Office Productivity: The Impacts of Staffing, Intellectual Specialization and Technology

PETER G. SASSONE

ABSTRACT *This paper reports on a series of 20 case studies of office productivity and office technology in major US corporations. The case studies were carried out between the mid-1980s and the early 1990s, and involved over 1700 employees in 95 distinct offices. These studies were shaped by a new conceptual model of the office which focuses on the intellectual content, rather than the physical attributes, of office work. Our major finding is a significant lack of intellectual specialization among managers and professionals. That is, managers and professionals devote a relatively small fraction of their work time to management and professional level work, and a relatively large fraction of their time to support and non-productive tasks. In addition, we found significant staffing imbalances throughout our cases: in nearly every office, there were more managers and professionals, and fewer support workers, than were required to perform the work cost-effectively. Our analysis suggests that a typical organization could reduce its annual office payroll costs by 15% by recalibrating its staffing mix and increasing the intellectual specialization of its office workers. Further, we find that the apparent failure of massive corporate investments in office technology to achieve commensurate increases in white-collar productivity is likely to be due, in large measure, to reductions in the intellectual specialization of office workers resulting from myopic staffing decisions. The paper offers a specific methodology for measuring and tracking office productivity, for developing a coherent office productivity strategy, and for improving office staffing and technology decisions.*

Introduction

In 1985, we began a series of (what has become) 20 office productivity studies in five major US corporations. The purpose of the initial studies was to perform cost-benefit analyses of computer-based information systems. However, after the first several studies were completed, it became apparent that the data collection and analysis techniques that we had developed were yielding important productivity insights beyond the cost justification of office computer systems. In our data, we were finding a very clear, and largely unrecognized, productivity problem: a lack of intellectual specialization by white-collar workers. That is, we found that managers and professionals were devoting a very substantial amount of work time to tasks which could be done by lower paid employees. And we found correspondingly serious staffing imbalances in those offices studied. That is, given the intellectual content of the entire spectrum of work performed in an office, that same work could always (in our sample of 20 departments) be performed by a lower cost mix of managers, professionals and support staff. On average,

Peter G. Sassone is at the School of Economics, The Ivan Allen College of Management, Policy and International Affairs, Georgia Institute of Technology, Atlanta, GA 30332, USA.

0953-7325/96/030247-23 ©1996 Journals Oxford Ltd

Table 1. Companies studied (comparisons based on 1990 data)

Company	Industry	Sales or revenue (US$ billions)	Assets (US$ billions)	Employees
Company 1	Manufacturing	> 50	> 100	> 500 000
Company 2	Consumer products	5–10	> 10	10 000–25 000
Company 3	Financial services	15–25	> 50	25 000–50 000
Company 4	Commercial banking	Not applicable	> 25	10 000–25 000
Company 5	Electric utility	5–10	15–25	25 000–50 000

Downloaded by [Universitaetsbibliothek Bonn] at 00:40 02 March 2015

we found potential payroll savings of at least 15% in the typical office. To put this in perspective, in many companies an annual saving of 15% of white-collar payroll costs would more than double annual corporate net earnings.

The purpose of this paper is to report our findings, to describe a new office productivity modeling and measurement technique that can be used to identify and overcome the problems of intellectual non-specialization, to explore why intellectual non-specialization occurs, to explore the relationship between office technology and non-specialization, and to present some implications of this work for corporate management.

Study Methodology

Between 1985 and 1994, we studied white-collar work in 20 departments of five major US corporations. Each of these departments represented a separate case study. In total, over 1700 employees in 95 distinct offices in 89 locations throughout the US were involved in these studies. Table 1 describes the five companies. The names of these companies are withheld in order to honor confidentiality agreements. Table 2 describes the 20 departments that we studied.

In each case study, a closed-ended time logging instrument, or 'diary', was developed to capture employee time by the defined tasks and activities. This instrument was tested, revised and refined to eliminate any ambiguities, omissions or other problems. While the diaries were broadly similar in all studies, we developed unique versions specific to each organization studied. In fact, in most cases, we developed versions unique to each level of worker in the organization (for example, omitting management tasks on secretaries' diaries).

This study is novel in several important respects. First, because it is based on a new conceptual model of the office (which focuses on the intellectual content of office work), we were able to collect detailed work content data that are inter-organizationally comparable. This has been a major stumbling block in previous work. Second, by focusing on entire organizational units rather than on isolated individuals, we were able to develop important conclusions about the total volume of work of different intellectual content, the efficiency with which organizations operate and opportunities for significantly improving office productivity. Third, the magnitude of this study (over 1700 individuals in 20 organizations) appears to be significantly greater than that of the previous studies of which we are aware.

Downloaded by [Universitaetsbibiothek Bonn] at 00:40 02 March 2015

Table 2. Departments studied

Company	Type of department	No. of offices	No. of locations	No. of employees
Company 1	Engineering	1	1	476
Company 1	Marketing	1	1	52
Company 1	Accounting	2	2	119
Company 2	Legal	1	1	5
Company 2	Marketing	1	1	104
Company 3	Underwriting	1	1	76
Company 3	Underwriting	1	1	31
Company 3	Underwriting	1	1	67
Company 3	Sales offices	32	32	214
Company 4	Lending offices	11	11	73
Company 4	Corporate banking	1	1	52
Company 4	Corporate banking	1	1	44
Company 4	Corporate banking	1	1	51
Company 4	Cash management	1	1	21
Company 4	International banking	3	1	20
Company 4	International banking	2	1	14
Company 4	Branch banking	16	16	73
Company 4	Branch banking	13	13	72
Company 4	Systems development	1	1	98
Company 5	Treasury	4	1	57
Total	20	95	89	1719

Results

We use the term 'intellectual specialization' to characterize how a manager or professional spends his or her day. Loosely, a manager who spends much of her day doing management level work (work that cannot be delegated downward to non-managers) is intellectually specialized. A senior professional, say an experienced engineer or financial analyst, who spends much of his day doing work which could be done by lesser skilled and lesser paid employees, is intellectually non-specialized. We found intellectual non-specialization to be the dominant characteristic of most organizations.

A very useful concept is the 'work profile matrix'. The matrix shows the office hierarchy down the left side, and across the top are the categories indicating the intellectual content of the work. The office hierarchy is often: managers, senior professionals, junior professionals, technical support workers and administrative support workers. A more or less detailed stratification can also be used, however. The work categories are defined to correspond to the positions in the hierarchy. So, in this example, all tasks in the office would be uniquely classified as management-level work, senior professional-level work, junior professional-level work, technical-support level work, administrative support-level work or non-productive work. The final category (non-productive work) is always included, regardless of the stratification used. In general, tasks are assigned to an intellectual content category based on the lowest level in the hierarchy to which the task may reasonably be delegated. The work profile matrix, then, is actually an abstract model of an office. It can be used to represent a single office or an aggregation of offices.

The aggregated (mean) work profile matrix for our set of offices is shown in Table 3. The major finding is the significant lack of intellectual specialization among managers and professionals. It is interesting to note the clear pattern of intellectual specialization, as measured by the main diagonal of Table 3. Intellectual specialization uniformly decreases as job levels increase. That is, managers spend the least time (29.91%) in work at their position level, while at the other end of the diagonal, administrative support workers spend the most time (81.67%) in work at their level. Senior professionals, junior professionals and technical support workers fall neatly between these extremes. This pattern is so pronounced in most of the individual cases as well as in the aggregated data that it might well be called the 'law of diminishing specialization of office work'.

The bottom row of Table 3 shows the overall distribution of work by its intellectual content. For our sample of 20 departments, about 5% of the work is at management level. Senior- and junior-level professional work each account for about 28% of the total. The sum of technical and administrative support work is about 45% of the total. About 14% of the total is non-productive work. By showing the fundamental structure of an organization's work, the summary row of a work profile matrix is an extremely useful set of statistics. In the next section, we show how these statistics are used to analyze and optimize an organization's staffing structure.

The managers in our study are, of course, the managers of the functional areas listed in Table 2. These managers are all either first-line managers or middle managers (in some larger departments that we studied, there were two or three layers of management). However, the managers in our studies would not be considered senior, executive or corporate management. This distinction is critical. While we did not ask senior managers to complete time logs, we did interview senior managers as part of most case studies. The clear indication from these interviews is that senior managers are more intellectually specialized than lower level managers. That is, they do not perform much work which could be delegated to lower level workers. In most cases, the reason is clear. Senior managers, in general, have adequate staff support. A senior manager usually has more than adequate secretarial support, he or she has priority in marshaling technical support when he or she needs it, and his or her responsibilitics usually do not include doing functional professional work. And, of course, the position enables him or her to delegate work more easily than subordinate managers can. Thus, the law of diminishing specialization seems to apply within functional departments, but not at the corporate management level.

Why do managers and professionals spend substantial portions of their time doing work that is more appropriately done by lesser paid employees? The easy (and almost tautological) answer is that organizations are top heavy: that there are relatively more managers and professionals, and relatively fewer support staff, than are needed to perform the organization's work. Consequently, some of the support work must be performed by managers and professionals.

Why has this staffing imbalance occurred, and why does it apparently persist? Even though this is an economic issue, economic theory provides little insight in addressing this puzzle. This is because conventional economic theory assumes that firms are efficient resource allocators—that firms know how to determine the least costly mix of inputs (different types of labor, in this case), that they do make such determinations and that they act accordingly.[1] Thus, economic theory dismisses, or at least skirts, the problem of firms misallocating resources on a continuing basis.

Based on our observations and our discussions with managers, we can proffer several hypotheses to account for this phenomenon. First, there is the tendency of firms to manage staffing by head count, rather than by payroll. In growing organizations, managers periodically make their case to their superiors for increased head count. Given permission to expand their staff by a given number of employees, the tendency among department managers is to hire additional managers and professionals rather than additional support staff.

Similarly, when business conditions force reductions in staff, those cuts are often

Downloaded by [Universitaetsbibiothek Bonn] at 00:40 02 March 2015

Downloaded by [Universitaetsbibiothek Bonn] at 00:40 02 March 2015

Table 3. Mean work profile matrix ($n = 1719$)

Position in the office hierarchy	No.	Management work (%)	Senior professional work (%)	Junior professional work (%)	Technical support work (%)	Administrative support work (%)	Non-productive work (%)	Sum (%)
Managers	197	29.91	28.91	8.97	3.02	14.46	14.73	100
Senior professionals	550	3.96	41.52	18.07	5.40	18.67	12.38	100
Junior professionals	336	1.52	7.36	51.78	4.72	18.16	16.45	100
Technical support	311	0.08	0.23	5.52	68.44	11.02	14.70	100
Administrative support	325	0.00	0.00	0.77	6.57	81.67	10.99	100
Total	1719	5.07	18.29	18.28	16.74	27.98	13.63	100

planned and executed in terms of head count. The same reasoning leads to management and professional-level workers keeping their jobs; and support workers being released. As a company experiences periodic business cycles, this tendency (of hiring managers and professionals on the upswing, and releasing support workers on the downswing) creates and sustains a top-heavy organizational structure. The tendency is reinforced by the recognition among department managers that their own compensation and the prestige of their departments are both more likely to be enhanced by having relatively more, rather than relatively fewer, managers and professionals in their organizations.

Another cause of top heavy staffing appears to be office information systems. Compared with traditional expenditures on office capital equipment (typewriters, file cabinets and desks), office computer systems are a very significant budget item. Many firms decide to pay for their office information systems by reducing their support staff. The reasoning is simply that computer systems can absorb and eliminate some work, and can increase the efficiency with which some of the remaining work gets done. Thus, fewer support workers are needed. The problem has been that many office computer systems have not delivered on this promise. For numerous reasons, these systems have not yet appreciably improved overall office productivity. Thus, with a diminished support staff, the managers and professionals are forced to perform additional support work. Paradoxically, although office computer systems can unmistakably increase productivity in a limited set of office activities (e.g. typing, filing, creating and distributing forms, spreadsheet analyses, graphics), their indirect and unintended effect on staffing may cause overall organizational productivity to decline. This point is discussed further later.

Another contributor to the problem is the combination of stagnant growth and traditional personnel policy. As concerns about competitiveness have proliferated, companies have attempted to control personnel costs by not hiring additional white-collar workers, and not replacing many who leave. However, routine pay raises and career track promotions move some professional level workers into management level positions, and at least a few support-level workers into professional-level positions. As new duties and responsibilities are defined for these new professionals and managers, who must now draw on a diminished support staff, the effect is to create or exacerbate a top-heavy organizational structure.

The final, and perhaps the most conspicuous, cause of top-heavy organizations is the efficiency drive. As companies strive to cut costs, office support workers are often released in greater proportions than managers and professionals. Numerous rationales are invoked to support this strategy. One line of thinking is that the volume of needed office support work will somehow diminish as the support staff diminishes. Another line of thinking is that support work is less important and less necessary than management and professional work, and that the organization can simply get along with less of it. Another rationale is that managers and professionals, representing substantial investments in training, have high replacement costs; whereas support workers represent little investment and are easily replaced. The net effect, regardless of the rationale, is top-heavy staffing and diminished intellectual specialization.

Top-heavy staffing can persist in an organization because, until now, there has not been a statistically based methodology to confirm its presence, or to measure its extent, or to determine the changes that are needed. The next section describes and illustrates the methodology for analyzing and optimizing staffing structure.

Analysis

What are the costs of this lack of intellectual specialization in white-collar work? While

Downloaded by [Universitaetsbibiothek Bonn] at 00:40 02 March 2015

the data reported here are too narrow to draw sweeping conclusions, some insight into the magnitude of costs (and potential benefits) can be gained by looking at a 'typical' department. Our typical department (represented in Table 4) is staffed very nearly as the average of the 20 departments we studied, and the work profile matrix is also near the mean matrix reported in Table 3. The hours worked per week, weeks worked per year (52 weeks less holidays less vacation less sick days less training days) and loaded annual salaries are representative of our data, although they are not the actual values for any specific case.

Suppose that the work and the jobs in our typical department could be restructured to increase intellectual specialization. That is, suppose managers could spend, say, 50% (instead of 26.88%) of their time in management type work. Suppose that other workers could also increase their intellectual specialization. And suppose that (through improvements in processes, procedures and technology) non-productive time could be reduced to only 5% for all workers.[2] The target work profiles are shown in Table 5. These profiles, while not reflecting the exact time allocation of any specific real organization that we are aware of, are a stylized version of the more intellectually specialized departments in our database (the top quartile). In other words, based on our observations of actual departments, the work profiles in Table 5 are attainable. Let us now examine the financial implications of increased intellectual specialization.

In order to analyze these potential changes, let us explicitly recognize the variables and the constants in our analysis. The constants are the total number of hours of each type of work which must be performed each week. We assume that the totals given at the bottom of Table 5 (i.e. 165 hours/week of management work, 635 hours/week of senior professional work, etc.) represent fixed requirements.[3] We assume that the numbers of employees in each category are variable. That is, because we are changing the work profiles of employees, the optimal number of each type of worker is likely to be different from the baseline numbers of staff.

In order to determine the optimum number of employees at each level, we can formulate and solve the problem using linear programming. Our objective is to find that number of each type of employee which minimizes the total departmental payroll, and at the same time accomplishes the required work.

Let M represent the number of managers, S the number of senior professionals, and J, T and A the numbers of junior professionals, technical support and administrative support people, respectively. We want to minimize:

$$\text{Payroll} = 75\,000M + 60\,000S + 45\,000J + 35\,000T + 25\,000A \tag{1}$$

Subject to the constraints:

$$20M + 2S + 0J + 0T + 0A \geqslant 165 \tag{2}$$

$$10M + 24S + 2J + 0T + 0A \geqslant 635 \tag{3}$$

$$4M + 8S + 28J + 2T + 0A \geqslant 664 \tag{4}$$

$$2M + 2S + 4J + 32T + 2A \geqslant 619 \tag{5}$$

$$2M + 2S + 4J + 4T + 36A \geqslant 1094 \tag{6}$$

$$M, S, J, T, A \geqslant 0 \tag{7}$$

Equation (1) is simply the expression for calculating the department's payroll. Inequalities

Downloaded by [Universitaetsbibliothek Bonn] at 00:40 02 March 2015

Table 4. A typical department

Position in the office hierarchy	No.	Management work (%)	Senior professional work (%)	Junior professional work (%)	Technical support work (%)	Administrative work (%)	Non-productive work (%)	Sum (%)	Hours per week	Weeks per year	Annual loaded salary (US$)
Managers	11	26.88	27.18	14.29	2.39	16.36	12.90	100	40	46	75 000
Senior professionals	28	3.23	42.01	18.13	5.26	19.39	11.98	100	40	46	60 000
Junior professionals	16	1.51	6.79	55.12	4.27	18.28	14.02	100	40	46	45 000
Technical support	18	0.08	0.23	5.52	68.44	11.02	14.70	100	40	46	35 000
Administrative support	18	0.00	0.00	0.82	4.14	84.57	10.46	100	40	46	25 000
Total	91	165*	635*	664*	619*	1094*	462*		3640		4.305 million

Note: *In hours/week.

Downloaded by [Universitaetsbibliothek Bonn] at 00:40 02 March 2015

Downloaded by [Universitaetsbibiothek Bonn] at 00:40 02 March 2015

Table 5. Restructured work profile

Position in the office hierarchy	No.	Management work (%)	Senior professional work (%)	Junior professional work (%)	Technical support work (%)	Administrative work (%)	Non-productive work (%)	Sum (%)	Hours per week	Weeks per year	Annual loaded salary (US$)
Managers		50	25	10	5	5	5	100	40	46	75 000
Senior professionals		5	60	20	5	5	5	100	40	46	60 000
Junior professionals		0	5	70	10	10	5	100	40	46	45 000
Technical support		0	0	5	80	10	5	100	40	46	35 000
Administrative support		0	0	0	5	90	5	100	40	46	25 000
Total (hours/week)		165	635	664	619	1094					

(2) to (6) state that the numbers of managers, senior professionals, etc. must be such that, if they spend their time according to the work profile in Table 5, the necessary weekly hours of management-level work (165 hours), senior professional-level work (635 hours), etc. will be accomplished. Inequality (7) simply states that the solution values of the variables must be non-negative.

The solution to this linear programming problem is: $M = 5.982$, $S = 22.685$, $J = 15.376$, $T = 14.035$ and $A = 25.528$. While the solution values are not integers, in practice these numbers would be rounded up or down to whole persons. However, for the illustrative purposes of some subsequent calculations, we will simply use the fractional values.

The optimized staffing plan indicates that the total number of required employees is 83.6 (versus 91 originally). The total payroll is now US$3 631 000 (versus US$4 305 000 originally). The savings, US$674 000 annually, represent 15.7% of the original payroll. In other words, by trimming non-productive time, by redefining jobs to increase intellectual specialization and by optimizing the staffing mix, our 'typical' department could save 15.7% of its total labor costs and still continue to get the same amount of work accomplished. Another way to look at this result is that there is US$674 000 divided by 91, or about US$7400, of potential annual (not simply one-time) savings per white-collar employee in a typical department. For most firms, annual savings of that magnitude (if realized across most white-collar departments) would represent a very substantial increase in annual profits—more than doubling profits in many cases.

What if the productivity goal in this hypothetical department was to increase output while holding costs constant, rather than to decrease costs while holding output constant? In this case, we could simply scale the previous solution up to the initial level of the payroll. That is, we would scale up M, S, J, T and A by 18.6% so that the payroll reaches US$4 305 000. The solution in this case would be $M = 7.092$, $S = 26.896$, $J = 18.230$, $T = 16.640$ and $A = 30.266$. In other words, by trimming non-productive time, by redefining jobs to increase intellectual specialization and by optimizing the staffing mix, our 'typical' department could increase output (or at least increase all levels of work) by 18.6% without increasing payroll costs.

A New Model of the Office

What factors account for an office's work profile, how does that work profile change as the staffing changes and how are output, productivity and work profiles affected by technology? In this section, we develop a simple model of an office which answers these questions.

Let us adopt the following assumptions. First, assume that there are three types of employees in the office: managers, professionals and support workers. Assume that they number four, 20, and 12 respectively. Second, assume that each hour of management or professional work generates the need for 2 hours of support work. The ratio of required hours of support work to the sum of management and professional work hours is called the support ratio (which is assumed to be 2.00 for this example). Third, assume that managers devote an average of 30% of their time to management-level tasks, that 15% of their time is absorbed by non-productive activities, and that their remaining time is split between professional and support work in the same proportion that professionals' time is split between those two work categories. Fourth, assume that everyone works a 40-hour week, and that professionals and support workers lose an average of 15 and 10% of their time, respectively, to non-productive activities.

Downloaded by [Universitaetsbibiothek Bonn] at 00:40 02 March 2015

Any or all of these assumptions could be modified without materially altering the model. As they stand, they simplify our example while preserving the basic ideas of the model. The work profile matrix can be initially represented as in Table 6.

Notice that the time allocated by managers and professionals to professional and support-level work is represented by the variables $a\%$, $b\%$, $c\%$ and $d\%$. Note also that in the last row of the table, we have defined P as the total number of hours of professional work performed in the office per week, and S as the total number of hours of support work. Because there are four managers and 20 professionals, each of whom works 40 hours/week, the weekly total number of hours of professional level work is $(4 \times 40 \times a\%) + (20 \times 40 \times c\%)$, or $P = 160a\% + 800c\%$. Similarly, $S = (4 \times 40 \times b\%) + (20 \times 40 \times d\%) + (12 \times 40 \times 90\%)$, or $S = 160b\% + 800d\% + 432$.

In what follows, we will develop a new model of the office based on the concepts of the supply and demand for support work. Using this model, we will show that the variables ($a\%$, $b\%$, $c\%$, $d\%$, P and S) have unique equilibrium values which are determined by the intersection of our supply and demand functions.

Because all work hours must add up to 1440 for this office, the supply of support work, denoted as supply(S), is simply the hours not devoted to management, professional or non-productive work. That is,

$$\text{supply}(S) = 1440 - 48 - P - 192 \tag{8}$$

The demand for support work, written demand(S), is determined by the second assumption above: that each hour of management work (48), and each hour of professional work (P), creates a demand for 2 hours of support work. That is,

$$\text{demand}(S) = 2(48 + P) \tag{9}$$

The equilibrium condition is, of course, that the supply of support work must equal the demand for support work, or

$$\text{supply}(S) = \text{demand}(S) \tag{10}$$

or, substituting from (8) and (9):

$$1440 - 48 - P - 192 = 2(48 + P) \tag{11}$$

The solution to this equation is $P = 368$ hours/week. Substituting this value into either the supply or demand equation yields $S = 832$ hours/week.

Note that both the supply of support work and the demand for support work are functions of P, the amount of professional work.[4] The more professional work done, the more support work must be done. However, the more professional work done, the less time there is available (to managers and professionals) to do support work. Thus, the demand for support work is an increasing function of the amount of professional work and the supply of support work is a decreasing function of the amount of professional work. These functions and the resulting equilibrium are graphically illustrated in Figure 1.

Once the equilibrium values of P and S are determined within the model, the equilibrium values of the work profile variables a, b, c and d can also be determined.

Because each row of the work profile matrix must sum to unity, we have

$$30\% + a\% + b\% + 15\% = 100\% \tag{12}$$

$$0\% + c\% + d\% + 15\% = 100\% \tag{13}$$

Downloaded by [Universitaetsbibliothek Bonn] at 06:16 02 March 2015

Downloaded by [Universitaetsbibiothek Bonn] at 00:40 02 March 2015

Table 6. Example work profile matrix

Position in the hierarchy	No.	Management work (%)	Professional work (%)	Support work (%)	Non-productive work (%)	Hours per week	Loaded salary (US$)
Managers	4	30	a	b	15	40	100 000
Professionals	20	0	c	d	15	40	75 000
Support workers	12	0	0	90	10	40	30 000
Total	36	48 h/wk	$P = 160a\% + 800c\%$	$S = 160b\% + 800d\% + 432$	192 h/wk	1440	2 260 000

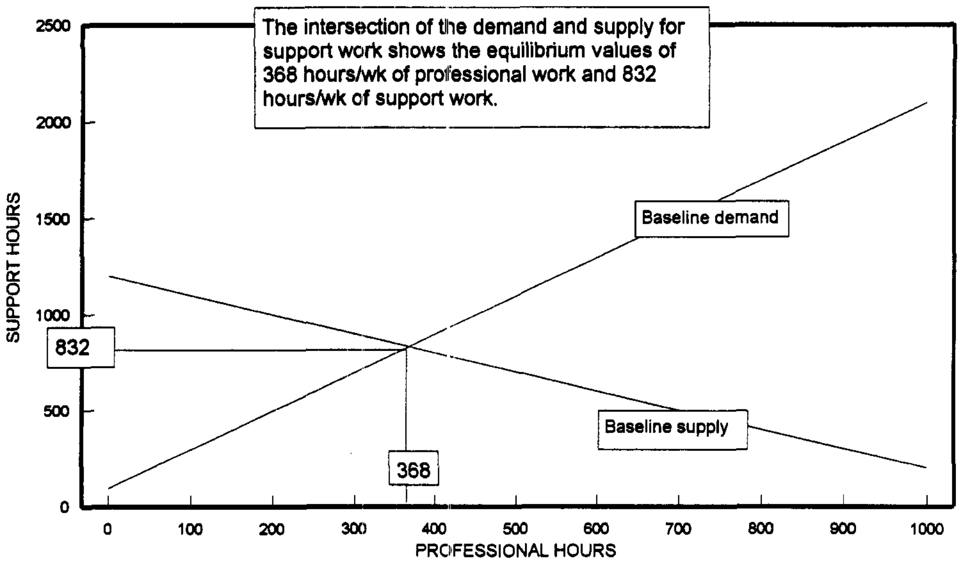

Figure 1. Demand and supply of support hours (baseline case).

According to the third assumption, managers and professionals split their total professional and support time the same way, or

$$a/(a+b) = c/(c+d) \tag{14}$$

We know the equilibrium value of P is 368, so from the last row of Table 6, we have

$$368 = 160a\% + 800c\% \tag{15}$$

Statements (12) to (15) are four independent equations in the four unknown variables $a\%$, $b\%$, $c\%$ and $d\%$. The solution values are $a\% = 26.35\%$, $b\% = 28.65\%$, $c\% = 40.73\%$ and $d\% = 44.27\%$. The equilibrium work profile matrix is shown in Table 7.

It is easy to demonstrate that the equilibrium values of P, S, $a\%$, $b\%$, $c\%$ and $d\%$ vary according to the assumed numbers of managers, professionals and support workers and according to the support ratio.

In the following section, we use this model to shed light on why office productivity appears to be stagnant, even as business investment in office information technology has skyrocketed.

Table 7. Equilibrium work profile matrix

Position in the hierarchy	No.	Management work (%)	Professional work (%)	Support work (%)	Non-productive work (%)	Hours per week	Loaded salary (US$)
Managers	4	30	26.35	28.65	15	40	100 000
Professionals	20	0	40.73	44.27	15	40	75 000
Support workers	12	0	0	90	10	40	30 000
Total	36	48 h/wk	$P = 368$ h/wk	$S = 832$ h/wk	192 h/wk	1440	2 260 000

Technology, Downsizing, Re-engineering and Productivity

Over the past decade, US businesses have invested very many hundreds of billions of dollars in information technology (consider that IBM alone has earned revenues exceeding US$600 billion over the past decade). A significant fraction of that investment involved purchasing, installing, supporting and upgrading office information systems. At the same time, although there are no widely accepted 'official' statistics, it is generally accepted that average office productivity did not improve markedly (or perhaps at all) during that period. What happened? Why was there so little apparent productivity payoff associated with such massive investment?

We can begin to understand these events by identifying and analyzing several common business scenarios:

(a) Some firms, as discussed previously, have attempted to control costs by reducing the number of office support personnel.
(b) Some firms have installed office technology to enhance professional workers (e.g. engineering work stations), and simultaneously reduced the number of support personnel.
(c) Some firms have installed office technology to enhance support personnel (e.g. PCs for word processing), and simultaneously reduced the number of support personnel.
(d) Some firms have installed office technology to enhance professional workers (e.g. engineering work stations), and have left the number of support personnel unchanged.

Each of these scenarios can be analyzed using our model of the supply and demand for office support work. To make the analysis concrete, let us continue using the numerical example introduced in the previous section. Suppose that in each of the first three scenarios, the number of support workers was reduced from the baseline number of 12 to a new value of six. Suppose that in scenarios b and d, the efficiency of professional work is increased by 25%; and that in scenario c, the efficiency of support work is increased by 25%. Efficiency refers simply to output per hour. An increase in the efficiency of, say, professional work by 25% means that 25% more professional work is accomplished per hour devoted to professional work.

Figure 2 shows the effect of decreasing the number of support workers in our example office. The supply (of support work) curve, as defined previously and depicted in Figure 1, shifts downward as shown. The demand for support work remains unchanged. The new equilibrium values of P and S, determined by the intersection of the demand curve and the new supply curve, are 296 hours/week of professional work and 688 hours/week of support work. As expected, the model shows that a decrease in support workers causes the total amount of professional work to decline. The reason is clear from Table 8, which is the corresponding new equilibrium work profile matrix. With fewer support workers, managers and professionals must increase the amount of time that they devote to support work in order to get the department's work done. The amount of professional work (arguably the best measure of the department's output) declines from 368 hours/week to 296, or a reduction of about 20%. The payroll saving associated with the fewer support workers is about 8%.

Figure 3, corresponding to scenario b, shows the effect of increasing by 25% the efficiency with which professional work is accomplished (say through information technology), and simultaneously decreasing the number of support workers from 12 to six (perhaps to recover the cost of the investment in information technology). Because professional work is done by both managers and professionals, the 25% improvement in

Downloaded by [Universitaetsbibliothek Bonn] at 00:40 02 March 2015

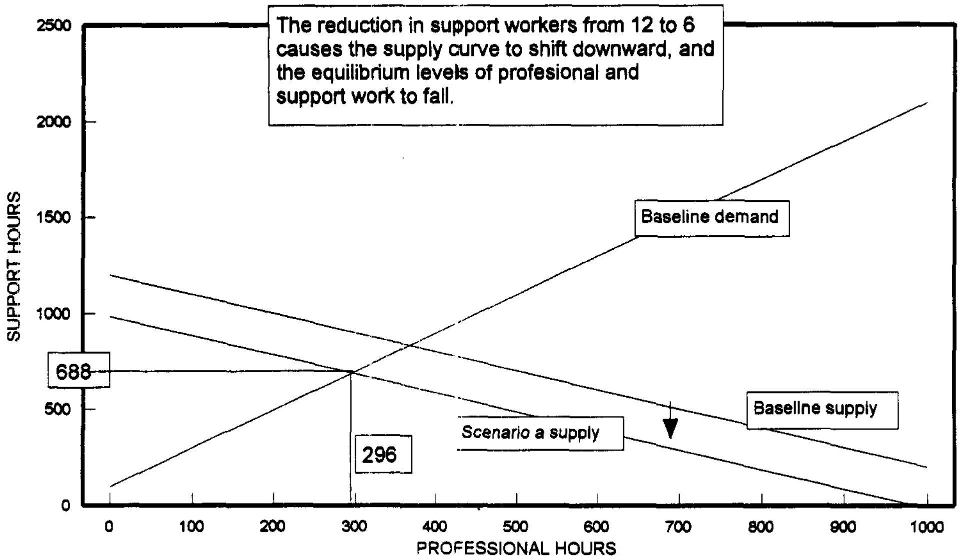

Figure 2. Demand and supply of support hours (scenario a).

efficiency applies to the professional work done by both these groups. As in Figure 2, the supply curve shifts downwards. Unlike Figure 2, the demand curve rotates upwards because each hour of professional work now requires 25% more support work. The new equilibrium values of P and S are 253.7 and 730.3 hours/week respectively. Because of the 25% increase in the efficiency of professional work, the output of professional work would be $253.7 \times 1.25 = 317.1$ 'hours worth' of output. Note that in spite of a significant enhancement in the efficiency of doing professional work, the total output of professional work has still declined by about 14%. The reason, of course, is the unavoidable decrease in intellectual specialization among the professionals, just as in Table 8. (In this case, the new equilibrium values of the work profile matrix are $a = 18.17\%$, $b = 36.83\%$, $c = 28.08\%$ and $d = 56.92\%$.)

Scenario c shows the effect of increasing by 25% the efficiency with which support work is performed, and simultaneously decreasing the number of support workers from 12 to six. Again, because support work is done by managers, professionals and support workers, the postulated increase of 25% efficiency applies to the support work done by all three groups. As in the previous figures, the supply curve shifts downwards to reflect the truncated support staff. The demand curve rotates downwards because the increased efficiency of support hours means that fewer support hours are needed per hour of

Table 8. Equilibrium work profile matrix for scenario a

Position in the hierarchy	No.	Management work (%)	Professional work (%)	Support work (%)	Non-productive work (%)	Hours per week	Loaded salary (US$)
Managers	4	30	2[illegible].20	33.80	15	40	100 000
Professionals	20	0	32.76	52.24	15	40	75 000
Support workers	6	0	0	90	10	40	30 000
Total	36	48 h/wk	$P = 296$ h/wk	$S = 688$ h/wk	168 h/wk	1200	2 080 000

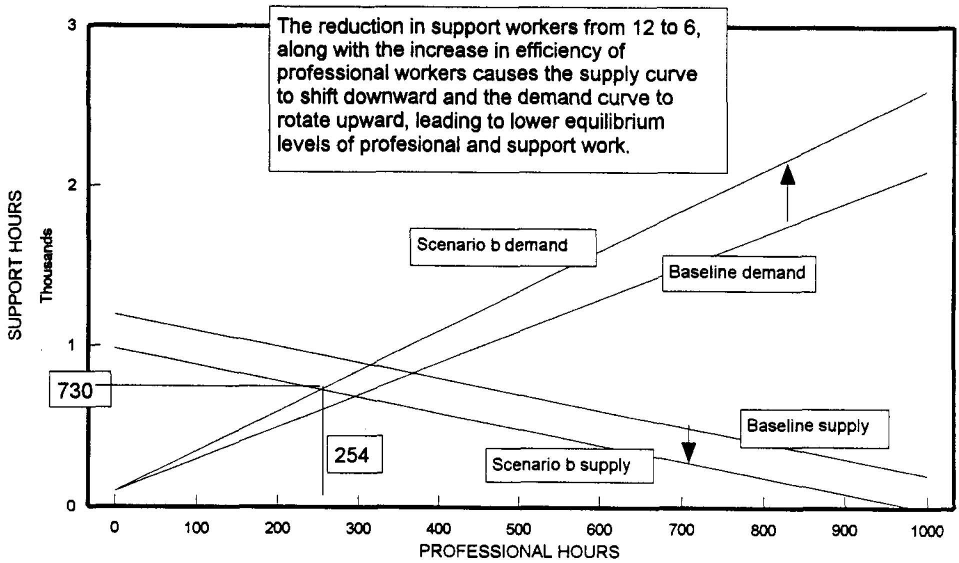

Figure 3. Demand and supply of support hours (scenario b).

professional work. The resulting equilibrium values of P and S are 348.9 and 635.1 hours/week respectively. In this case, the output of professional work declines by about 5%, despite the increased support efficiency of everyone in the department. The new equilibrium values of the work profile matrix are $a = 24.99\%$, $b = 30.01\%$, $c = 38.62\%$ and $d = 46.38\%$.

Finally, scenario d is a case with no postulated decrease in the number of support workers, and with a postulated 25% increase in the efficiency of hours devoted to professional work. It would seem that the output of professional work should increase dramatically in this case. In fact, only a modest increase occurs because the increased demand for support hours (each hour of professional work now requires 25% more support work) is not matched by an increase in the supply of support hours. Therefore, once again, more of managers' and professionals' time must be diverted to performing support work. The supply curve is unchanged, and the demand curve rotates upward. The resulting equilibrium values of P and S are 315.4 and 884.6 hours/week respectively. Because the efficiency of hours in professional work increased by 25%, professional output would be $315.4 \times 1.25 = 394.3$ 'hours worth' of output. Therefore, professional output increases by about 7%. Again, the reason for the modest increase in output is the unavoidable decrease in intellectual specialization caused by the relative (to support work) increase in the efficiency of professional work. The new equilibrium work profile values are $a = 22.59\%$, $b = 32.41\%$, $c = 34.91\%$ and $d = 50.09\%$.

These four cases (scenarios a to d) are summarized in the top half of Table 9. In that table, all percentage changes are calculated from the base case, which is shown in the first line of the table, and in more detail in Table 7.

These four examples—reasonable (even if abstract) representations of the office resource allocation strategies pursued by many organizations during the past decade—shed some light on why office productivity has stagnated in the face of massive investments in information technology. The examples also help to explain the paradox of office technology. On the one hand, the ability of office technology to save office workers' time in specific tasks has been amply demonstrated by vendors and consultants,

Downloaded by [Universitaetsbibiothek Bonn] at 00:40 02 March 2015

Downloaded by [Universitaetsbibiothek Bonn] at 00:40 02 March 2015

Table 9. Summary of office productivity impacts under various scenarios

Scenario	Description	Professional work (equivalent hours)	Percentage change in professional work	Support work (equivalent hours)	Percentage change in support work	Payroll (US$ millions)	Percentage change in total payroll
Base case	SeeTable 7	368.00		832.00		2.26	
a	Support workers reduced from 12 to 6.	296.00	− 19.57	688.00	− 17.31	2.08	− 7.96
b	Support workers reduced from 12 to 6. Technology increases efficiency of professionals by 25%.	317.14	− 13.82	730.29	− 12.23	2.08	− 7.96
c	Support workers reduced from 12 to 6. Technology increases efficiency of support workers by 25%.	348.92	− 5.18	793.85	− 4.59	2.08	− 7.96
d	Support workers unchanged. Technology increases efficiency of professionals by 25%.	394.29	+ 7.14	884.57	+ 6.32	2.26	0.00
e	Support workers increased to 18.	440.00	+ 19.57	976.00	+ 17.31	2.44	+ 7.96
f	Technology increases efficiency of all office workers by 25%.	460.00	+ 25.00	1040.00	+ 25.00	2.44	+ 7.96
g	25% of previously required support work eliminated.	451.20	+ 22.61	748.80	− 10.00	2.26	0.00
h	Support workers increased to 18. Technology increases efficiency of all office workers by 25%. 25% of previously required support work eliminated.	672.00	+ 82.61	1098.00	+ 31.97	2.44	+ 7.96

and even experienced first-hand by a large segment of office workers. Computer-based applications such as word processing, spreadsheets, databases and graphics can and do save time. There is no longer any serious dispute about that. On the other hand, overall office productivity—however reasonably defined—has not tended to reflect these apparent improvements. Our model and examples demonstrate that extracting overall office productivity improvements from technology depends on more than simply buying and using it. It depends on balancing the impact of technology on support workers and professionals, and on calibrating the office staffing at least to maintain, but preferably to increase, the level of intellectual specialization. Many organizations have invested heavily in technology, but they have not made the essential adjustments in staffing to take advantage of the technology. Indeed, in many instances (scenarios b and c), firms have made squarely the wrong decisions. They have used technology to decrease, rather than to increase, intellectual specialization.

Downloaded by [Universitaetsbibiothek Bonn] at 00:40 02 March 2015

The Three Keys to Office Productivity

An effective office productivity strategy involves three elements. We have mentioned two already: recalibrating the staffing mix and using technology to improve the efficiency with which work is accomplished. The third element is, perhaps, the most obvious: using technology or other means simply to eliminate part of the workload.[5] Let us continue to use our example office to illustrate each of these. We will analyze the following four scenarios:

(e) Suppose our example office increases the number of support workers from 12 to 18.
(f) Suppose our example office successfully implements office information technology, which enhances work efficiency by 25% across the board.
(g) Suppose our example office finds a way to eliminate 25% of the previously required support work, perhaps through eliminating the preparation of redundant or low-value reports.
(h) Finally, as a best case illustration, suppose our example office implements all three of these improvements.

In scenario e, an increase in the number of support workers shifts the supply curve upwards. The demand for support curve remains unchanged. The new equilibrium time allocation for the office is 440 hours/week of professional work and 976 hours/week of support work. The new equilibrium values of the work profile matrix are $a = 31.51\%$, $b = 23.49\%$, $c = 48.70\%$ and $d = 36.30\%$. Note that the change in professional work (and presumably output) is from 368 to 440 hours/week, or an increase of nearly 20%. The corresponding increase in the office payroll is US$180 000, or only about 8%. As long as there is the opportunity to use the additional professional hours profitably, this case illustrates the significant productivity opportunity associated with improving the staffing mix.[6]

In scenario f, a uniform 25% increase in the efficiency with which management, professional and support work is accomplished has no effect on the supply of support work, and it causes exactly offsetting changes in the demand curve. The increased efficiency of management and professional work causes the demand for support to shift upwards (as each more productive hour of management and professional work requires more support work). However, the increased efficiency of support work causes the demand curve to shift downwards (as each hour of professional work requires fewer of the now more productive hours of support work). The net effect in this case is that the upwards and downwards shifts of the demand curve balance each other exactly, and the

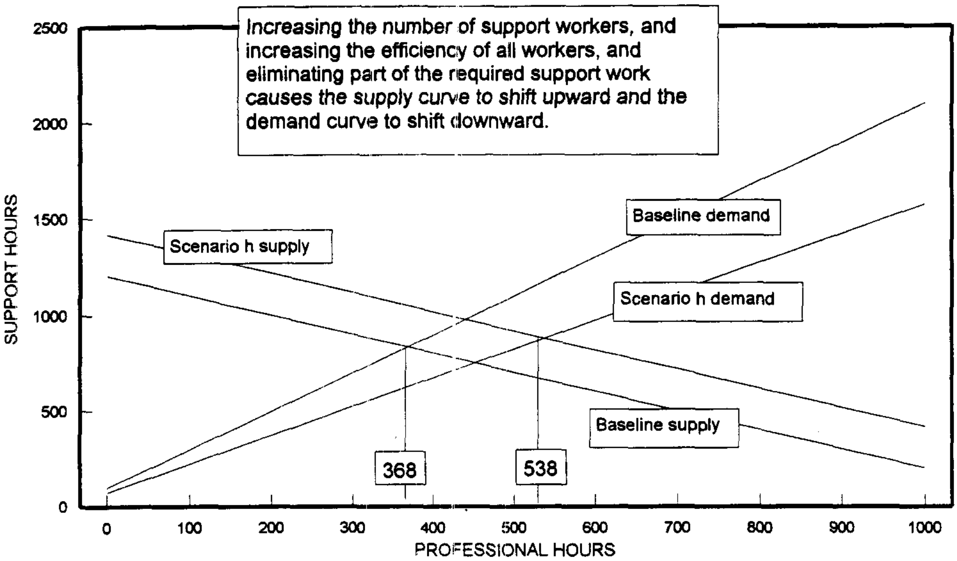

Figure 4. Demand and supply of support hours (baseline and scenario h cases).

demand curve remains unchanged. Thus, the equilibrium office time allocation also remains unchanged. However, the output of professional work (and other work as well) increases by 25% in this scenario, due, of course, to the postulated increase in efficiency and to the unchanged number of hours devoted to professional work.

In scenario g, the elimination of 25% of the required support work causes the demand curve to rotate downward because fewer hours of support work are now required per hour of professional work. The resulting new equilibrium time allocation is 451.2 hours/week of professional work and 748.8 hours/week of support work. The new work profile matrix values are $a = 32.31\%$, $b = 22.69\%$, $c = 49.94\%$ and $d = 35.06\%$. The amount of professional time (and work) increases by over 22%, while the amount of support work decreases by about 10%.

Finally, Figure 4, illustrating scenario h, combines the previous three scenarios as a 'best case' example. Here, the firm implements all three prongs of the office productivity strategy. The supply curve shifts upwards, efficiency increases across the board and the demand curve rotates downwards. The resulting equilibrium time allocation is 537.6 hours/week of professional work and 878.4 hours/week of support work. The corresponding values of the work profile matrix are $a = 38.50\%$, $b = 16.50\%$, $c = 59.50\%$ and $d = 25.50\%$. Because of the increase in efficiency, professional output increases to 672 'hours worth' of output (537.6 hours $\times$ 1.25), which is an increase of 83% over the baseline level of output. Note that the results of scenarios e through h are shown in the lower half of Table 9.

Note that if the business strategy were to cut costs rather than to expand output, these scenarios are equally applicable. For example, in scenario h, this office's payroll could be scaled from US$2 440 000 per annum (four managers, 20 professionals and 18 support workers) down to about US$1 325 000 (two managers, 11 professionals and 10 support workers) and still accomplish approximately as much work as was originally being done.

Conclusions

Guided by a new conceptual framework for modeling the office (the work profile matrix), which focuses on the intellectual content of office work, we studied the allocation of time by white-collar workers in a series of 20 department-wide studies within five major US corporations. These studies, conducted between 1985 and 1994, are perhaps the most extensive set of office productivity studies to date. Overall, we collected detailed time log data from over 1700 individuals in 95 physical offices around the US.

Our major findings are: (a) there is a widespread and pronounced lack of intellectual specialization among managers and professionals; (b) in a typical office, intellectual specialization tends to decrease as one moves up the hierarchy; (c) the proximate cause of intellectual non-specialization is top-heavy staffing; and (d) the annual financial cost of this resource misallocation is about 15% of total white-collar payroll costs in a typical case.

Based on our conceptual framework, our empirical findings, our interviews and discussions with managers and our related technology cost justification work,[7] we developed a quantitative economic model of office labor resource allocation. The model, whose main analytic elements are the supply and demand for support labor within the office, explains and predicts how office output and office productivity are affected by the staffing mix, by the intellectual content of the office work and by office information technology. Among other things, the model helps to explain why massive US corporate investments in office technology have failed to ignite an explosive increase in office productivity.

With the aid of Figure 5, let us review the main points of our model of office work. Starting at the right side, office productivity (which can be defined as professional output divided by total office hours, or alternatively as the unit cost of professional output) is determined by the level of intellectual specialization (i.e. the work profile matrix, which shows how much of their time workers devote to work of differing intellectual content and the resulting total amounts of management, professional and support work accomplished in the office) and by work efficiency (how much management, professional and support output is produced by each hour devoted to management, professional and support work respectively). Intellectual specialization, in turn, is determined by the staffing structure (how many managers, professionals and support staff are employed in the office), by the work structure (how much management work must be done and how much support work is required by each hour of professional and management work) and by work efficiency (mentioned above). Both the work structure and the work efficiency are affected by the use of information technology (electronic data, text, image and voice processing). We showed through numerical and graphical examples that in each office there is an 'equilibrium' level of intellectual specialization towards which the office will gravitate, that this equilibrium is determined by the supply and demand for support work, that the supply curve is based on the staffing structure, that the demand curve is based on the work structure and work efficiency, and that information technology can shift the demand curve up or down (depending on whether the technology enhances professional workers or support workers).

Implications for Managers

What implications, useful to managers, can we draw from our empirical results and from our analytic model of the office? Here are several.

> Learn to understand, to measure and to track the intellectual content of office work, and learn how to staff the office accordingly.

Downloaded by [Universitaetsbibiothek Bonn] at 00:40 02 March 2015

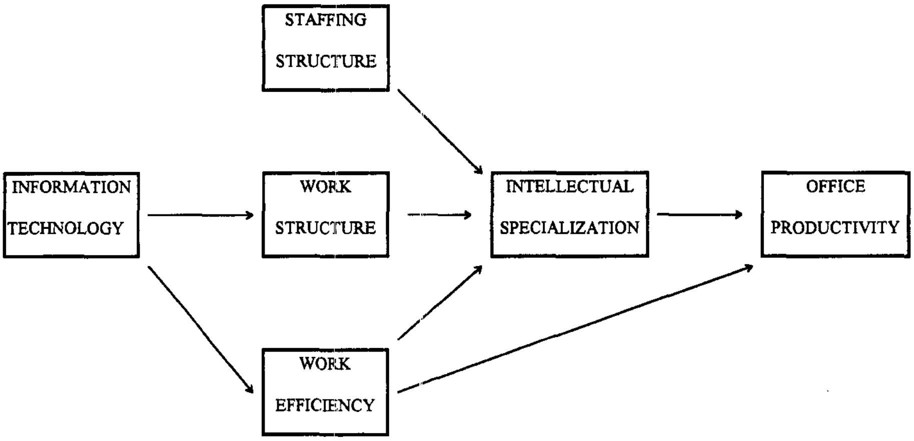

Figure 5. The fundamental elements of office productivity.

In every one of the 20 departments that we studied, there was a top-heavy staff. That is, as compared with the most efficient mix of managers, senior and junior-level professionals and technical and administrative support workers, every department had more than the desirable number of managers and/or senior professionals, and fewer than the desirable number of support workers. The financial cost of this misallocation of resources is very significant—averaging 15% of the total white-collar payroll. The annual savings associated with correcting this misallocation of resources could double the net earnings of many companies.

Focus on intellectual specialization.

Managers must learn and focus on the concept of intellectual specialization, which is the key to productivity in the professional office. As suggested by Figure 5, intellectual specialization is the virtual *sine qua non* of office productivity. An office simply cannot achieve a high level of productivity unless its managers and professionals are devoting most of their time to professional level work.

Recognize that intellectual specialization leads to job enrichment.

Intellectual specialization does not mean task specialization. In achieving intellectual specialization, managers and professionals free themselves from many of the tasks that can be performed by lesser skilled workers. The variety and diversity of the management and professional tasks performed by managers and professionals need not diminish, and might well expand, as they have more time to devote to those activities. Intellectual specialization tends to enrich management and professional jobs, and it tends to reduce the time spent on the tasks that managers and professionals find least enjoyable. Similarly, intellectual specialization in the office can enrich the support jobs as well. As managers and professionals off-load some of the support tasks that they were performing, they increase the diversity and the level of responsibility of the support jobs. We have found (through our interviews of office workers) that, in general, the support tasks performed by managers and professionals are the tasks that support workers would most prefer to do. This is hardly surprising, since managers and professionals, even when circumstances force them to do support tasks, have some discretion in selecting which support tasks they will do and which they will delegate. Of course, they tend to delegate the more dreary tasks and to keep the more interesting ones. In terms of job quality for both professional and support workers, then, intellectual specialization is a win–win strategy.

Do not use a back office strategy in a professional office.

In formulating office technology strategy, it is critical to distinguish clearly between so-called 'back' offices and 'professional' offices. A back office is one whose function and primary work is clerical. Typical back office functions are payroll, accounting, order entry, billing and claims processing. In a back office, the clerical work is generated externally to the office; whereas in a professional office, the support work is generated by the managers and professionals working within (and performing the function of) that office.[8] Unlike the largely successful experience with back office automation during the 1960s and 1970s, the substitution of information technology for support labor in today's professional office is not necessarily a winning strategy. In a professional office, technology is both a substitute and a complement for labor. Depending on which aspect dominates in a particular office, technology may demand more, rather than fewer, support workers. Unfortunately, the idea that technology is always a substitute for labor still survives in many businesses. The notion is encouraged by technology vendors who can point to past instances of successful back office automation, and who suggest that their current offerings can be similarly cost-justified.

Develop integrated (rather than piecemeal) office productivity strategy.

Perhaps the primary reason why the past decade's massive investment in office technology has not yielded significant widespread and visible productivity results is that concurrent and short-sighted staffing decisions were inadvertently mitigating the positive effects of the technology. In other words, labor resource allocation decisions and capital resource allocation decisions were unwittingly working at cross purposes. The lesson is that piecemeal office strategies are dangerous. The office is a complex work system where the staffing structure, the work structure, the professional-work enhancing technology and the support-work enhancing technology all simultaneously affect how the staff members spend their time[9] and how much work gets accomplished. Thus, managers need to develop a holistic vision of office resources and to develop integrated (rather than piecemeal) office productivity strategies.

Downloaded by [Universitaetsbibliothek Bonn] at 00:40 02 March 2015

Notes and References

1. For example, see W. Nicholson, *Microeconomic Theory*, 4th Edn (Chicago, The Dryden Press, 1989); E. Silberberg, *The Structure of Economics: A Mathematical Analysis*, 2nd Edn (New York, McGraw-Hill, 1990). For alternative points of view which are consistent with enduring resource misallocation within the film, see H. Leibenstein, 'Allocative Efficiency vs "X-efficiency"', *American Economic Review*, 1966; H. A. Simon, 'Theories of Decision-making in Economics and Behavioral Science', *American Economic Review*, 1959.
2. The reduction in non-productive time is not necessary to our analysis, but because it reflects typical re-engineering strategy, we have incorporated it here.
3. This assumption simplifies our analysis but it can easily be modified. In fact, typically, we might use technology or other means to absorb or eliminate some work, thereby reducing the required hours. Alternatively, we can forecast a growth in business resulting in increased work requirements. The same analytic techniques discussed here can be used under these circumstances.
4. Our supply and demand functions differ from those normally employed in economic models. Normally, both the supply and the demand for a good or service are functions of the price of that good or service. The supply function is a positive (upward sloping) function of price, and demand is a negative (downward sloping) function of price.

5. For a discussion of this point, see M. Hammer, 'Reengineering Work: Don't Automate, Obliterate', *Harvard Business Review*, July/August 1990, pp. 104–112.
6. Of course, the change in the staffing mix in this case is not necessarily the 'optimal' change. The concept of the optimal staffing structure and the procedure for determining it is discussed in this paper. In fact, in this case, a greater number of support workers would provide even greater productivity gains.
7. P. G. Sassone, 'Cost Benefit Analysis for Office Information Systems: A Hedonic Pricing Approach', in: R. Taylor (Ed.), *Proceedings of the IEEE First International Conference on Office Automation* (Washington, DC, IEEE Press, 1984); P. G. Sassone, 'Cost Benefit Methodology for Office Systems', *ACM Transactions on Office Information Systems*, *5*, pp. 273–289; P. G. Sassone, 'A Survey of Cost–Benefit Methodologies for Information Systems', *Project Appraisal*, *3*, 1988, pp. 73–84; P. G. Sassone & A. P. Schwartz, 'Corporate Strategy for End User Computing', in: J. Goldthwaite (Ed.), *OAC '85 Conference Digest* (Washington, DC, AFIPS Press, 1985); P. G. Sassone & A. P. Schwartz, 'Cost Justification of Office Information Systems for Engineering Organizations', in: *Proceedings of IEEE Conference on Systems, Man and Cybernetics* (Washington, DC, IEEE Press, 1985); P. G. Sassone & A. P. Schwartz, 'Cost Justifying OA', *Datamation*, 15 February 1986, pp. 83–88.
8. A model of the back office would, therefore, be very different from the model of the professional office that we have discussed in this report. The back office model would look more like a model of a manufacturing assembly line, where parts are shipped in and processed in some way, and then the resulting product is shipped out. In a back office, there is little or no 'professional' level work, and 'management' work is primarily supervisory.
9. This is a subtle but critical point: the office's work profile matrix (how people in an office spend their time) is largely determined by staffing, work structure and technology. It is not determined by the personal preferences of the workers or by management fiat.

Downloaded by [Universitaetsbibliothek Bonn] at 00:16 02 March 2015