

## **Application of Information Technology to Improve Productivity in Thai Manufacturing Industry**

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### **Introduction**

Productivity growth is essential to rising living standards in any country--from the most highly developed to the least developed. In the effort to improve their productive efficiency, business organizations in developed and developing countries have adopted various forms of advanced information technology (IT).

For the purpose of this study, IT means the application of modern computer technology to the input, storage, processing, retrieval, and transmission of information. A specific system of hardware and software designed for this purpose is a computer-based information system (CBIS). A widely-known classification (Laudon and Laudon, 1991) of CBIS adopted here, is into (a) Transaction Processing Systems (TPS), (b) Office Automation Systems (OAS), (c) Management Information Systems (MIS), (d) Decision Support Systems (DSS), and (e) Executive Support Systems (ESS).

Of these systems, TPS and OAS provide for the automated, and much more timely and efficient, performance of tasks which have long been accepted as those of the office worker. On the other hand, MIS, DSS, and ESS, in increasing order of sophistication, are designed to apply IT in support of managerial planning, and decision making. It is on the basis of this distinction that a firm that had installed a MIS, and possibly more advanced systems, was for the purpose of this study regarded as a "significant" user of IT, as elaborated below.

Has the introduction of IT improved productivity in those Thai business organizations, specifically manufacturing corporations, that have adopted

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it? It is generally believed that the introduction of advanced IT will greatly enhance organizational efficiency and hence increase productivity in the long run (Stonier, 1983). If further research findings justify this belief, Thai business organizations would be wise to introduce such technology, and the Thai Government might consider what incentives are possible to promote adoption of advanced IT in Thailand. Such findings might themselves provide some guidance towards government policy in assisting firms to adopt IT; and towards firms themselves when making decisions as to when and in what form to adopt IT, to ensure that they are getting the best return on a substantial financial investment.

Though there is much managerial interest in enhancing productivity, the effect of IT has hardly been considered. The specific purposes of this study were therefore

1. To investigate how, in contemporary Thai manufacturing corporations, the introduction of modern computerized IT has affected productivity.
2. To provide some guidelines towards government policy in assisting and encouraging firms in the manufacturing sector to adopt IT.
3. To test the hypotheses:

H<sub>1</sub> Research hypothesis (H<sub>1</sub>): The rate of increase of productivity in Thai companies significantly applying information technology is greater than those companies not significantly applying information technology.

Null hypothesis (H<sub>0</sub>): The rate of increase of productivity in Thai companies significantly applying information technology is the same as in those companies not significantly applying information technology.

H<sub>2</sub> Research hypothesis (H<sub>2</sub>): The rate of increase of productivity at a time after introduction of information technology is greater than at a time before introduction of information technology.

Null hypothesis (H<sub>0</sub>): The rate of increase of productivity at a time after introduction of information technology is the same as at a time before introduction of information technology.

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## **Background to the Study**

Significant computer use by the private sector in Thailand began only in 1980 (Chaipanth, 1991). Over the years up to 1990 application of personal computers by private enterprise grew at the rate of 20-30% per year.

Boonmark (1990) surveyed the use of microcomputers among small trading and service corporations. The major applications were in accounts, finance and marketing and in database management. MIS were coming into use quite widely, allowing increased speed of access to data more appropriate to the user's requirements.

The state of the personal computer (PC) market in Thailand was surveyed by Kananurak (1993). Total sales in 1995 were 269,994 units, valued at US\$ 568.14 million. These comprised 90.27% desktop PCs, 7.30% portables, and 2.43% classified as PC servers, designed to meet the needs of more than one user. This represented an increase over the previous year of 42.33% in unit sales and 62.66% in value. Prices were falling, including those of Pentium based PCs, which have now become standard. The maximum future growth rate was forecast for PC servers, sought by companies that see data collection as the key to competitiveness in a globalized age; and for the increasingly lighter and more versatile portables.

Productivity and profitability are the factors that decide the survival and growth of an organization or an economy. Basic definitions of productivity have been reviewed by Edosomwan (1995: 2-5; see also Alexander Hamilton Institute, 1977: 1-5; Dewitt, 1990; Kendrick and Creamer, 1965; Mundel, 1983). In common to all these definitions, is the idea of productivity as a ratio of output to input of resources, measures of output and input appropriate to the situation under study having been decided.

Productivity ratios were applied to measurement of overall national productivity for a variety of Asian countries in papers presented at an APO symposium in 1979 (Asian Productivity Organization [APO], 1979). Mundel (1986) studied productivity in manufacturing firms in five Asian countries: the Republic of China, India, Indonesia, the Philippines, and Singapore. Total factor productivity, using formulae incorporating labor, physical capital, and real intermediates into the input, was applied to a study of industrial growth in Thailand by Wiboonchutikula (1987).

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Data on national productivity for Thailand have been given by Khunponkaew (1996). In Thailand, industry is still relatively labor intensive, as compared with the US, Japan, Singapore or Europe, and labor productivity, defined as annual gross domestic product per worker, is higher than that of the United States, Japan or Singapore. Thailand's productivity situation is in this respect favorable. However, as the country moves towards further development, industry will become less labor intensive and more capital intensive.

Until recently, little attention had been given to the effect of IT on productivity. In a opinion survey on organizational culture carried out in 1989 by Swierczek, among mostly Thai managers, only 1.8% attached even minimal importance to technology. Participants viewed office technology as an advanced typewriter or filing system. They did, however, show a very high concern for human resource management, that Strassmann (1985: 181-219) considers essential if computerized IT is to be developed to the maximum advantage.

Concern for enhanced productivity in Thailand has in fact so far stressed human resource development (Phornprapha, 1992; Thadasi, 1988: 10-22; Tansuvan and Saeng-Xuto, 1992; Watakeekul, 1992). This is confirmed by a survey carried out in 1992 (Thailand Management Development and Productivity Center [TMDPC], 1992) among 93 owners and top management, and 529 supervisors and workers, of a random sample of companies. The survey revealed a widespread, though rather superficial, awareness of the importance of productivity. Thus 91.4% of owners/managers considered productivity increase to be the most important of managerial functions. Productivity programs emphasized various techniques from Japanese management and the importance of gain sharing as a means to motivate employees.

Though there has been widespread adoption of computerized IT by organizations in Thailand, the consequences for productivity remain a wide open field for research.

With the publication by Choi, Subramanian, Lee and Kim (1989) of the results of a survey undertaken by the APO under the project title "Productivity Through People in an Age of Changing Technology," we come to a study of the effects of introduction of computerized IT in, mostly developing, Asian countries. In the case of Thai enterprises, along the factors motivating the choice of technology was the hope--often realized in practice--that advanced technology would enhance efficiency and productivity. Of the authors' six case studies in

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Thailand, all firms investigated claimed gains economically, in customer services, and most significantly, in increased productivity. Quantitative data on productivity increase were not however given.

The study found Thailand receptive to change and innovation, and the authors concluded that Thai cultural values tend to aid the first phases of technological change. Thailand has been described as having a "loosely structured" social system (Embree, 1950). It is a relatively open society that emphasizes individualism. Such a society may appear to lack discipline, but it possesses values that are able to maintain continuity while adjusting itself to changing circumstances. These features of Thai social structure are likely to affect management style and the relationship of the executive with other members of the organization. There is a respect for independence and freedom; and at the same time a respect for seniority which tends to lead to a hierarchical command structure. Organizational norms and efficiency depend much on who leads the organization. Organizational behavior is concerned with promoting good relationships among persons in the organization.

The study found that employees generally accepted directives from top management without comment, and felt secure in their jobs so long as they performed satisfactorily. Employees who temporarily became idle during computerization were willing to be patient until they could be relocated to other branches of the firm. None of the firms laid off employees during the process of change. Each took pains to train and develop personnel, who thus perceived that they had gained new skills and came to feel that they were more valuable.

## **Research Methodology**

The methodology was designed to compare productivity of Thai companies which had, and those which had not, installed, and were actively using, a CBIS at the level of sophistication of a MIS. It further investigated the current extent of use of CBIS and the opinions of respondents towards the consequences of such use.

For this purpose the investigator

1. Selected as the target population Thai manufacturing companies established before 1988, with head offices located in the Bangkok Metropolitan Area, and listed in the current volumes of Thailand Company Information 1995-

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Then

$$\text{Productivity} = \text{Real Output/Real Input}$$

and

$$\begin{aligned} \text{Annual productivity increase} \\ &= \frac{P_x - P_{x-1}}{P_{x-1}} \times 100 \end{aligned}$$

where  $P_x$  = Productivity for year X

and  $P_{x-1}$  = Productivity for year X-1.

The average annual productivity increases, over each three year period, before and after IT introduction, for each company, were taken as the figures for statistical analysis.

In making the comparison between significant and less than significant users of IT, where the statistical distribution followed by observed values of annual productivity increase is unknown, nonparametric tests are in order, and moreover would be preferred in view of the small sample size (Mendenhall and Reinmuth, 1982: chap. 17; Watson, Billingsley, Croft, and Huntsberger, 1993: chap. 18).

The Mann-Whitney U test was chosen to compare data between the two groups of significant and less than significant users of IT. The Wilcoxon Matched-pairs Signed Ranks test was used to compare the paired sets of productivity data for each company before and after introducing IT. Descriptive statistical analysis was employed to report and compare opinions as to productivity trends, and IT usage, by company personnel. A significance level of 0.05 was accepted.

To calculate and analyse data, the investigator used the Statistical Package Program for Social Science (SPSS/PC+). The Excel spreadsheet was employed to tabulate financial data and calculate annual percentage productivity increase.

## **FINDINGS FROM THE STUDY**

### **Comparison Between Significant and Less than Significant Users of IT**

Scores comparing the rate of increase of productivity, as between the two types of company, that is significant users of IT (MIS used), and less than

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significant users of IT (MIS not used), calculated according to the Mann-Whitney U test, are given in Table 1,

**Table 1**  
**Rate of increase of productivity:**  
**Comparison between significant and less than significant users of IT**

Type of company	Mean rank	
	Before IT	After IT
Significant users (MIS used)	33.57	41.07
Less than significant users (MIS not used)	27.43	19.93
Mann-Whitney U test	358.0	133.0
$Z_{cal}$	-1.3604	-4.6867
One-Tailed P	0.0809	0.0000
	$P > .05$	$(P^* < .05)$

Not surprisingly, before installation of IT, the rates of increase of productivity for the companies using MIS and the companies not using MIS were not significantly different ( $P > .05$ ). However, after installation of IT, the difference between the rates of increase of productivity for the two sets of companies, 30 companies using MIS and 30 companies not using MIS, was large enough to be significant ( $P^* < .05$ ). It can be seen that companies using MIS had increased their productivity more so than companies not using MIS.

Thus, for Hypothesis  $H_1 : H_0$  was rejected while  $H_1$  was accepted.

#### **Comparison Between Periods Before and After Installation of IT**

Scores comparing the rates of increase of productivity, as between the two periods of use, that is before and after installation of IT, calculated according to the Wilcoxon Matched-pairs Signed Ranks test, are given in Table 2.

**Table 2**  
**Rate of increase of productivity: Comparison**  
**between periods before and after use of IT**

Type of company	Mean rank	
	After IT used < Before IT used (-)	After IT used > Before IT used (+)
Significant users (MIS used) (30 companies)	10.70	17.90
	Ranks - = 10 cases, Ranks + = 20 cases. $Z_{cal} = -2.5813$ , One - Tailed $P = 0.0049$ $P^* < .05$	
Less than significant users (MIS not used) (30 companies)	20.00	11.56
	Ranks - = 14 cases, Ranks + = 16 cases. $Z_{cal} = -0.9770$ , One - Tailed $P = 0.1643$ $P^* > .05$	

It was found that, for those companies that were significant users of IT, that is had installed MIS, the rate of increase of productivity after installation of IT was significantly greater than that before installation of IT ( $P^* < .05$ ). For companies employing only TPS and OAS, the rates of increase of productivity, for three years before and three years after installation of IT, did not differ significantly ( $P > .05$ ).

Thus, for Hypothesis  $H_2 : H_0$  was rejected while  $H_2$  was accepted.

### **Application of IT by Thai Companies**

Responses to the question "Please state type(s) of IT system(s) installed and first year of active use?" were as in Table 3 and Table 4 respectively.

**Table 3**  
**Type of IT system installed**

Type of IT system installed	Number N = 60	Percent 100.0
- TPS	60	100.0
- OAS	60	100.0
- MIS	30	50.0
- DSS	12	20.0
- ESS	7	11.7

**Table 4**  
**Type of IT system and the first year of active use**

Type of IT system installed	1980 to 1984 N = 8 (%)	1985 to 1989 N = 22 (%)	1990 to 1994 N = 30 (%)	Total N = 60 (%)
- TPS	8 (13.3)	22 (36.7)	30 (50.0)	60 (100)
- OAS	8 (13.3)	22 (36.0)	30 (50.0)	60 (100)
- MIS	- (-)	10 (45.5)	20 (66.7)	30 (50)
- DSS	- (-)	2 (9.1)	10 (33.3)	12 (20)
- ESS	- (-)	2 (9.1)	5 (16.7)	7 (11.70)

The tables list numbers and percentages of the respondents in the sample companies. All respondents stating that they used DSS or ESS were also users of MIS. The period 1980 to 1984 was the earliest period for import of IT systems into Thailand, 1980 being the year in which IBM introduced personal computers, from which time on application began to increase in both the public and the private sectors (Malaivongs, 1995: 23-24). Companies which had installed TPS or OAS in this earliest period were found to have the status of joint ventures.

All had mother companies abroad. Corporations using DSS were also foreign joint venture companies.

Responses to the question "Does your company already employ a person operating a management information system (MIS)?" were used to determine companies which were significant users of IT. The sample comprised 30, or 50% employing, and 30, or 50% not employing, MIS personnel.

### **Opinions of Respondents on Productivity**

Replies to the question "In your opinion, has the introduction of IT increased productivity, decreased productivity, or had no effect? were of interest, as shown in Table 5.

**Table 5**  
**The effect of IT introduction and use on productivity**

The effect of IT introduction and use	Number N = 60	Percent 100.0
Increase	47	69
Decrease	0	0
No effect	21	31

*Note:* The number of respondents (68) who gave opinions on productivity was higher than the number (60) of those who gave company facts and data.

Replies to the question "If there has been an increase in productivity since introducing your latest IT system(s), by what percentage would you estimate that productivity has increased as an annual average?" were as in Table 6.

**Table 6**  
**Increase in productivity since introduction of most recent system**

Percentage productivity increase	Number N = 44	Percentage of respondents
10 %	13	29.6
15 %	1	2.3
20 %	21	47.7
30 %	4	9.1
40 %	1	2.3
50 %	2	4.5
80 %	2	4.5

*Note:* For this question, there were only 44 respondents who gave an opinion. The remaining 22 respondents did not answer the question. When contacted by telephone to request further explanation, reasons given for no reply were (a) they could not make an estimate, because their companies did not use a productivity ratio to measure business performance; or (b) they did not clearly understand the formulae to measure productivity.

Clearly, most respondents had a positive opinion towards productivity increase.

Replies to the question "How would you view recent trends in your company's productivity? In your opinion, has your productivity increased, decreased or not changed significantly?" were as in Table 7.

**Table 7**  
**Respondents' views on recent trends in company productivity**

Recent trend in productivity	Number N = 68	Percent
Increase	50	73.5
Decrease	2	2.9
No change	16	23.5

Again the replies suggested that most respondents' expectations for productivity in the near future were positive.

In summary, for both pairs of hypotheses, the results justified rejecting the null hypothesis. Hypothesis 1, H<sub>1</sub> and Hypothesis 2, H<sub>2</sub> were supported by the data. We may conclude that, for this sample of manufacturing firms, productivity as measured by the ratio of revenue to costs of production increased significantly only among those companies that had installed MIS. This seems to be in agreement with previous studies (Arndt and Bauton, 1978; Lawrence, 1984; Leamer, 1984; Maskus, 1983) that have suggested that organizational performance is related to the level of technology employed. Growth in productivity will be greater in those organizations that attempt to exploit the full capabilities of advanced IT than in those that make only elementary use of this technology.

The results confirm the earlier, qualitative case study findings (Choi, Subramanian, Lee, and Kim, 1989) that reported gains in productivity by Thai organizations adopting IT.

They are also in agreement with the subjective assessment by informants that their firms' productivity had increased following the introduction of IT. Of the survey sample, 69% considered that productivity had increased following the introduction of IT--when an estimate of the percentage increase was given, this was usually in the range 10-20%. In general, respondents had an optimistic view of their companies' productivity trends.

All corporations in the survey sample had introduced computerized TPS and OAS systems. The use of MIS was becoming well established. DSS and ESS were coming into use, though still by only a few corporations.

## CONCLUSIONS AND RECOMMENDATIONS

### Conclusions from the Study

It was concluded that the active use of a MIS has a statistically significant positive effect on the rate of increase of productivity. By "active" use of the system, it is understood that the system is not merely installed, but that qualified personnel are employed to use the system in the course of the company's business. Over the period of the survey, companies that had introduced MIS were enjoying a higher rate of productivity increase than were those that made more elementary use of IT. The effect was found for a limited sample, but should be generalizable to the total population of manufacturing corporations in Thailand.

The basic conclusion of the study is diagrammed in Figure 1.

**Figure 1**  
**The relationship between MIS use and period of active IT use**

		PERIOD OF ACTIVE USE	
		Before	After
MIS USE	Companies not using MIS	Productivity effect: no significant increase.	Productivity effect: no significant increase.
	Companies using MIS	Productivity effect: no significant increase.	Productivity effect: positive and significant increase.

The investigator considered four types of company situation:

1. Not using MIS, before active use of IT. Productivity effect: not significant.
2. Not using MIS, after active use of IT. Productivity effect: not significant.
3. Using MIS, before active use of IT. Productivity effect: not significant.
4. Using MIS, after active use of IT. Productivity effect: positive and significant.

The above scheme expresses a proposed theoretical model which is suggested for further research and application. It is believed that in the near future it may be developed into a definitive theory of application of IT for improved productivity.

It is surprising that IT usage did not begin to make its impact on productivity until it reached at least the level of sophistication of a MIS. The absence of an appreciable effect from TPS or OAS was unexpected. The superiority of MIS requires an explanation.

One reason for the lack of any significant effect of TPS and OAS on productivity may be that these systems are being used merely to automate existing, routine office practice. We may recall Swierczek's 1989 study finding that many managerial personnel at the time regarded an OAS only as an advanced typewriter or filing system. Similarly a TPS might be regarded merely as a means of recording data for accounting purposes. As pointed out by Hammer and Champy (1993: 82-83), such use of technology may actually have a negative effect, in reinforcing out-of-date procedures. Moreover, such applications are allotted to nonmanagerial personnel, not concerned with decision making. There is a gap between IT personnel and management.

On the contrary, a decision to install a MIS involves a definite commitment to apply the full capabilities of IT to managerial planning. Whereas TPS and OAS are employed at the input and output stages of the system process, a MIS functions at the transformation stage, the conversion of data into information that is of value to management.

In the view of Rene T. Domingo (1991) true productivity increase is achieved by minimizing the input to achieve the desired output. The desired output

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is determined by the market: It is the quality and quantity of product the customer wishes to buy, delivered at the right time. The question then becomes: How does IT contribute to optimum use of the resources, material and human, available? That it does so is consistent with a survey carried out in 1990 by Chaipanth (1991), who noted a progression in management style in response to IT, emphasis shifting towards increased planning and control for more efficient use of resources.

The studies of Choi, Subramanian, Lee and Kim (1987) found among factors motivating the introduction of IT: (a) a move towards greater capital investment and automation, that is to replace investment in labor by investment in IT and equipment, and (b) a need to conserve energy, energy consumption being a major factor in production costs. The use of IT enabled increased speed and efficiency of access to information for management and administration, in support of production planning, marketing and inventory control; and increased speed and efficiency of customer service. A consideration of these cases suggests that IT enhanced productivity by enabling more economic use of both labor and time inputs.

One of the commonest reasons given for the introduction of IT is in fact that it will enhance productivity by enabling reduced labor input. Indeed reduction of staff has been the motivation of many firms to introduce computerized technology. This is the basis of the fear, often expressed, that automation will lead to unemployment. There is however no general consensus on what the long-term effects of IT on employment will be (Forester, 1987). In the case of Thailand, it does not appear that unemployment as a result of computerization is likely to be a problem in the near future. The problem will rather be one of shortage of qualified personnel, which can only be forestalled by greatly increased government and private investment in education and technological training, including training in IT.

The case studies cited above suggest that viable companies can retrain and relocate, rather than lay off, employees during the process of computerization. Any reduction is likely to be at the level of decreased recruitment. At the same time, enhanced efficiency and competitiveness could allow expansion and increased demand for qualified personnel. It seems probable that--at least where massive population pressure is not a problem--full employment can be maintained during the transition from low skilled, labor-intensive to high value-added, knowledge-based industries.

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For the individual firm, however, it is clearly the case that the introduction of IT, both at the management and production levels, makes possible sustained or increased output from a greatly reduced input of labor.

Secondly, IT enhances productivity through increased speed and efficiency. The ways in which CBIS and automation enable access to and management of information and its application to managerial decision making are discussed by Senn (1995: 220-249, 480-525). Views of informants in the present study, when asked how IT served to improve productivity within their own companies may be summarized as follows:

1. IT enables more efficient use of time.
2. IT reduces the incidence of human errors. A company using IT will make fewer mistakes.
3. IT promotes competitiveness.
4. IT leads to more efficient and accurate decision making.
5. IT extends human skills and efficiency.
6. IT enhances the versatility and effectiveness of automated manufacturing equipment.

### **Recommendations for Improved Productivity**

There is sufficient evidence of the positive effect of IT on productivity to justify increased private and public investment in IT and for increased government support for such investment. This should be accompanied by efforts to promote managerial awareness of IT and its applications.

The immediate implication of this study is straightforward: A company that has not yet incorporated IT into its operations should do so. Moreover, a management considering the introduction of IT should not limit its initial investment to elementary applications, TPS and OAS alone, but should invest at least in MIS and should seriously consider investment in more advanced systems, DSS and ESS.

At the same time, a management considering the introduction of IT with a view to improved productivity must keep in mind that IT cannot be considered in isolation if the goal is to be met. Where companies that have introduced IT fail to achieve a higher productivity, the fault lies not with the technology, but with the failure of management to utilize it effectively.

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The use of IT must be innovative to be effective. Like every major development in management technique, from scientific management onwards, IT demands that the company and its work processes be reorganized to take maximum advantage of the new technique. Employees and management at all levels must be involved. It is failure to realize this fact that is, according to Magnet (1995), the reason why, in the developed countries, though computers first came into use some 40 years ago, it is only now--after a spate of reengineering--that the payoff in increased productivity is beginning to be seen.

Reorganization will include training of employees in the use of IT, and motivation of employees to adjust to a changed and changing environment. The TMDPC (1992) survey stressed the importance of education to strengthen labor-management relations, and of gain sharing to motivate employees. Without fair distribution of productivity gains reflected in remunerations and other incentives, the company cannot expect cooperation from employees in work improvement and productivity increase.

Moreover, IT should not be considered in isolation from all the other factors which go to determine productivity, profitability and competitiveness. IT has not rendered the insights of the past redundant. IT must be integrated into an overall scheme of productivity management. If so integrated, IT has the potential to become a very powerful tool. A company utilizing advanced IT has access to more accurate, up-to-date and timely information. It can work more quickly, important when many companies are now competing on time. When many suppliers are able to supply products and services of equal quality, at economical prices, it is the one that can deliver fastest that has competitive advantage.

Advanced IT enables managers to make faster, more accurate decisions--their own decisions, in which they can be confident. A company has its own, internal means of access to worldwide information on sources, market trends, and changes in the financial, social, and political environment relevant to its business. It no longer has to rely, as in the past, on external informants and consultants. IT is a means by which the organization may know itself, know its competitors, and know its environment.

A customer no longer needs to wait, as in the past. The company on receiving a customer's enquiry, can immediately locate and arrange to deliver the required products--it need not, by delay, lose the chance of business. This is one impact of IT on productivity.

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Mosley, Pietri, and Megginson (1996: 520-521) point to a number of emerging trends in the use of CBIS in business. While computer power is increasing, users are becoming more skilled. There is increasing awareness among managers of the decision making potential of systems such as MIS or DSS. Significantly, IT personnel are becoming more oriented towards the needs of the customers they serve. Increasingly, the systems are being seen as a major way to improve productivity and quality--and technology is becoming geared towards integration, linkage, and interfacing,

The development of modern IT is effecting far more profound changes than the introduction of CBIS to assist management within the boundaries of the firm. Organizations are becoming in a very real sense "open systems."

Malone, Yates, and Benjamin (1994) argue that IT is shifting the flow of goods and services away from control by the managerial hierarchy and its decisions, to control by the market. The customer can easily access and evaluate information on a variety of potential suppliers. Suppliers can make complex product information available to a varied population of potential buyers. Electronic connections, within and between organizations, that reduce the costs of coordination, are becoming increasingly important.

A new management style, based on global communication and access to information, is likely to emerge (Schein, 1994). The information superhighway has been built. More and more, people are, for instance, talking of "doing business on the Internet" (Cronin, 1995). Over the past few years, this formerly academic network has become one of the fastest growing media through which businesses can share information.

IT is making it possible for a company of any size, small as well as large, to be competitive in the global business arena. If we may coin a phrase, the new management style may be called the "superhighway management style."

In view of the clear evidence, as illustrated by this study, that expanded use of IT is essential to organizational growth and increased productivity, managers of Thai corporations are urged to adopt the new style. Only then can they maintain their position in the changing, uncertain, but we may be sure intensely competitive, business arena, as the world enters the 21st century.

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