

A Critical Review of the Literature on the Organizational Impact of Information Technology

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Abstract — A critical review of the literature on the impact of information technology on organizations, as suggested by the currently available evidence, is presented. The impact is discussed at four different levels—individuals, groups, organizations, and societies. Issues discussed include ergonomics, stress, job satisfaction, attitudes, industrial relations, leadership, power, politics, decision making, organization structures and organizational changes affecting individuals, groups and organizations. The critical review points to some directions along which more comprehensive surveys should be done in the future.

The term *information technology* was coined in the late 1970s to refer to the nexus of modern technology, including computing technology, microelectronics, and telecommunication technology, together with major parts of consumer electronics and broadcasting (Illingworth, Glaser and Pyle [20]). Although mankind has processed information since primitive society, early technologies such as the abacus and simple counting devices were too primitive and too slow to exert pervasive impact on the then society. The emergence of computing technology and microelectronics (especially VLSI circuits), coupled with advanced telecommunications, allows data and information (including digitized voice and image) to be rapidly processed and transmitted over a long distance (Otway and Peltu [32]). Information technology, as it now stands, makes many previously impossible tasks feasible. New emerging fields include office automation (Hirschheim [18]), management information systems (Culnan [11]), robotics (Scott [40]), and flexible manufacturing systems (Kathawala [23], Raouf and Ahmad [36], and Warnecke and Steinhilper [43]), to name a few.

The impact of information technology on modern society can be felt in daily life and every sector of society (Kling [26]). Although the impact of technology in general on organizations has been actively studied by organizational behaviorists for a long time (Hulin and Roznowski [19]), the specific impact of information technology on organizations has not been fully accounted for (Kling and Scacchi [27]). Research in this area hitherto appears to be piecemeal, fragmented and incomplete, partly due to the newness of information technology.

Nevertheless, in the Information Age, changes in organizations caused by the introduction of information technology are inevitable as organizations are compelled by the external environment to be efficient and competitive in order to survive. Office automation (Hirschheim [18]) is one way of making routine clerical operations efficient and cost effective. Some may be alarmed that the factory has taken over the office (Bjorn-Andersen [6]) while office functions are computerized.

Introduction of information technology into organizations often meets with mixed reactions. Information technologists are excited about the technical feasibilities made possible by modern technology, whereas trade unionists fear unemployment as a result of implementation of information technology. Given the fact that information technology is here to stay, it

is important to understand its full impact on organizations, especially for implementors and policymakers.

It is the purpose of this paper to critically review the literature on the impact of information technology on organizations in detail as suggested by currently available evidence so that a coherent view may be formed. In this endeavor, we are interested in answering the following questions: (a) What are the researchers trying to determine? (b) How have they gone about it? (c) What did they find? (d) What are their contributions?

A PHILOSOPHICAL FRAMEWORK

In assessing the impact of information technology on organizations, it is important to understand the three predominant views in this area: the optimist view, the pessimist view, and the pluralist or relativist view (Hirschheim [18]). The optimist view asserts that information technology increases the productivity of all concerned; creates as many new jobs as it destroys; increases organizational effectiveness and efficiency; enhances communication; improves the quality of working life; and makes possible more leisure, medical facilities, etc. The pessimist view believes that the contrary is true—namely, most management jobs are too unstructured to be automated; a large scale deployment of information technology will lead to unemployment, deskilled jobs, less job satisfaction, deteriorated working life, centralization of power, and lessening of personal privacy and freedom. Among these two extremes lies the middle ground—the pluralist or relativist view that the positive or negative impact of information technology is dependent on the way the technology is put to use. This view is more concerned with the development of criteria for social and organizational acceptance and applications of information technology in appropriate circumstances. Most people generally adopt one of these views, either consciously or unconsciously, depending on their background and prior training.

These three views of the impact of information technology can be placed in an epistemological and ontological framework. The ontological assumptions are concerned with the nature of the world, whereas the epistemological assumptions are concerned with the nature of knowledge and its acquisition (Hirschheim [18]). Within ontology, there are two propositions: realism and nominalism. Realism postulates that the universe is comprised of objectively given, immutable objects and structures, whereas nominalism believes that reality is simply a subjective construction of the human mind. On the other hand, there are two propositions within the epistemology: positivism

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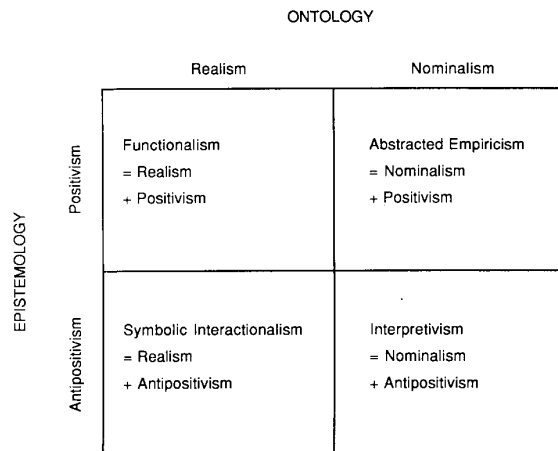


Fig. 1. The ontological and epistemological framework.

and antipositivism. Positivism approaches an inquiry by concentrating on the explanation and prediction of observable phenomena through the identification of causal relationships. In contrast, antipositivism rejects the appropriateness of the causal model for understanding social or human actions, except for physiological responses. The combinations of realism, nominalism, positivism and antipositivism form four different categories: functionalism (realism + positivism), interpretivism (nominalism + antipositivism), abstracted empiricism (nominalism + positivism), and symbolic interactionalism (realism + antipositivism) (see Fig. 1). Generally speaking, the optimist often adopts the functionalism approach to the development of information technology, whereas the pessimist often adopts the interpretivism approach to assess the impact of information technology since there is no social reality to be measured. The pluralist or relativist adopts either abstracted empiricism or symbolic interactionalism, taking a mixed reaction position.

The impact of information technology may be studied at four different levels: individuals, groups, organizations, and societies. We present collected evidence of the impact as reported in the literature at these four different levels, each of which will be discussed in detail. In assembling evidence, impacts that cannot be substantiated will not be included. This way, the approach will provide us with a balanced and coherent view of the impact of information technology on all areas that affect our daily lives.

IMPACT OF INFORMATION TECHNOLOGY ON INDIVIDUALS

Individuals are at the receiving end of information technology, therefore it is important to understand the full impact of information technology before introducing it to the workplace.

The Ergonomic Aspects of Information Technology

As the name implies, information technology processes information. The first step in such a transformation process is to create machine readable data so that further processing by machines can be carried out. This step is commonly performed by data-entry operators whose sole jobs are to key in data from documents into machines using keyboards. Such a data-entry job is normally routine and monotonous.

Shortly after the widespread use of visual display units (VDU) in the 70s, concerns about the possible health hazards of VDUs were expressed by trade unionists. However, the possibility of health hazards could not be confirmed, though it was generally agreed that prolonged exposure to VDUs could lead to eye strain. In recent years, repetitive strain injury (RSI) has become a serious hazard associated with VDU work (Brown [7], McGraw [29], and McLean [30]). The exact causes of RSI are by no means clear, but possible factors that might cause RSI are rapid and repetitive movements, stressing of joints, poor posture, and a fast work pace over a long period of time. It is estimated that ergonomic factors account for 35 to 40 percent of RSI incidents (McGraw [29]).

Employers' attitudes towards RSI also play a key role in alleviating or worsening the problem. Some employers hold the view that "the use of word processors cannot be justified economically unless they can be utilized all day" (Bjorn-Andersen [6]), as if machines were more important than humans! Fortunately, health and safety legislation has been introduced in many countries to counteract the trends (Evans [15]), though establishing a norm is still a long way off.

Preventive measures against RSI should be taken. A summary of noteworthy recommendations is given below (Armbruster [2], Brown [7], McGraw [29], and McLean [30]):

- (i) job rotation should be introduced so that repetitive movement can be reduced;
- (ii) incentive bonus schemes, if any, should be scrapped;
- (iii) the workplace should be redesigned with ergonomics in mind;
- (iv) the practice of having a five minute break after one hour of keyboard work should be established; and
- (v) a maximum limit of four hours of work per day at a VDU should be established.

A survey of the recent literature (Brown [7], McGraw [29], and McLean [30]) reveals that although RSI is a widely discussed topic, there is a general lack of field surveys to establish the extent of the impact of RSI on keyboard operators. Perhaps this is not surprising given the lack of general agreement on RSI—some psychologists even dispute the existence of RSI!

Employee Attitudes and Behavior towards Information Technology

The attitudes of employees towards working with computers have an impact on the success of introducing information technology into organizations. Employees who adopt the pessimistic view may resist or avoid the use of information technology whenever they can due to unnecessary anxiety and irrational fears. By using a self-reporting questionnaire, Rafaeli [34] surveyed 284 white-collar, non-managerial employees of three medium size manufacturing organizations and found that employees who had made more extensive use of a computer reported more positive attitudes towards working with them. However, the correlations between attitudes towards working with computers and job involvement, as well as organizational commitment, were moderate. The findings suggest that it may be possible to alleviate some of the anxiety about computers by giving employees opportunities to use them on their jobs.

Stress and strain are the results of modern busy life styles, and are the concerns of medical professionals and organization behaviorists. Apparently stress and strain are not only harmful to health but also affect work performance. In a detailed study of changes associated with computerization of

administrative work, Johansson and Aronsson [22] used a questionnaire to survey some psycho-social stressors in connection with work at a VDU. One hundred and twenty-eight employees were selected to represent different amounts and types of work at VDUs; 21 of them—11 with extensive and 10 with no work at VDUs—were studied in their leisure time in addition to regular work time. It was found that mental strain, demand for concentration and the amount of routine work increased, whereas job responsibility, variety and autonomy remained unchanged. Mental strain caused by prolonged and extensive VDU work was found to be particularly alarming, and those studied required long hours to relax after work. Furthermore, mental strain was worsened by unexpected breakdowns of the computer, interruptions by phone calls, and noise in the open-space office. One interesting finding from this study is the rise in expectations on the response time of a computer. Retrieval of information from paper files that previously took several minutes to perform is now expected to be accomplished by a computer in not more than five seconds. A more surprising result is the anxiety caused by the occasional slow response time of the computer. It is interesting to note that fast response time provided by the computer is one of the many guidelines for humanizing computerized information systems as reported by Sterling [42].

Job satisfaction has been one of the main concerns of organization behaviorists since the invention of scientific management by Taylor. Job enlargement and job enrichment are two of the arrangements used by organization behaviorists for counteracting the boredom created by scientific management. The former constitutes horizontal job loading as it brings a variety of unconnected tasks together under one person. In contrast, the latter constitutes vertical job loading as it makes an employee responsible for a cycle of connected tasks. In a survey (details undisclosed) conducted by Rajan [35] on the service sector, he found evidence of job enlargement and job enrichment following the introduction of information technology into workplaces. Examples of job enlargement were encountered mainly in building societies and banks where tellers were expected to perform back office functions such as typing and filing in addition to their duties at the counter. On the other hand, examples of job enrichment were mainly evident in insurance and distributive trades where, through on-line systems, individual clerical staff perform a full cycle of work involving customer enquiries, liaison with brokers, processing new applications, and claim handling. However, contradictory results can be found in the same industry but in different organizations (Ranan [35]). Clearly, the impact of information technology on job satisfaction depends on how the new technology is managed. In an independent survey conducted by Cheney and Dickson [9], they found that user job satisfaction appeared to be very much influenced by the managerial sophistication of the information systems department, but not so much influenced by the technical sophistication.

Job deskilling caused by the introduction of information technology is another area that has been studied by organizational behaviorists. Here the concern is that affected employees are reduced to performing simple operations that do not require a great deal of discretion, self-control and brain power while computers take over their functional skills. In a survey conducted by Rajan [35] on eight well-defined occupations (technicians, draftsmen, foremen, trade craftsmen, non-transferable craftsmen, transferable craftsmen, and skilled operators) in 850 companies, the results showed that an

overwhelming majority reported “no impact” or “impact of a limited extent.” However, in other studies (Attewell and Rule [3]), contradictory results and mixed reactions were obtained—four occupations showed modest but statistically significant downgrading of skills over the last 15 years, six showed significant upgrading, and three showed no trend. The problem is complicated by a flaw found in the *Dictionary of Occupational Titles* (DOT, published by the U.S. Department of Labor) that was the basis of the skill content assigned in most studies (Attewell and Rule [3]). Over the last 25 years, there has been little change, if any, in the skill content as defined by the DOT skill measures. Thus, research in job deskilling caused by information technology remains inconclusive.

IMPACT OF INFORMATION TECHNOLOGY ON GROUPS

Work group formation is a well-known phenomenon in organizational behavior (Baron [4]). In this section, we discuss the impact of information technology on work groups as suggested by the evidence.

Industrial Relations and Technological Changes

Information technology offers organizations new services and opportunities. Technological changes are unavoidable if organizations are to survive and prosper. The issue, however, is the way technological changes are introduced. A mishandling of technological changes often leads to industrial unrest.

Many employers view the introduction of information technology as their right to manage, and often take unilateral actions to introduce technological changes as they see fit (Evans [15]). On the other hand, employees are fearful that the introduction of new information technology will lead to a widespread displacement of workers (Deery [14]). This is often one of the incentives for introducing information technology in the first place. Consequently, trade unions often take an aggressive stance on matters related to employment protection. The introduction of information technology is thus clouded by trade union resistance and industrial disruption. In many cases, the aims of trade unions are not to obstruct technological changes, but rather to ensure long term employment security.

In a survey by the Australian Department of Productivity, out of 282 companies in which redundancies occurred, only 3 percent stated that trade unions were informed of impending redundancies (Deery [14]). In a national survey conducted by the Australian Department of Science and Technology on the consultative and personnel practices associated with the introduction of new technology, out of 165 companies, no more than 7 percent of the technological changes were accompanied by formal consultative processes (Deery [14]). In a more recent survey conducted by the Australian Bureau of Statistics on behalf of the Committee of Inquiry into Technological Changes in Australia, out of 1200 companies, only 5 percent responded that they were engaged in consultation with their employees (Deery [14]).

Indeed, what is badly needed is the establishment of formal consultative mechanisms between employers and trade unions for negotiating technology agreements. In the absence of a technology agreement, smooth implementation of technological changes can hardly be realized. The feasibility of a technology agreement depends critically on the willingness of the employer to negotiate and retrain affected employees.

In many countries (e.g., United Kingdom, West Germany, Australia, USA), legislation such as the Health and Safety Act

in the U.K. have been introduced to protect the interests of workers, but nationwide agreements for introducing technological changes have not been reached. When more organizations are affected by information technology, such nationwide agreements are indeed necessary.

The Impact of Information Technology on Top Management

Will the computer change the job of top management? Dearden [13] believed that it never would. On close scrutiny, we find that two of his three basic assumptions are wrong — namely, “Computers will continue to do what they have been doing for the past 25 years,” and “technology will remain the same and that there will not be a new technology involving an organic construction.” Clearly, computer technology has undergone drastic changes in the last 25 years, especially the emergence of personal computers, with a fifth-generation computer system forthcoming. Good counterexamples to Dearden’s arguments were provided by Davis [12]. For example, it was found that top managers had used personal computers, coupled with advanced software such as decision support systems and spreadsheets, to assess the risk of new products. Obviously, there are ample opportunities for top managers to do creative work with computers; the limitation is one’s imagination.

It is true that not all management tasks can be automated, and it is important to understand what cannot be automated. Management systems in most organizations are characterized by formal organizational structures and informal information networks. A formal organizational structure provides the chain of command and the formal authority (Baron [4]). An informal information network provides the management with crucial information to sense opportunities in the market, detect crises before they occur and allow managers at different levels to achieve harmony. Information systems developed by naive computer specialists are often based on formal structures of organizations and fail to take the informal aspects into consideration (Argyris [1], Crozier and Pave [10], and Wynne [44]). Such computer-based information systems often reduce the informal flexibility and also reduce the psychological and intellectual support and the share of responsibility with subordinates. Top managers whose competence will be judged at all times are therefore left to exercise authority and responsibility on their own.

Furthermore, computer-based information systems will eliminate sources of information, leaving the credibility of information unchecked, which could otherwise be determined from informal contact. Moreover, the availability of precise information provided by a computer-based information system may cause the management to focus attention on relatively trivial areas at the expense of more important but ill-defined management problems.

In analyzing the tape records of 25 actual work meetings following the introduction of computer-based information systems, Argyris [1] found that executives experienced (a) a reduction of free movement, (b) psychological failure and a feeling of being in a double bind, (c) a leadership based more on competence than formal power, and (d) decreased feelings of essentiality. One important conclusion made by Argyris was that MIS (management information systems) specialists were not equipped to cope with the emotional problems caused by their systems.

In general, the literature on the impact of information technology on top management is too descriptive and lacks analytical results backed by field surveys.

Leadership Substitutes and Computer Professionals

The introduction of information technology into organizations has created a new breed of computer specialists whose influence on organizations depends on the degree and extent of information technology implemented. They possess so-called expert power (Baron [4]) and have a great deal of influence on organizations whose business activities depend critically on the success of computer-based information systems. It has also been noted that professionals are more committed to their profession than to their organizations.

Leadership substitutes are defined as having the characteristics of an individual subordinate, a work task, or an organization that prevent leadership from affecting employee attitudes and behaviour and make such leadership unnecessary (Howell and Dorfman [16]). In a survey of 354 professionals and non-professionals at several different hospitals, they analyzed leadership substitutes among professional and non-professional workers. They found that intrinsic task satisfaction and the importance placed on organizational rewards emerged as two strong leadership substitutes for professionals. Furthermore, high levels of ability, expert knowledge, experience and need for independence prevented leadership from having an impact on job satisfaction. Generally speaking, professionals preferred no substitute for role clarification. These are the factors that managers must be aware of in dealing with computer professionals. Apparently, non-professionals require a different set of criteria.

IMPACT OF INFORMATION TECHNOLOGY ON ORGANIZATIONS

In this section, we discuss the impact of information technology on organizations as units. This is examined from the power structure and the organizational structure points of view.

The Intraorganizational Power of Information Systems Departments

The theory of strategic contingencies (Hickson, Hinings, Lee, Schneck and Pennings [17]) states that the intraorganizational power of a department is based on the ability of this department to deal with actual or potential organizational problems and is derived from the combination of its ability to cope with uncertainty, substitutability and centrality. According to this theory, the information systems department in an organization should be perceived as possessing intraorganizational power for the following reasons (Lucas [28]):

- (i) the development of computer-based information systems in an organization has created operational uncertainty which can only be sorted out by the information systems department;
- (ii) information systems are normally documented poorly partly due to projects running behind schedule and partly due to the unwillingness/inability of systems developers to document them, thus making other users critically dependent on the information systems department; and
- (iii) information systems are developed and built to service other departments and the degree of pervasiveness is normally very high, making its impact on other departments immediately felt should an information system fail.

In a survey, using a questionnaire, conducted by Lucas [28] on 136 managers in the domestic manufacturing plants of three large multinational corporations (industrial containers, electronic equipment, and chemical manufacturers), the information systems departments were found to rank at one of the lowest levels, together with the accounting departments, in terms of intraorganizational power. In contrast, the production and marketing departments were perceived to have the highest levels of power. This somewhat surprising result was subsequently confirmed by Saunders and Scamell [39] in a separate survey of 20 department heads in four companies (oil tool manufacturers and oil distributors).

An explanation of the deviation is in order. A close examination reveals that most of the information systems departments surveyed by Lucas [28] and Saunders and Scamell [39] were performing typical data processing operations which automated routine and clerical tasks for cost reduction purposes. Hardly any of the departments in question were involved in strategic planning or high-level decision making. In other words, they did not involve themselves in formulating the missions of organizations. The results perhaps point to a crucial omission from the theory of strategic contingencies—namely, the survival factor of an organization. Furthermore, the development of end user computing also gradually reduces the intraorganizational power of the information systems department as end users become less dependent on them to access databases.

The Influence of Information Systems on Organization Structures

Once information technology is introduced into an organization, some changes will result. But will computer-based information systems ever alter organizational structures? Some authors argue that information systems cause centralization since accurate information becomes readily available to top management. Others contend that current computer systems take over only routine decision making at the lower and middle levels of management, and thus increase the capacity of managers at these levels to make less routine decisions. The result, of course, is increased decentralization (Otway and Peltu [32]).

In order to answer the above question, Robey [37] and his coworkers surveyed eight organizations in five countries. Their finding was that computers were used in organizations to decentralize decision making without causing loss of control over the entire operation. In other words, computers entailed delegation of more routine decision making to lower levels without causing top management to lose power. Evidently computer-based information systems are being used as tools for achieving better bureaucratic control.

Moreover, Robey found that computer-based information systems had not changed organizational structures; instead, they reinforced them. This is expected, as the traditional approach to systems design is to automate routine operations rather than introduce radical changes to an organization. A similar conclusion was also reached by Carter [8].

Other aspects of organizational changes were studied by Keen [24]. He identified four main causes of the social inertia that resists the implementation of computer-based information systems in organizations:

- (i) information is only related to a small component of decision making processes in organizations;
- (ii) human information processing relies on simplification;
- (iii) organizations are complex, and only incremental and evolutionary changes are possible; and

- (iv) information is not only an intellectual commodity, but also a political resource.

Clearly, the implementation of a computer-based information system should be evaluated from the technical and organizational points of view as well as from the political point of view. Many computer professionals seem to ignore the political aspects of life, thus rendering technically successful information systems liable to failure.

IMPACT OF INFORMATION TECHNOLOGY ON SOCIETIES

The innovations of telecommunication technology — such as text and image transmission — have made teleconferencing possible, and have also made working at home or at a neighborhood work center a possibility. Some authors have speculated about possible improvements to the so-called quality of working life following the adoption of working at home since transportation, time spent on transportation, petrol consumption and air pollution can be reduced and minimized (Shamir and Salomon [41]). But field surveys and supporting data have been scarce. Furthermore, in discussing working at home, it is important to distinguish between compulsory working at home, voluntary working at home, and flexiplace (similar to flexitime) options since they have different impacts on individuals, homes and organizations. In the case of compulsory working at home, some degradation of the quality of working life may occur. For example, professional peer interaction may be lacking, job satisfaction may be reduced to less skill-variety and task meaningfulness, insufficient feedback due to lack of informal and non-verbal information, fewer opportunities for social relationships, role conflicts in work and home duties, lack of social and peer group support, and lack of work group identity. In the case of voluntary working at home and flexiplace, such negative impact may be minimized or eliminated, so although working at home may create employment opportunities for the physically handicapped and single parents with young children, its impact on the quality of working life may be negative. More detailed studies are obviously needed.

Apart from working at home, another possibility is a neighborhood work center whereby people living nearby can come and work together for several organizations that share office space or a building. Communication with parent organizations, which are far away and unrelated to each other, may be made through telephone or computer networks. It is thought that a neighborhood work center is better than working at home since individuals working for different organizations are brought together at one place hence social contact across occupations, job levels, and organizational boundaries is possible. However, in an experiment on a neighborhood work center conducted over a two-year period, the preliminary results were not optimistic (Becker [5]). The causes of failure are many, such as social isolation due to the lack of peer groups and underutilization of facilities. On the whole, the experimental neighborhood work center lacked vitality and a sense of life, and there was a lack of clear organizational culture for supporting the distinctive social and organizational concepts of the center.

This raises the question as to why do people go to work at all. Besides the monetary rewards, some of the key reasons why people go to work are to overcome social isolation through wider social contact and interaction with peers, to make sense of life, and to achieve personal growth. Working at home, the

neighborhood work center and such likes do not seem to support individual needs in other latent functions of work. Furthermore, they undermine the organizational climate and culture necessary to preserve organizational and individual identity.

CONCLUDING REMARKS

In this paper, we have provided the reader with a critical review of the impact of information technology on organizations as reported in the literature. The organizational impact of information technology has been discussed at four different levels—namely, individuals, groups, organizations, and societies—in order not to lose sight of the trees or the forest. The issues discussed include ergonomics, stress, job satisfaction, attitudes, industrial relations, leadership, power, politics, decision making, organizational structures, organizational changes, quality of working life, working at home, and neighborhood work centers.

In recent years, organizations have been adopting strategic systems planning of information technology in order to achieve competitive advantages (Ives and Learmonth [21]). As a consequence, more and more advanced information technologies will be introduced into organizations, and the organizational impact will be increasingly felt. As information technology increasingly affects one's working life, it is important to come to grips with its impact as early as one can so that avoidable pitfalls can be avoided. For example, knowledge of the political aspects of computer-based information systems will naturally suggest the participative approach to systems design (Mumford [31]) so that all affected parties can thrash out their differences at an early stage of system development rather than try to resist its implementation later. At present, there are not enough field surveys and data to analyze the full impact of information technology on organizations, partly due to the non-transferability of some survey results. As they stand now, existing survey results are incomplete, fragmented, contradictory, and inconclusive. Nevertheless, this critical review has charted at least a picture which points to some directions along which more comprehensive surveys should be pursued in the future.

The consequentialist approach (Klein and Hirschheim [25], Hirschheim [18]) is a way of assessing the possible organizational impact of information technology. However, for a more accurate measure, a contingency approach is more appropriate because one should take into account the organizational culture and climate as well as the internal politics.

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