring skills) as cases of upgrading, as well as some arguments linked to the nature of data that would allow conclusions to be drawn about compensation. In particular, it had to be determined whether subjective data alone could command changes in compensation and whether current classification systems could take into account technological changes such as office automation.

The empirical studies we examined pose the problem of evaluating jobs in various ways; more often than not these are mere observations. The questions studied are:

- Does office automation have an impact on employee salary levels?
- Does office automation require new or additional skills from the employee-user? Must these be taken into account in calculating compensation?
- Is training in automated office techniques recognized with respect to salary?
- Are automated jobs reclassified?

### 2.3.1 Office automation and employee salary level: research strategies and employees category

A study on 1,000 private companies in countries such as Canada, the U.S., England, France, Germany, Belgium, Switzerland and Austria by Macauley (1985) looked at the relation between use of office automation and employee salary. Only 13% of the 1,000 companies said they paid higher salaries to employees trained in and using office automation. This salary increase (based on job category) came to an average of 8% of the employee's salary. According to the author, most companies seemed to consider the use of office automation a normal skill requirement for a given job.

In a more specific study, Fusselman (1986) looked at 1,250 secretaries using various automated office tools in their work. The results bear out those of Macauley (1985). Fusselman observed that 90% of respondents felt that using office automation had not reduced their level of competence, and at least three-quarters of them thought instead that their secretarial role had been considerably enlarged, particularly because of the more diversified, complex and creative work. And yet, examining factors that might have caused salary increases (annual increase, merit, cost of living, etc.), these results show that only about 8% of these increases were due to the acquisition of new skills linked to the use of automated office tools.

One of the reasons proposed for this poor correlation seems to be the distance between secretaries and senior executives. According to the

author, secretaries think that even if their immediate superiors appreciated their new skills, the same was not true of senior executives, who are supposed to control decisions regarding their mobility and salary.

Two other studies already mentioned collected data on compensation. Roy (1983) found that before implementation 90% of secretaries felt their pay should increase because of the new skills acquired by learning to use automated office equipment. In fact, after automation, the use of office automation resulted in no increase in salaries for 97% of new operators.

Less dramatically, the research by Benoît (1985) comparing salaries of typists with those of word processor operators showed that 48% of the organizations surveyed paid higher salaries to their operators, with the variance between the two groups being 7%.

### 2.3.2 Office automation and new work skills

Even though compensation, in the majority of cases, does not vary with the use of automated office tools, as we have just seen, this is not necessarily because the employees using these tools do not acquire new skills. When we looked at the Fusselman (1986) study, we saw that the majority of secretaries felt they had increased not only their work load but their responsibilities, even if these were not specified in their job description.

All the studies that have paid any attention at all to this question agree that, in the opinion of users (operating personnel in this case), use of office automation is a situation where new skills are acquired. But the problem, as in most of the research results reported here, lies in the nature of the data compiled. Most of these studies are based on replies by respondents, while the facts themselves are rarely observed.

Training is sometimes considered as an indicator of the process of acquiring new skills, but this is not always a hard and fast rule, since the quality of training (duration, depth) is often questioned when the time comes to evaluate it (Pinard & Rousseau, 1985).

### 2.3.3 Office automation and job reclassification

The specific problem of job reclassification is rarely studied, and what we have to say about it is more in the nature of remarks. Two studies dealt with this topic; these were carried out by the GRIS group at Laval University (1987) and the Bureau of Management Consulting of Supply and Services Canada (Canada, 1981).

The survey by the Bureau of Management Consulting (Canada, 1981) notes that the questions of acquiring skills, in addition to its methodological aspects, poses an organizational problem. In the public service, for example, some existing jobs linked to office automation (e.g. word processor operator) are classified in existing job categories laid down in accordance with previous phases of work automation, such as batch processing. These categories were defined on the basis that no skills or special conceptual competence was required (e.g. office machine operator).

Given the results of research on user opinions but also the versatility of automated office equipment, the validity of these classifications seems questionable.

Although the problem was raised in this 1981 study, it had still not been solved in 1987. The GRIS study on the Quebec public service showed that the problem of changing classification systems was one of the most important tasks users expected from their union. The impact of using office automation on these systems is, to our knowledge, either non-existent or at least not documented.

## 2.4 Staffing and recruitment criteria

Staffing and recruitment criteria is the last topic to be examined here. This discussion will be short, given the near total lack of documentation on this subject. The approach taken in this research area is based upon the recognition that the permanent and critical use of office automation requires the user to display a certain degree of new skill. Obviously, as in most of the research themes we have examined, the subjects observed were almost exclusively employees at the operating level, in this case word processing machine operators. The skills in question will thus be related to these subjects.

For this theme, we found two empirical research reports. The first, which uses the Delphi technique, was specifically aimed at identifying and ranking in order of priority the skills or abilities needed by office workers in a computerized work environment. The second was concerned with current recruitment and selection processes in eight organizations that had already introduced automated office equipment. We will look at the second study first.

### 2.4.1 Recruitment and selection in a computerized environment

According to the study sponsored by the English Association of Secretaries and Stenographers (1984), the rate of recruitment has declined on average in the eight computerized organizations surveyed. In the vast majority of cases, employees were hired to compensate for various types of leave. This hiring was often done within the company itself, particularly since in the work force in general employees with word processing experience demanded higher salaries. The selection thus placed more emphasis on word processing experience, with a bonus paid to employee with experience on the same type of equipment as that used in the company. The other study (Delphi technique) is somewhat more informative than the one we just looked at. It brought together a panel of 55 people with experience in the areas of

education and design and use of office automation for an iteractive Delphi study lasting three days (Erickson and Asselin 1986).

Participants were asked to rank on a Lickert scale a hundred statements regarding the abilities of office workers in the office of the future. The results were somewhat surprising. The first three abilities, judged high priority by the majority of participants, were:

- Office personnel should have good listening skills, be bilingual, be able to prepare reports by inserting the appropriate information, be able to determine the proper form and style for a given document and know how to edit them.

- Office personnel should, from the point of view of abilities and personality, develop a positive attitude toward people and their work (autonomy, creativity, versatility, etc.) and also toward new computerized tools.

- Office personnel should have the abilities necessary to use automated office equipment.

These results are surprising insofar as the image they form is one of office workers with a broad range of skills, as opposed to the scenarios that saw them confined to word processing teams performing tasks with no variety. It should also be noted that these abilities are in line with the trend to versatility in jobs discussed in Chapter Two on the nature of tasks.

We should nevertheless remark here that the results reported in this section have yet, to a great extent, to be confirmed, given the scarcity of research on this theme.

## 3.0 PART III: A REVIEW OF REVIEWS OF LITERATURE

This chapter is intended to compare and possibly relate the preliminary conclusions we arrived at to those reached in previous years (1982, 1984, 1986, 1987) in research similar to our own. Most of these literature reviews analysed a good many empirical studies and were published in prestigious journals.

Given the absence in the research we cite here of inquiry related to the evaluation of jobs and criteria for staffing and recruitment, this section will cover only the first two themes of this status report:

. The impact of office automation on organizational structures

. The impact of office automation on the nature or content of tasks

In general, these works recognize the contradictions coming out of research (centralization or decentralization, upgrading or deskilling) and indicate that the organizational situation is the (often ignored) dimension that makes it possible to explain these apparently contradictory results.

### 3.1 Organizational structures

Three reviews covering empirical research were studied: Kraemer and King (1986), Huff (1986) and Er (1987).

For Kraemer and King (1986), based on fifteen years of documented research, the results suggest that work automation in public organizations does not in itself lead to decentralization or centralization of organizational structures. For them, technology allows the organization to harmonize its various ways of arranging its resources and regulating itself. This arrangement is more strongly dependent on the organizational context than on any

other factor, particularly technological factors. For Kraemer and King, work automation tends to reinforce prevailing trends in organizations, but cannot be considered as the cause of any impact on organizational structure.

Huff (1986) also reaches the same conclusions as Kraemer and King: technology per se has no impact on structures; it opens the way for reinforcement of prevailing tendencies which are in turn influenced by "history, traditions and the individual preferences of those in power" (p. 77). For Er (1987), empirical research tends to show that work automation normally strengthens the existing organizational structure rather than changing it. When there is a change, he notes, it is routine decisions that are responsible, and these imply no loss of power to managers and senior executives.

### 3.2 The nature of tasks

If the results concerning the impact of work automation on organizational structures tend to show a consensus in their interpretations, the same is not true as regards the impact on tasks. In their 1982 review, Skinner & Chakraborty note that, as opposed to the education and health fields, work automation has had a negative impact on the tasks content of office workers in the banking, retail and wholesale fields. Qualifications were downgraded, and there was no change in the degree of variety and responsibility of employees at the operating level, whereas for managers and senior executives, these aspects of their work changed positively.

In 1984, Attewel and Rule did recognize the existence of a trend towards upgrading and deskilling. They felt that none of the observations were false and that their coexistence in fact raised the problem of which of the trends really predominated. This predominant trend, however, can only be sought at the macroecomonic, or even sectorial, level.

The same year, Wall, Burnes, Clegg and Remp (1984) concluded from their examination of research that new technologies tended to speed up the trend to rationalization of work by imposing simplified tasks requiring only a few skills and little autonomy from the worker. As well, new information technologies offered the possibility of enriched work in which the worker would use a broader range of abilities and would have more control over his work. Wall and others interpreted these results not as depending on technology, but rather as being based on the degree of control or autonomy given to employees on implementation. For them, the contradictory results are due to management practices and not to differences in research methods.

For Rajan (1985) as well, the effect of context, in particular the management philosophy, plays a more important role in the effects attributed to new technologies. He claims, for instance, that many analyses do not take into account the fact that office work was already highly fragmented and routine before computerization. Thus, employees could not have much autonomy or control.

Kraemer and King (1986), whose conclusions correspond to those of Huff (1986), noted that, in general, studies showed that employees perceive new information technologies positively, in particular their effects on performance, work environment and the reduction in the number of problems related to their daily work. Very few employees perceive effects or changes in supervision and in their capacity to influence others. The authors do not feel that these results corroborate the thesis of deskilling. They think that, here again, context is a conclusive factor.

# CONCLUSION

We began this status report with an overview of concepts and their definitions in order to help the reader gain a better perspective of the thematic discussions that followed. We looked at four research themes. In summary, the analyses suggest that:

- Research on the impact of office automation on work is, in most studies, limited to office workers.

- New information technologies in themselves are not responsible for any changes; left to themselves, they reinforce existing trends in work organization.

- New information technologies do not necessarily affect organizational structure, but the uses to which they are put tend towards centralization.

- The impact of office automation on the nature of tasks remains mixed because of the relative effect of context; case studies sometimes show deskilling and sometimes also upgrading.

- There is little documentation of the impact of office automation on classification plans, despite the importance of the subject. The same situation exists for the theme of staffing and recruitment criteria.

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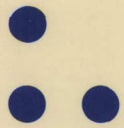

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