Influence on Productivity of Staff Personality and Team Working

BUTLER COX
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PEP Paper 7, September 1988

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by Chris Woodward

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Chris Woodward was one of the founders of Butler Cox and is a senior consultant specialising in the management of information systems. He is currently responsible for the productivity assessments for PEP sponsors. He has over 20 years' experience in the field of computer systems.

One of his particular areas of interest is the people aspects of systems development. He was co-author of the Butler Cox Foundation Report, Managing the Human Aspects of Change, and has conducted several consultancy projects concerned with organisational and human factors in systems and their development. For example, he assisted the CCTA in identifying the key factors in the user interface with systems and led an organisational study of the information systems function of a major IT vendor. His other work has included both research for the Butler Cox Foundation and also consultancy in the areas of systems development tools and quality assurance.

In addition to consultancy work, Chris also has first-hand experience of managing systems development. Prior to joining Butler Cox he worked in the systems functions of a manufacturing company and an international bank. With CAV (a subsidiary of Joseph Lucas) he led projects concerned with the design and implementation of design, manufacturing, and servicing databases, and with Citibank he managed teams developing financial systems for branches and subsidiaries of the bank in London, the Middle East, and Europe. While at Butler Cox he has been seconded to manage clients' development teams in the publishing and insurance businesses.

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Contents

Chapter 1

People-related factors in systems development productivity

Methods, tools, and practices are all important contributors to systems development productivity. However, the most important single class of factors contributing to effective systems development relate to the people themselves. Taking due account of people-related factors provides more scope for improving productivity in systems development than any other means.

PEOPLE-RELATED FACTORS

In all industries and countries, skilled systems development staff are in short supply. PEP sponsors report that half of their projects experience staffing constraints. The broader demand for human resources is illustrated by the computing-services industry in the United Kingdom. The industry employs about 17,000 professionals who are fully or mostly engaged on systems analysis and programming. Staff turnover averages about 12 per cent a year. Some organisations lose as many as 50 per cent of their staff each year. To make up for losses and to meet its growth objectives, the industry is estimated to be looking for about 4,000 new staff a year. The picture in the United States is a similar one, where the aggregate demand for new programming staff across all industry sectors will amount to more than 120,000 in 1988.

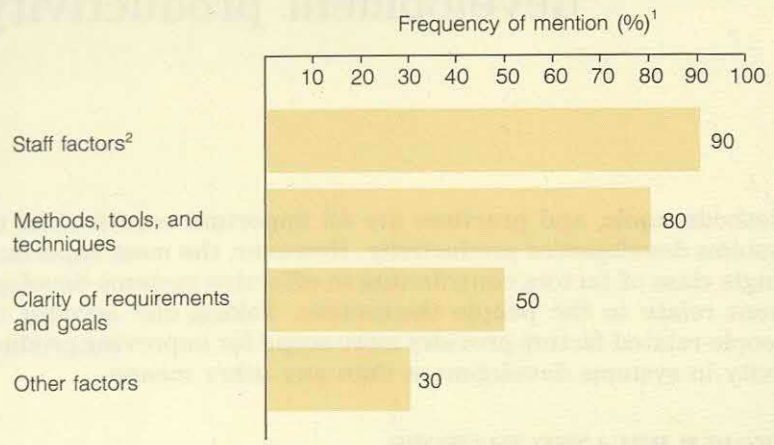
The staff shortages reflect the demand for computer systems, which continues to grow unabated. At the same time, systems managers are under growing pressure to contain costs. The largest single cost element in most systems development departments is staff, which emphasises the critical importance of improving the productivity of development staff.

Staff themselves are the most significant factor in productivity

Improved staff productivity is an objective that is common to virtually every systems installation. At the same time, it is the staff themselves who are the most significant factor in productivity. This assertion is confirmed by our own findings. At an early stage in our research for this paper we asked systems development managers what they thought were the most important factors affecting productivity in systems development. Their responses are summarised overleaf in Figure 1.1. In aggregate terms, staff factors were mentioned by about 90 per cent of the systems development managers we questioned. Methods, tools, and techniques came close behind in terms of frequency of mention, yet they were rarely mentioned first.

We went on to probe systems development managers in greater depth about the staff factors they thought to be important. We also undertook a separate, comprehensive, questionnaire-based survey of systems development staff themselves (the survey is described briefly on pages 3 and 4, and a summary of the staff factors that the questionnaire asked about can be found in the appendix). The responses from managers and staff make an

Figure 1.1 Factors affecting systems development productivity



[1]Based on frequency of mention by systems development managers in a telephone survey that asked them about the factors that are important in achieving systems development productivity.

[2]The most frequently mentioned staff factors were staff quality and skills (50%) and staff motivation (35%).

(Source: Butler Cox survey of PEP sponsors)

interesting contrast, as is shown in Figure 1.2, which sets out our findings side by side. Managers rated training and skills as most important, whereas the staff themselves rated career development, which included acquiring new skills and opportunities for promotion and advancement, as most important. (Career development was ninth in importance according to the managers.) This vividly illustrates the difference that exists between what managers and their staff believe to be important.

PURPOSE OF THE PAPER

Staff productivity is an involved and complex subject. Figure 1.3 on page 4 shows just some of the factors that may influence the productivity of the development team, and some of the connections between them. The impact of the various factors is further confused by each person's own work experience, not only in their current job, but also in previous employment.

Although the people factors affecting productivity have been widely researched, they are still poorly understood. The difficulty of conducting controlled experiments is well known — because of the 'Hawthorne' effect, for example, which indicates that the performance of a group can improve just because they realise someone is paying attention to their concerns. It would therefore be presumptuous to attempt a full analysis of all these factors within the scope of a single PEP Paper. Instead, we have chosen to focus on factors that our research showed systems development managers believe to be important, and which are not covered in other PEP Papers.

People factors affecting productivity are still poorly understood

As Figure 1.2 shows, apart from training and skills, the most highly ranked people-related factors were staff motivation, project (or team) leadership, recognition, the working environment,

Figure 1.2 People-related factors affecting systems development productivity

Based on frequency of mention by systems development managers in a telephone survey that asked them about the human factors that are important in achieving systems development productivity. For comparison, the importance rankings given by systems development staff in response to the questionnaires are also shown.

People or people-related factor affecting productivity	% of systems development managers mentioning the factor	Rank order given by development staff
Training and skills	85	8
Motivation	50	*
Project management/leadership	45	6
Support by technology	35	3
Recognition, achievement, personal worth	35	7
Office environment	30	5
Job factors	30	12
Team factors	30	15
Career development	20	2
User factors	15	1
Methods	15	10
Pay and benefits	15	13
Organisation structure and policies	15	16
Senior management/interpersonal communications	10	14
Goal setting and achievement	—	11
Security of employment	—	4
Personal/family circumstances	—	9

*Questionnaire respondents were not asked to rank motivation as a separate factor

(Source: Butler Cox surveys of PEP sponsors)

job factors, team factors, and career development. Therefore, this paper focuses principally on the influence of staff motivation and team working on systems development productivity.

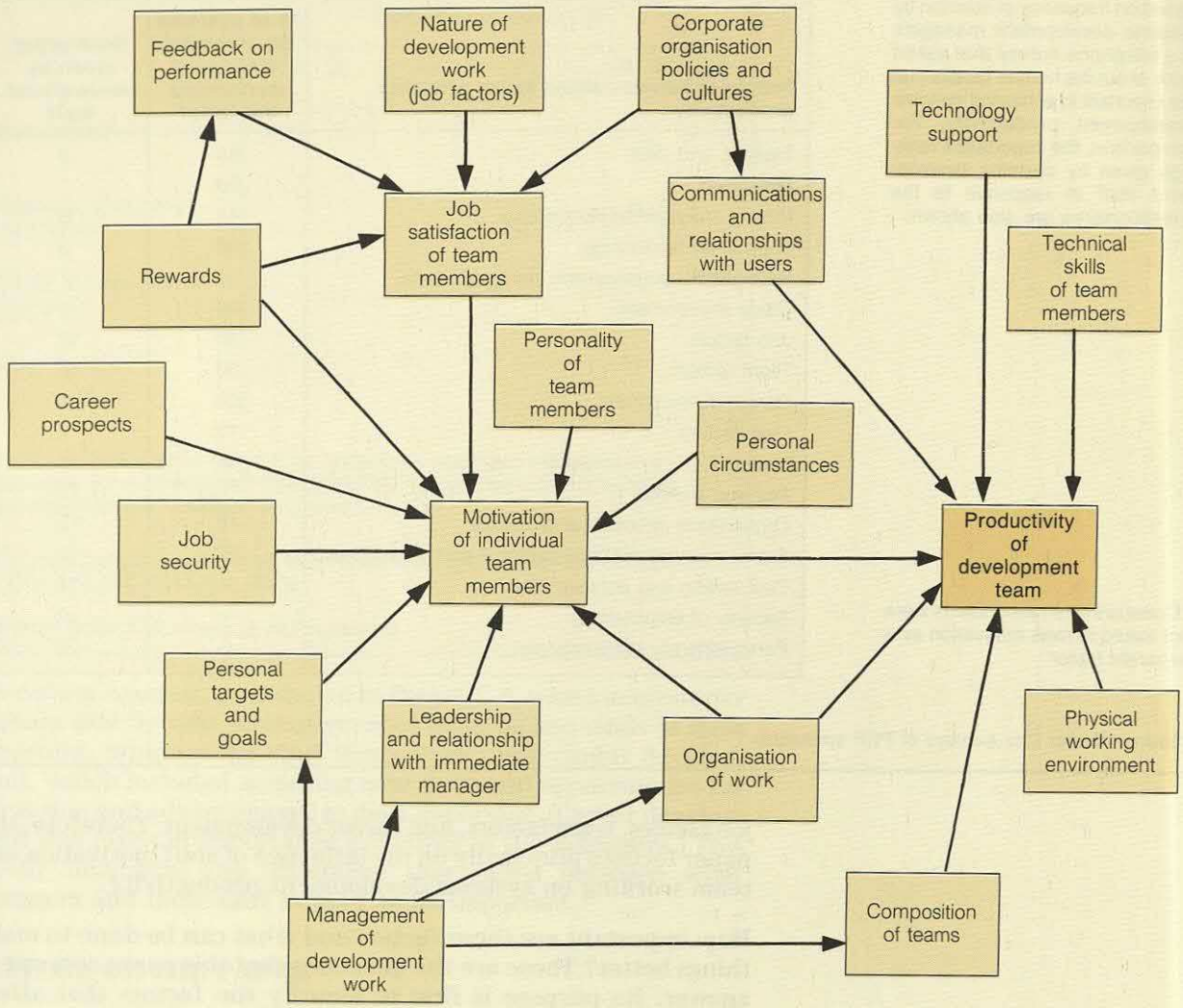
How important are these factors and what can be done to make things better? These are the questions that this paper sets out to answer. Its purpose is first to identify the factors that affect productivity within the scope defined above, and then to recommend ways of making improvements. The paper is intended for PEP sponsors who are managers of systems development staff, because it is they who are best positioned to take action as a consequence of the paper's findings. It will, however, be of interest to all those involved in systems development.

THE PEP SPONSOR SURVEY

This paper draws on our own research, and research that has been conducted in recent years both in the United States and the United Kingdom, and which is now in the public domain. Our research included a questionnaire survey of several hundred staff within seven organisations in the United Kingdom, representing both the public and private sectors. All seven are sponsors of PEP. Each has a centralised systems department with at least 40 systems development staff tackling a mixture of new development work and maintenance of existing systems. In aggregate, a wide range of hardware suppliers and model sizes is represented.

Survey questionnaires were sent to the vast majority of the staff involved either directly or indirectly with systems development

Figure 1.3 Some of the factors that influence systems development productivity



The boxes indicate the factors; the arrows show the influence each factor exerts on other factors and on the productivity of the development team. For simplicity, the diagram omits the influence of feedback from earlier experiences in the development group and on the interactions between the factors shown.

in each of the seven organisations. In all, some 700 questionnaires were sent out, of which more than 600 were completed and returned. A profile of the questionnaire respondents is set out in Figure 1.4, for each of the seven participating businesses, and overall. It shows, for instance, the average age of respondents to be 32 years, that more than three-quarters were male, and that nearly half were qualified to degree level. About 70 per cent of respondents were analysts and programmers, and 30 per cent were project leaders and managers.

The questionnaire identified 84 factors (arranged into 16 groups) that we believe from previous research to influence staff productivity (see the appendix for details). Respondents were asked to rate each factor in two ways, each time on a low-to-high scale of 1 to 7. The first rating was how important the factor was in

Figure 1.4 Profile of questionnaire respondents

Organisation	PI*	Average age	Male/female (%)	% with a degree	Percentage breakdown by type of job					
					Systems development managers	Project managers	Project leaders	Analysts	Analysts/programmers	Programmers
A	19	30	73/27	47	1	10	5	15	69	0
B	17	33	84/16	29	3	5	21	4	41	26
C	17	33	69/31	58	0	18	26	0	56	0
D	16	28	76/24	66	2	4	18	0	58	18
E	12	35	63/37	47	0	4	20	10	42	24
F	11	34	81/19	58	0	10	30	0	37	23
G	8	32	72/28	59	0	13	13	0	74	0
All	15	32	78/22	45	2	8	19	4	51	16

*Typical Productivity Index found in PEP assessments

affecting their ability to work well, and the second how satisfied they were with the factor within their own systems development environment.

The scorings of importance of the 16 factor groups are shown in Figure 1.5 overleaf. The figure also shows the minimum and maximum scores of importance found across the seven businesses, and the highest and lowest rankings. There is a strong measure of agreement on the ranking of career-development opportunities, team factors, departmental organisation, immediate-manager relationships, goal setting, training and skills, and technology. These factors are those most under the control of the systems development function. On the other hand, the widest divergence of rankings were mainly for the factors that tend to be influenced by the organisation as a whole: secure employment, the work environment, relationships with senior management, and recognition. This is perhaps not surprising, bearing in mind the different kinds of organisation included in our sample. There were also significant differences between the seven organisations in the importance rankings given to personal circumstances. These differences could be due to the ways in which the organisations support staff with personal problems.

Figure 1.6 (on page 7) plots the average ratings of importance (across the seven organisations) against their average ratings for the degree to which these factors are satisfied. There is little correlation between the two ratings. Most of the factors are rated as being of relatively high importance, scoring between 5 and 6 (out of 7). Satisfaction with these factors is, in general, not rated quite as highly (about 4 to 5), and there is a wide spread between the different factors. Certain factors stand out as having relatively high importance but relatively low satisfaction: career development, user factors, and, to a lesser extent, relationships with immediate managers. On the other hand, team factors and personal circumstances seem to have relatively high satisfaction but lower importance.

Again, not surprisingly, there are significant differences between the satisfaction ratings from the seven organisations surveyed. The factors on which there were the greatest differences in satisfaction were pay and benefits and the working environment. There were also comparatively large differences in satisfaction with user factors and relationships with immediate managers.

STRUCTURE OF THE PAPER

In Chapter 2 we examine the motivational characteristics of systems development work. Although the work can be highly motivating, the motivating potential varies widely according to the type of systems development job. Moreover, the work itself is a significant source of unfulfilled expectation — our survey analysis found that staff expect more from the work than they actually get. Improving feedback to the staff about the effect of the work they do, and increasing the variety of work through planned rotation and job enlargement, are ways in which the situation can be improved.

In Chapter 3 we look at the personality characteristics of systems development people. We find a marked difference between systems development staff and the average in the world at large. Systems development staff are more introverted, more intuitive, more thinking, and more judgemental. As a result, they have a lower need than is usual for social contact, and a lower team orientation. This has implications for both individual and team working. For instance, there is considerable evidence that project teams

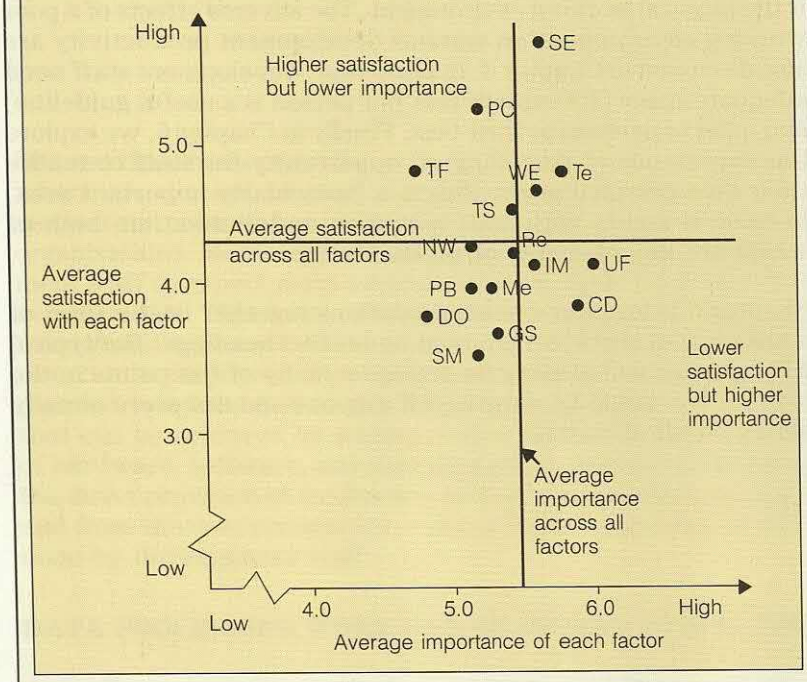
Figure 1.5 Rank order of factor groups influencing productivity of systems development staff

Survey respondents were asked to rate the importance of each factor on a scale of 1 (low) to 7 (high).

Factor group	Rank	Average rating	Highest and lowest average rating given by an individual organisation		Highest and lowest average ranking given by an individual organisation	
			High	Low	High	Low
User factors	1	5.9	6.1	5.8	1	5
Career-development opportunities	2	5.8	6.0	5.7	2	3
Technology	3	5.8	6.0	5.5	2	5
Security of employment	4	5.7	6.4	5.4	1	9
Work environment	5	5.6	6.1	5.4	1	8
Immediate manager factors	6	5.6	5.8	5.5	3	6
Recognition	7	5.4	5.6	5.2	4	11
Trainings/skills	8	5.4	5.5	5.4	7	10
Personal/family circumstances	9	5.3	5.5	5.2	6	13
Methods	10	5.3	5.6	5.1	7	12
Goal setting	11	5.3	5.5	5.1	9	12
Nature of the work	12	5.2	5.5	5.2	9	13
Pay and benefits	13	5.2	5.4	4.9	10	15
Senior management/interpersonal communications	14	5.1	5.5	4.9	8	14
Team factors	15	4.8	5.1	4.7	15	16
Departmental organisation	16	4.8	5.2	4.4	14	16

(Source: Butler Cox survey of PEP sponsors)

Figure 1.6 Importance of, and satisfaction with, the factors affecting development productivity



Key to factors:

CD Career-development opportunities	Me Methods	SM Senior management relationships
DO Departmental organisation	NW Nature of work	TF Team factors
GS Goal setting	PB Pay and benefits	Te Technology
IM Immediate manager relationship	PC Personal/family circumstances	TS Training and skills
	Re Recognition	UF User factors
	SE Security of employment	WE Work environment

(Source: Butler Cox survey of PEP sponsors)

lack sufficient staff with the characteristic called 'feeling' (as opposed to 'thinking') that enables them to better understand the real meaning that often lies behind the spoken word.

Chapter 4 examines team size, composition, and leadership. We find that small teams of no more than five or six people are more productive than large teams. It helps if team members have different — even clashing — personalities, particularly during the early phases of a project when routine is at its lowest. Rather than acting as a driving force, the primary role of team leaders is to influence and assist team members in their work, by building unity between team members and ensuring that their goals are aligned. The key activities for team leaders are participating, supporting, goal setting, and organising. To consolidate their position, team leaders need to influence the behaviour of team members. Interestingly, the most important sources of influence turn out to be expertise and the ability to provide challenging work.

In Chapter 5 we introduce a further dimension — the changing skills that are required by systems development staff as a result of recent changes, not only in methods and tools, but in the nature and type of systems that are worked on. These changes imply a

need for people with a wider range of systems development skills — and perhaps with personalities less different from those in the world at large. This need puts a new emphasis on training, goal setting, and recruitment. Another factor affecting productivity is the physical working environment. The adverse effects of a poor working environment on systems development productivity are also discussed in Chapter 5. In particular, development staff need adequate space (100 square feet per person is a useful guideline) and quiet to perform at their best. Finally in Chapter 5, we explore the importance of providing an opportunity for staff to realise their own personal goals. This is a particularly important area, because it assists with staff retention and motivation, both of which are key elements of productivity.

Chapter 6 brings our recommendations together in the form of a brief action checklist, grouped under five headings. The typical PEP sponsor will already be acting on many of the points in the list, but we would be surprised if any one sponsor were already acting on all of them.

Chapter 2

Motivational characteristics of systems development work

Systems development work can be highly motivating, particularly where an element of staff management is involved. But the motivating potential varies widely from job to job and across organisations. Moreover, it is commonplace for systems development staff to expect more satisfaction from their work than they actually get. There are a number of reasons for this, and understanding them helps to point out ways in which job motivation can be improved. One is by increasing job variety through planned rotation. A second is by job enlargement — something that can be achieved by adding responsibility for defined areas of hardware, software, and user support. A third is by improving the direct provision of feedback — both from immediate managers and from the user community — about the effectiveness of work done by development staff.

DATA PROCESSING WORK CAN BE HIGHLY MOTIVATING

According to a survey carried out in the United States, data processing, compared with other professions, has the potential to be highly motivating. The survey results were used to calculate a measure called Motivating Potential Score (MPS) for a range of occupations.

HIGH MOTIVATING POTENTIAL OF DATA PROCESSING

Figure 2.1 shows a sample list of occupations, together with the MPS for each one. The MPS of 154 for data processing professionals places the occupation at about the same level as managerial and other professions, and well ahead of other occupations in terms of motivating potential.

Figure 2.1 Motivating potential of a selection of occupations

Job category	MPS*
Other managers	156
DP professionals	154
Other professionals	154
Service	152
Sales	146
Construction	141
Machine trades	136
Bench work	110
Clerical	106
Processing	105

*MPS: Motivating Potential Score, a measure of the motivating potential of jobs. The higher the score, the more motivating the job.

(Source: US survey carried out in 1980 by Cougar and Zawacki)

MEASURING MOTIVATING POTENTIAL

The motivating potential of a job is derived from five key measurable job dimensions

The MPS measure results from the Job Diagnostic Survey technique originally developed by two American researchers, J Richard Hackman and Greg R Oldham. According to Hackman and Oldham, the motivating potential of a job is derived from five key measurable job dimensions: skill variety, task identity, task significance, personal responsibility, and work feedback. An equally weighted combination of the first three dimensions is used to provide a measure of the perceived importance of the job.

Skill variety is the extent to which the job calls for different skills and talents. Task identity measures the completeness or wholeness of the work involved in the job. Task significance is to do with the job's impact on other people. The fourth dimension measures the job holder's perception of personal responsibility for the work in terms of freedom, independence, and discretion in determining job procedures. The fifth dimension, work feedback, is concerned with the job holder's knowledge of the outcome or effectiveness of the work. Both the extent and the timeliness of feedback are important.

Each of the dimensions is rated on a scale of 1 (low) to 7 (high), and the MPS is defined as the product of perceived importance of the job, the personal responsibility of the job holder for the work done, and work feedback. MPS measures can therefore range from 1 to 343.

WIDE VARIATIONS EXIST IN THE MOTIVATING POTENTIAL OF SYSTEMS DEVELOPMENT WORK

The relatively high overall score for the motivating potential of data processing work hides wide variations between individual jobs within any one organisation, and across organisations. These variations are due to the different nature of the work entailed by different systems development jobs, by lack of scope and work variety, and by lack of work feedback.

VARIATIONS IN MOTIVATING POTENTIAL OF DIFFERENT JOBS

The motivating potential of jobs within data processing varies widely, as measured by MPS. The job of data processing manager scores nearly twice as high as program maintenance, for instance. Figure 2.2 compares the MPSs of data processing jobs with other jobs, based on the results of studies by Daniel Cougar, Robert Zawacki, and Mel Colter (references 1 and 2). These studies were undertaken in the United States in 1980 and 1985. The researchers surveyed more than 1,500 staff using Hackman and Oldham's job-diagnostic survey technique described above.

Figure 2.2 also shows the MPSs for five systems development jobs and the average for all systems development jobs, and compares them with the MPSs of two further categories of job — other professional staff and other managers. Of the five systems development jobs, data processing management has the highest MPS at 199, and maintenance the lowest at 106. Programming scores 137, whilst analysts and analyst/programmers are virtually the same at 154 and 152 respectively. Of the dimensions that make up the overall MPS for each of the five data processing jobs, it is work feedback which scores lowest in all cases except one.

Figure 2.2 Motivating potential of systems development jobs compared with other jobs

Job dimension	Systems development jobs						Other jobs	
	Analysts	Analyst/ Pro-grammers	Pro-grammers	Main-tenance [1]	Managers	All staff	Pro-fessionals	Mana-gers
Skill variety [2]	5.55	5.45	5.23	4.80	6.16	5.41	5.36	5.57
Task identity [2]	5.37	5.29	5.00	4.30	5.80	5.21	5.06	4.72
Task significance [2]	5.75	5.72	5.46	5.40	6.30	5.61	5.62	5.81
Responsibility for work done	5.31	5.49	5.13	4.70	6.10	5.29	5.35	5.73
Knowledge of outcome of work (feedback)	5.20	5.05	5.10	4.30	5.25	5.13	5.08	5.15
Motivating Potential Score (MPS)	154	152	137	106	199	154	154	156

Notes: 1 Data relates to staff who spend more than 80 per cent of their time on maintenance work.
2 The average of the rating for each of these dimensions forms the rating for the importance of the job.
3 MPS is calculated by multiplying the average rating of the first three dimensions by the rating of the last two dimensions.

The above data comes from a US survey carried out by Cougar and Zawacki in 1980, except for maintenance staff, where the data was gathered in a 1985 US survey by Cougar and Colter. In both cases, survey respondents rated each of the job dimensions on a scale of 1(low) to 7(high).

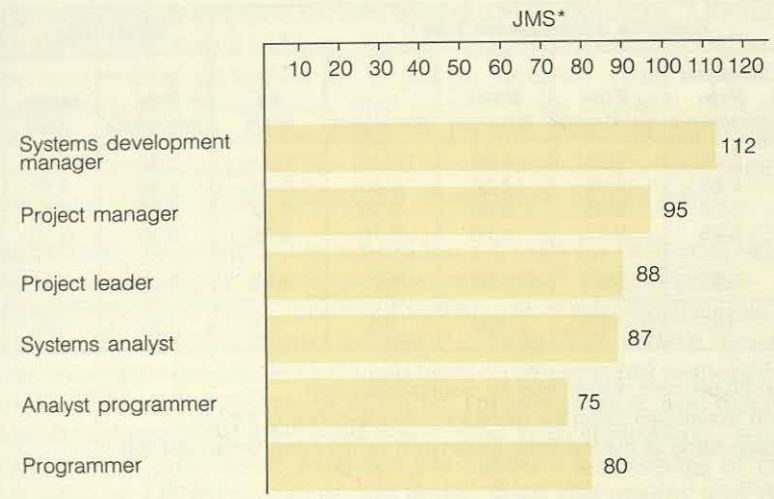
In our own survey of 600 data processing professionals conducted for this paper (see pages 3 and 4), we undertook a similar investigation to those of Cougar, Zawacki, and Colter. However, we asked for two sets of responses to the job-diagnostic survey questions. One set measured how important respondents judged the dimensions to be in affecting their ability to work well; the other set measured their assessment of satisfaction with each job dimension in the context of their working environment. Our survey respondents also quantified their responses using a seven-point scale, which we were able to reconcile with the points-scoring method used in the American surveys. We refer to the measures of motivation derived from our own survey as Job Motivation Scores (JMSs) to distinguish them from the MPS scale used by Cougar, Zawacki, and Colter.

We found both similarities and differences between the JMS and MPS results. There was considerable agreement between the surveys over the large difference in the motivating potential of jobs within data processing. Figure 2.3 overleaf shows the JMSs of the six jobs that we measured. Both results suggest that the motivating potential of jobs rises through the ranks from programmers' jobs to systems development managers' jobs.

MOTIVATING POTENTIAL OF MAINTENANCE WORK

We examined how involvement in maintenance work affects the motivating potential of systems development jobs. The result, measured on the JMS scale, is shown overleaf in Figure 2.4. The pattern is one of falling job motivation as the level of maintenance work increases, except for those fully or almost fully involved in maintenance. The score on the JMS scale for the latter group was only just less than that for programming work in general, in contrast to the finding of Cougar's survey (see Figure 2.2 again), which rated the motivating potential of the equivalent level of maintenance work at a significantly lower level than programming

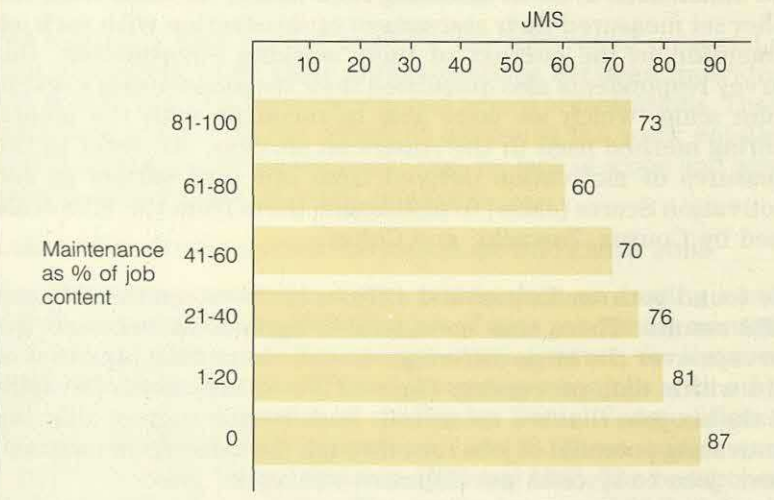
Figure 2.3 Job Motivation Scores (JMSs) for systems development jobs



*JMS is the product of three ratings, each of which is in the range 1 (low) to high (7). The three are importance of the job, responsibility for the work done, and knowledge of the outcome of the work.

(Source: Butler Cox survey of PEP sponsors)

Figure 2.4 Job Motivation Scores (JMSs) vary according to the amount of maintenance work performed



(Source: Butler Cox survey of PEP sponsors)

work in general. However, the number of staff involved in this level of maintenance in our survey was small and the data is therefore less reliable. The implication of both surveys is clear, however. Maintenance work should be minimised as much as possible at the individual level, by spreading it around the work force. Alternatively, systems development managers need to make sure that those engaged in full-time maintenance work are selected carefully. (We shall return to the topic of maintenance work in the next PEP Paper.)

VARIATIONS FOR OTHER REASONS

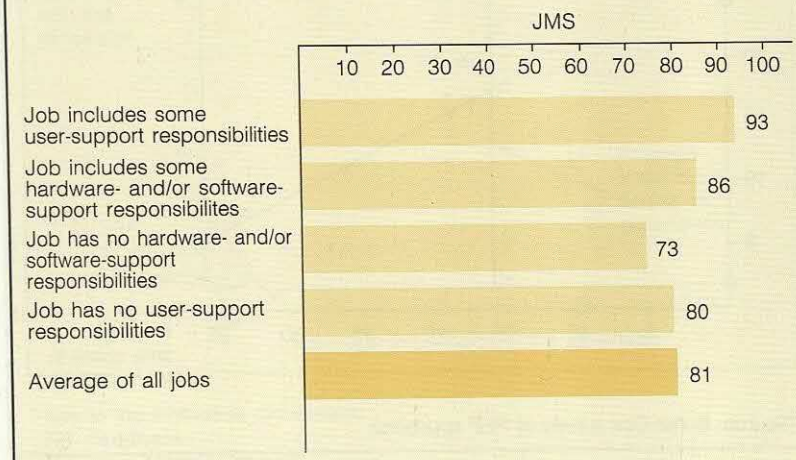
As well as variations in the motivating potential of jobs caused by the nature of the work itself, we also examined other reasons for differences in motivating potential. They can be summarised under three headings: support responsibility, work variety, and feedback.

Support responsibility

A job has a greater motivating potential when some user or technical support is included

Responsibility for directly supporting the user community is a positive motivating factor in systems development work, as is responsibility for directly supporting an aspect of the hardware or software. These findings are apparent both from Figure 2.5, and by comparing the motivating scores returned by the different businesses represented in our survey. Figure 2.5 shows that, when some user or technical support is included, a job has a greater motivating potential than when it is excluded.

Figure 2.5 Job Motivation Scores (JMSs) vary according to the support responsibilities of the job



(Source: Butler Cox survey of PEP sponsors)

One of the businesses in our survey reported a significantly higher JMS score for its systems development staff than the other six. We believe that this is due, in part, to the job-enlargement policy that this company has adopted. Its systems development staff are encouraged to become experts not only in systems development project work, but also in defined areas of software, hardware, and user support. The consequence of the job-enlargement policy is to increase skill variety, task significance, and personal responsibility.

Work variety

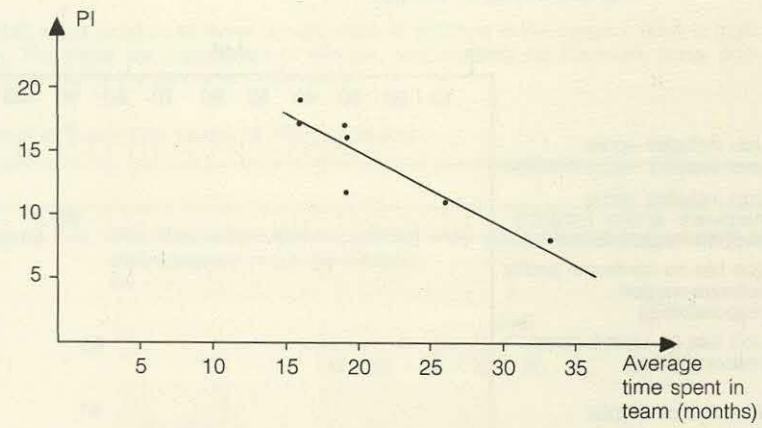
Greater work variety is a positive motivator

After a time, any job can become mundane when it lacks variety. Greater work variety is a positive motivator. Apart from career development, which by nature introduces individuals to a changing pattern of work and responsibility, the most obvious way of introducing variety is through job rotation. Some businesses take a planned approach to job rotation precisely because of the benefits it can deliver. One organisation, for instance, moves programmers into new teams every two to two-and-a-half years, and

systems analysts every three to three-and-a-half years. It further increases work variety by providing its staff with opportunities to develop productivity aids.

Figure 2.6 compares the typical Productivity Index (a key measure used in PEP productivity assessments) for each of the seven surveyed organisations with the average time spent in project teams. The figure suggests that there is a relationship between productivity and the time spent in project teams — with the Productivity Index reducing as the average time increases. This does not necessarily imply a causal relationship — both parameters could be influenced by project size, for example. The implied relationship is, however, consistent with the fact that projects of short duration are more manageable than long ones, and that they are better for avoiding the troughs in enthusiasm, drive, and vision that are often the consequence of prolonged project work.

Figure 2.6 Productivity Index (PI) reduces as average time spent in a project team increases



(Source: Butler Cox survey of PEP sponsors)

Nonetheless, excessive staff turnover should be avoided. As we demonstrate in Chapter 5, development productivity reduces once staff turnover increases beyond a certain point.

Feedback

Jobs that enable the individual to obtain feedback naturally and quickly from the work are intrinsically more motivating. Jobs that provide more limited or delayed work feedback need other external mechanisms to provide the required feedback. Hence, the importance of feedback from managers for some jobs. However, our survey indicates that systems development staff have greater expectations about the feedback from their managers than they actually receive. Systems development managers should therefore ensure that staff receive timely feedback about their performance.

Jobs providing feedback naturally and quickly are intrinsically more motivating

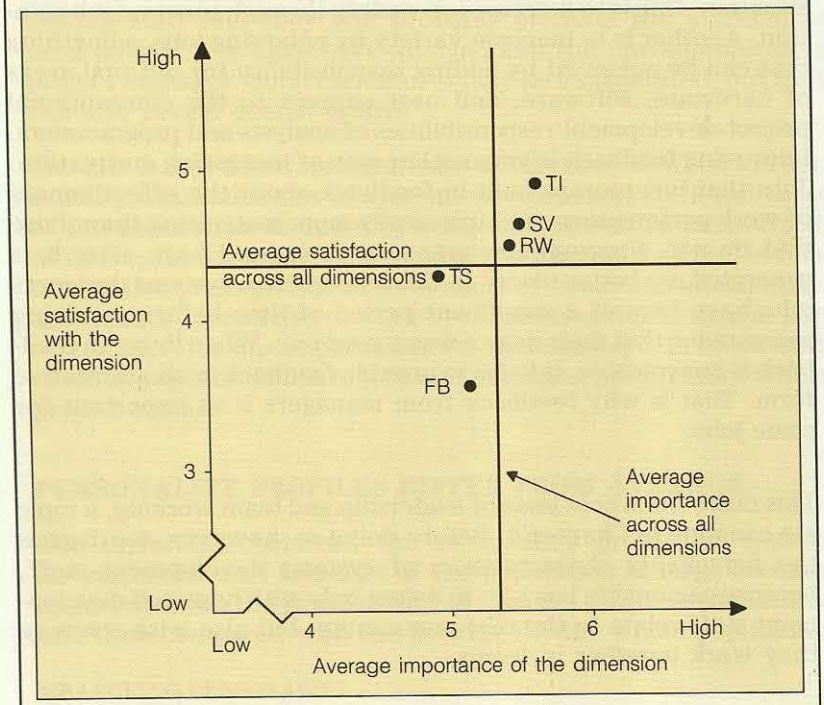
THE MOTIVATING POTENTIAL OF SYSTEMS DEVELOPMENT JOBS CAN BE INCREASED

In practice, most staff say they expect more from their jobs than they actually get. Fortunately, there are some actions that can be taken to help improve the position.

JOB MOTIVATION IN PRACTICE

Our survey of development staff asked them to rate on a scale of 1 (low) to 7 (high) the importance of, and their satisfaction with, the job-motivation dimensions. The results averaged across all staff within the seven organisations are shown in Figure 2.7.

Figure 2.7 Importance and satisfaction with the five job-motivation dimensions



Key to job-motivation dimensions:
FB Feedback
RW Responsibility for work
SV Skill variety
TI Task identity
TS Task significance

(Source: Butler Cox survey of PEP sponsors)

The dimensions rated as most important are task identity, skill variety, and responsibility for the work done. Feedback about the results of the work done was rated as having lower importance, but there was significantly less satisfaction with the feedback actually received compared to the other dimensions. The only dimension where there were significant differences in satisfaction between the seven organisations was on task significance. Overall, though, the staff in our survey saw less distinction between importance and satisfaction in the area of job motivation than in any other covered by our survey.

Our survey also asked about the importance of, and satisfaction with, feedback from the respondents' immediate managers. Here, importance was rated much higher than satisfaction than for any of the five job-motivation dimensions. Again, this emphasises that systems development managers should be paying much greater

attention to providing feedback about an individual's performance.

IMPROVING THE MOTIVATION POTENTIAL

Although it is commonplace for systems development staff to expect more satisfaction from their work than they actually get, there are steps that PEP sponsors can take to improve the situation. One is to increase job variety through planned job rotation. Another is to increase variety by enlarging jobs, something that can be achieved by adding responsibility for defined areas of hardware, software, and user support to the conventional project-development responsibilities of analysts and programmers. Improving feedback is yet another way of increasing motivation. Jobs that incorporate built-in feedback about the effectiveness of work performance are intrinsically more motivating than those that do not. Programmers whose code is used soon after it is generated are better placed in this respect than systems designers who have to wait a significant period of time before receiving reassurance that their design was a good one. When delay in feedback is unavoidable, it helps to provide feedback in an alternative form. That is why feedback from managers is so important for some jobs.

There are steps that PEP sponsors can take

This raises the whole issue of leadership and team working, a topic we examine in Chapter 4. Before doing so, however, we discuss the personality characteristics of systems development staff, because personality has a lot to do not only with how well development staff relate to the user community, but also with the way they work together in teams.

Chapter 3

Personality characteristics of systems development staff

Ask someone outside the profession for a caricature of data processing staff and they will probably mention the inarticulate programmer, the aggressive analyst, and the uncommunicative project manager. Such caricatures may be exaggerated, but they can also reveal deeper truths.

The fact is that there are significant differences between the personality characteristics of systems development staff and those of the population at large. Systems staff are more introverted, intuitive, thinking, and judgemental. As a result they are, in relation to the average, insensitive, short of communications skills, and 'loners', preferring to work by themselves rather than as part of a team. This has implications for management, in terms both of matching individuals to jobs and of mixing personalities within project teams.

PERSONALITY PROFILES DIFFER FROM AVERAGE

The difference between the personality profile of systems development staff and that of the population at large becomes apparent when the personalities of systems people are measured and then compared with the average for the whole population.

MEASURING PERSONALITY

Personality can be defined as the characteristics that determine the way a person thinks and behaves. Because it influences the behaviour and performance of staff, personality is a subject of interest to researchers. One measurement of personality is the Myers Briggs Type Indicator (MBTI), named after its two originators, Isabel B Myers and Katherine C Briggs. This measurement became widely used in the late 1970s.

The MBTI is based on the four interrelated dimensions of personality identified by Carl Jung — introverted/extroverted (I/E), sensing/intuitive (S/N), thinking/feeling (T/F), and judging/perceiving (J/P). Each dimension is a continuum extending between two end points, each of which corresponds to one of the two labels of the dimension. Thus, at one end of the judging/perceiving dimension an individual is concerned solely with processing the information to reach a conclusion (judging); at the other end, with gathering and processing information (perceiving). Similarly, an introvert is concerned with the inner world of concepts and ideas, and an extrovert with people and things in the world at large.

Individuals' personal MBTIs are stated in terms of their position on each of the four dimensions. MBTIs are assessed by using a structured questionnaire, the answers to the questions helping to position the respondents in the dimensions. Several businesses specialise in providing questionnaires of varying length and

precision that are similar in purpose and concept to the MBTI. For example, Organisation Design and Development Inc of Pennsylvania markets a product called the Personal Style Inventory. It is relatively easy to administer and is self scoring. Respondents fill in answers to each question using a numeric preference scale.

COMPARING PERSONALITY

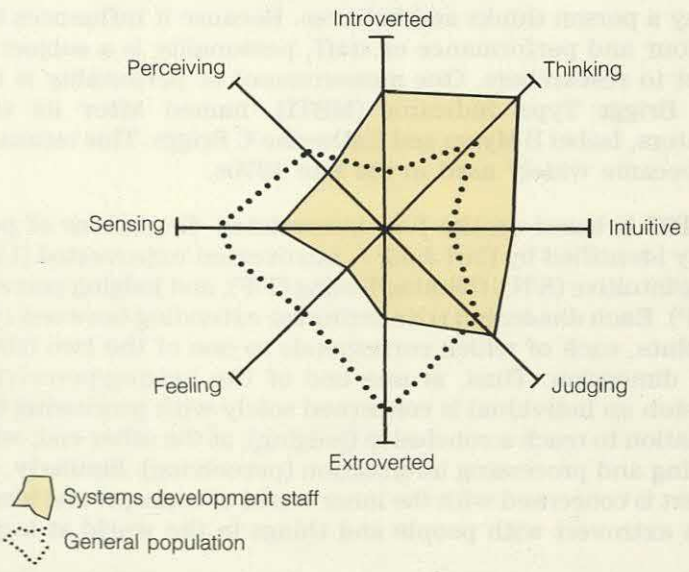
Studies have been conducted to identify the frequency of occurrence of different personalities as measured on the MBTI scale. These studies have covered both the population at large, and systems development staff. They show that there is a marked difference in the personality profile of systems development staff and the average person. Figure 3.1 provides one example. It shows that, compared to the average, systems development staff are more introverted, more intuitive, more thinking, and more judgemental. The measures of the personality profile of the systems development staff in this chart come from a study of 1,229 individuals conducted by Michael L Lyons during the period 1982 to 1985, largely in the United States (reference 3).

There is a marked difference in the personality profile of systems development staff and the average person

A more detailed analysis compares systems development staff and the general population in each of the 16 personality classifications (known as the Myers Briggs Personality Classifications) that can be combined from the end-point pairs of the four dimensions. It shows that more than half of all systems development staff fall into just three of the classifications, compared with only 8 per cent of the population at large (see Figure 3.2).

An extension of the same classification provides a further level of insight. It concludes that the typical systems development staff

Figure 3.1 Systems development staff have different personality characteristics to the general population



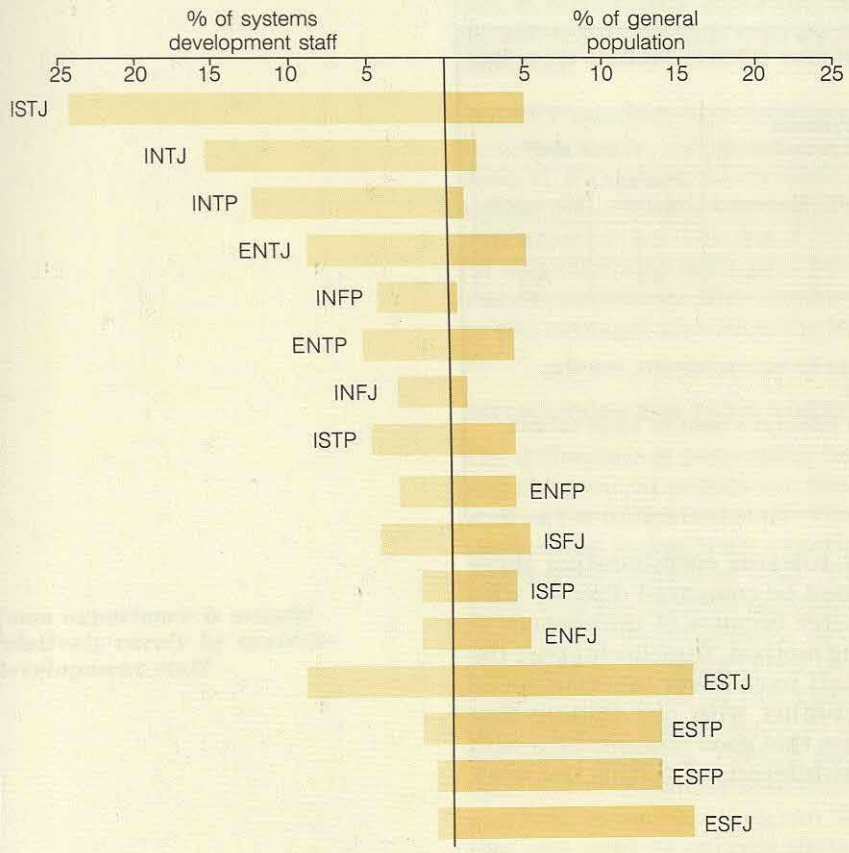
According to Carl Jung, personality characteristics can be measured on four axes. The shapes depict the proportions of the population that are extroverted and introverted, intuitive and sensing, feeling and thinking, and perceiving and judging. If all of the population displayed one of the pairs of characteristics, the shape would be wholly on that half of the axis.

personality mix contains an unusually high proportion of types known as reflective reasoners, thoughtful innovators, and logical decision makers — but an unusually low proportion of action-oriented realists and adaptable extroverts.

SOCIAL AND GROWTH NEEDS

The findings using the Myers Briggs indicator of personality is complemented by research undertaken by Cougar, Zawacki, and Colter, whose surveys of staff motivation have already been described in Chapter 2. These researchers constructed a measure of the need of staff for social contact, which they called 'social-need strength'. They found that this measure was distinctly lower

Figure 3.2 Personality comparison



Key:

I	= Introverted	E	= Extroverted
N	= Intuitive	S	= Sensing
T	= Thinking	F	= Feeling
J	= Feeling	P	= Perceiving

There are 16 personality classifications (known as the Myers Briggs Personality Classifications). Each corresponds to one of the 16 possible combinations of end points of the four personality dimensions and each is identified by the four corresponding end-point letters. Individuals are typed by the classification that accords most closely to their personality measures.

The chart shows the 16 combinations, and the proportion both of systems development staff and the general population corresponding to each one.

The most marked differences occur in six of the 16 classifications, ISTJ, INTJ, INTP, ESTP, ESFP, and ESFJ. In summary, they can be described as having the following characteristics:

— ISTJ Serious, quiet, practical, orderly, thorough, responsible.

— INTJ Original, sceptical, critical, independent, determined, stubborn.

— INTP Quiet, reserved, logical — having sharply defined interests.

— ESTP Practical, unhurried, mechanically minded.

— ESFP Easy going, friendly, sporty, practical.

— ESFJ Warm hearted, talkative, popular, conscientious, cooperative.

The chart shows that three of these classifications (ISTJ, INTJ, and INTP) account for more than half of all systems development staff, but only 8 per cent of the population at large. The other three (ESTP, ESFP, and ESFJ) account for 4 per cent of systems development staff, but 42 per cent of the general population. Clearly, the personality of systems development staff is by no means representative of the population at large.

(Source: Michael L Lyons)

for data processing staff than for other professions. They also obtained a measure of an individual's need for accomplishment, learning and developing, and for being stimulated and challenged, which they defined as 'growth-need strength', or GNS.

Significantly, Cougar, Zawacki, and Colter found that GNS measures are higher amongst systems development staff than in the population at large, and that social-need strength measures are lower than in the population at large. They also found more high GNS types amongst the systems development community than average. High GNS types are characterised by stronger goal orientation, ambition, interest in further education, assertion, inquisitiveness, and initiative. There was some difference in GNS (and need for social contact) between individuals in their survey, as Figure 3.3 indicates. GNS was highest amongst data processing managers.

Figure 3.3 Systems development staff have different needs to other staff

Needs measure	Systems development staff		Other staff	
	All staff	Managers	Profes-sionals	Managers
Growth-need strength (GNS)[1]	5.9	6.3	5.6	5.3
Social-need strength[2]	4.2	4.5	5.5	6.0

Notes:
1 GNS is a measure of an individual's need for accomplishment, learning, development, stimulation, and challenge.
2 Social-need strength is a measure of an individual's need for social contact.

(Source: Survey by Cougar and Zawacki)

Our own survey went some way towards corroborating these findings. Although the results cannot be compared directly with those of Cougar, Zawacki, and Colter because of differences in the questions posed and the scoring method, they do support the view that systems development staff have lower inherent social needs. However, this does not conflict with our finding that systems development staff recognise that good relationships with team members are important in the interests of getting the work done.

PERSONALITY DIFFERENCES AFFECT PROJECT SUCCESS

We said above that systems development staff are comparatively introverted, intuitive, thinking, and judgemental. They also have a relatively low need for social contact, and a relatively high one for training, development, and difficult assignments. There is evidence that these characteristics have a direct bearing on the success of project teams. It helps to take account of personalities when composing teams, which implies the need to measure the personalities of systems development staff.

It helps to take account of personalities when composing teams

IMPLICATIONS FOR THE INDIVIDUAL

The first implication of the personality characteristics of systems development staff is that they are more suited to working on

self-contained tasks. Supervisors and managers should therefore recognise that they are more likely to be managing a group of individuals rather than teams.

The second implication is that systems development people may be less inclined to communicate because of their leaning to introversion and their relatively low need for social contact. This inclination may also contribute to increased risks when using larger teams for systems development projects.

The third implication arises from the fact that systems development staff have high GNS measures. We said earlier that GNS types are characterised by being goal oriented, ambitious, and internally motivated, by their drive to seek increasingly difficult assignments, and by their need for feedback. To a large extent, these characteristics substitute for their low need for social contact. It is therefore important to match an individual with a high growth-need strength with a job that provides a high motivating potential.

One PEP sponsor, with high productivity as measured by the Productivity Index, recognises the individuality of its staff by asking them at six-month intervals about their wishes for future work assignments. It believes that between 90 and 95 per cent of staff requirements are being met. There is also strong encouragement for development managers to take account of individual needs and circumstances. This is achieved by clarifying what is expected by the manager and what the individuals are prepared to commit to.

IMPLICATIONS FOR TEAM WORKING

Team experience is sought relatively rarely by systems development staff

The difference in personality between systems development staff and the general population has implications for project teams as well as for individual staff. The first, and perhaps most obvious, implication is that team experience is sought relatively rarely by systems development staff. Perhaps less obvious is the consequence of the relative dominance of thinking as opposed to feeling types amongst systems development staff (81 per cent were classified as thinking types, according to the study by M Lyons referred to earlier in this chapter). The lack of feeling types in development teams seems to be an important contributor to the failure of projects. Feeling people are probably able to understand more completely than thinking types what others really think and believe because they can 'feel' the meaning behind the words that are used to express them.

Research by Kate Kaiser and Robert Bostrom (reference 4) seems to show that project teams should contain a balance of thinking and feeling personalities. Ideally, this balance should be reflected in both the systems development staff on the team, and the user department's representatives. Kaiser and Bostrom investigated a series of four projects within a single company, the first three of which were failures whilst the fourth was a success. They examined the mix of personalities of those involved in the successful project and one of the unsuccessful ones, looking for an explanation of the different project outcomes. The personality mixes in the unsuccessful and the successful teams were much the same for three of the four dimensions. The main difference occurred in the thinking/feeling dimension where, in the failed project, the

team members (including the user representatives) were thinkers rather than feelers, whereas the user department's clerical staff contained a much higher proportion of feelers.

In the successful project, feeling types were distributed almost equally amongst the user department, user representatives, and systems development staff. Moreover, although offset somewhat by the more extroverted user representatives, the complete absence of extroverted types amongst the systems development staff in the failed project seems certain to have had an influence.

Systems development managers may complain that it is hard enough to pick team members already, without the further complication of ensuring that the optimum personality mix is obtained. On the other hand, it is important to get it right if project success depends on getting the right blend. Knowing the personality characteristics of the staff is an essential starting point. It follows that we believe that systems development departments should introduce personality testing.

Systems development departments should introduce personality testing

Chapter 4

Team size, composition, and leadership

Because team working is commonplace in systems development, it is important to understand the factors that affect team productivity. In this paper, we are concerned with factors to do with individuals' personality and characteristics, and the way they interact in the team situation. The factors are many and diverse. In this paper, we focus on three of the most important — team size, team composition, and the role of the leader.

We consider these three factors in turn in this chapter, showing that small teams of five or six people are generally more productive than large ones, and that the primary role of the team leader is to facilitate the work of the team, and to influence the behaviour of team members through participation, support, goal setting, planning, and so forth.

SMALL TEAMS ARE MORE EFFECTIVE THAN LARGE ONES

Although they may not have disappeared entirely, the days of large monolithic systems development project teams are passing. Most organisations undertaking large systems development projects now usually break the project into a series of smaller self-contained ones. Our view is that the work should be subdivided so it can be performed by teams containing no more than five or six staff.

TEAMS AND TEAM ROLES

Although it is normal for systems development work to be undertaken by teams, little true team work takes place in practice. If it is properly planned, much of the work — particularly in the main system-build phase — can be made up from units of complete self-contained tasks. Each task can be undertaken by an individual, with short, though critical, periods of communication between the individuals performing the tasks. This principle is analogous to those used for high-quality system-design work, which is based on the principles of low coupling (little dialogue between modules) combined with high cohesion (grouping together highly interrelated tasks). The main purpose of grouping the individuals into teams is to ensure that everyone is committed to, and working towards, achieving the overall objective of developing a successful system. The key task for the team leader is to ensure that individuals' goals are aligned with those of the team.

Although much systems development work can be accomplished by individuals, there are times when genuine team working is needed in every project, such as during the design phase. Team composition and ensuring that the roles of the individual are clearly defined then become crucial.

There is a considerable body of material about the number of identifiable roles in a team. A case in point is the work carried out

by Dr R Meredith Belbin of the Industrial Training Research Unit (formerly part of University College, London) — reference 5. His research led him to identify eight team roles, each of which he believed to be essential to the success of the team (see Figure 4.1). This analysis assumes little or no ambiguity in role definition — something that becomes increasingly hard to achieve as the

Figure 4.1 Eight roles are essential for a successful team

Role	Typical characteristics	Positive qualities	Allowable weaknesses
Company worker: turning concepts and plans into practical working procedures; carrying out agreed plans automatically and efficiently.	Conservative, dutiful, predictable.	Organising ability, practical common sense, hard-working, self-discipline.	Lack of flexibility, unresponsiveness to unproven ideas.
Chairman: controlling the way in which a team moves towards the group objectives by making best use of team resources; recognising where team's strengths and weaknesses are; ensuring best use of members' potentials.	Calm, self-confident, controlled.	A capacity for treating and welcoming all potential contributors on their merits and without prejudice. A strong sense of objectives.	No more than ordinary in terms of intellect or creative ability.
Shaper: shaping the way team effort is applied; directing attention generally to the setting of objectives and priorities; seeking to impose some shape or pattern on group discussion and on outcome of group activities.	Highly strung, outgoing, dynamic.	Drive and a readiness to challenge inertia, ineffectiveness, complacency, or self-deception.	Proneness to provocation, irritation, and impatience.
Plant: advancing new ideas and strategies with special attention to major issues; looking for possible breaks in approach to the problems with which group is confronted.	Individualistic, serious-minded, unorthodox.	Genius, imagination, intellect, and knowledge.	Up in the clouds, inclined to disregard practical details or protocol.
Resource investigator: exploring and reporting on ideas, developments, and resources outside the group; creating external contacts that may be useful to the team and conducting any subsequent negotiations.	Extroverted, enthusiastic, curious, communicative.	A capacity for contacting people and exploring anything new. An ability to respond to challenge.	Liable to lose interest once the initial fascination has passed.
Monitor-evaluator: analysing problem; evaluating ideas and suggestions so that team is better placed to take balanced decisions.	Sober, unemotional, prudent.	Judgement, discretion, hard-headedness	Lacks inspiration or the ability to motivate others.
Team-worker: supporting members in their strengths; underpinning members in their short-comings; improving communications between members and fostering team spirit generally.	Socially orientated, rather mild, sensitive.	An ability to respond to people and to situations, and to promote team spirit.	Indecisiveness at moments of crisis.
Completer-finisher: ensuring team is protected as far as possible from mistakes of both omission and commission; actively searching for aspects or work that need a more than usual degree of attention; maintaining a sense of urgency within the team.	Painstaking, orderly, conscientious, anxious.	A capacity for follow-through. Perfectionism.	A tendency to worry about small things. A reluctance to 'let go'.

(Source: Dr R Meredith Belbin)

complexity of tasks to be undertaken by a team increases. In practice, however, Belbin found that one individual can perform more than one role so, according to this research, the number of individuals in a team need not be as many as eight.

SMALL TEAMS ARE PREFERRED

There is nothing more likely to attract media attention than a large IT development project that has failed to deliver. Few organisations these days are prepared to contemplate large projects of 100 work-years or more. Instead, they minimise the risks of failure either by trying to reduce the size of the project and the number of people in the teams engaged on each one, or by trying to divide the project into more manageable smaller ones.

One company we talked with estimated that one of its current projects would require between 100 and 140 work-years of effort. The project could be phased, but the first phase could not be reduced to fewer than 80 or 90 work-years. Furthermore, this phase had to be completed within nine months. To avoid the difficulties of managing such a large monolithic project, the company chose to split up the overall project into separate projects, each one to be undertaken by teams of no more than eight people. Another organisation (a PEP sponsor) has, in the past, used teams of up to 40 staff — but is seeking ways of avoiding this in future. It has learnt that large teams lead to problems with defining and allocating responsibilities and accountability, difficulties in identifying 'whole' or 'complete' pieces of work, problems with communications between team members, and to lower staff involvement.

The growing use of contemporary systems development methods is further encouraging the trend to small teams, as we explained in PEP Paper 6 on managing contemporary system development methods.

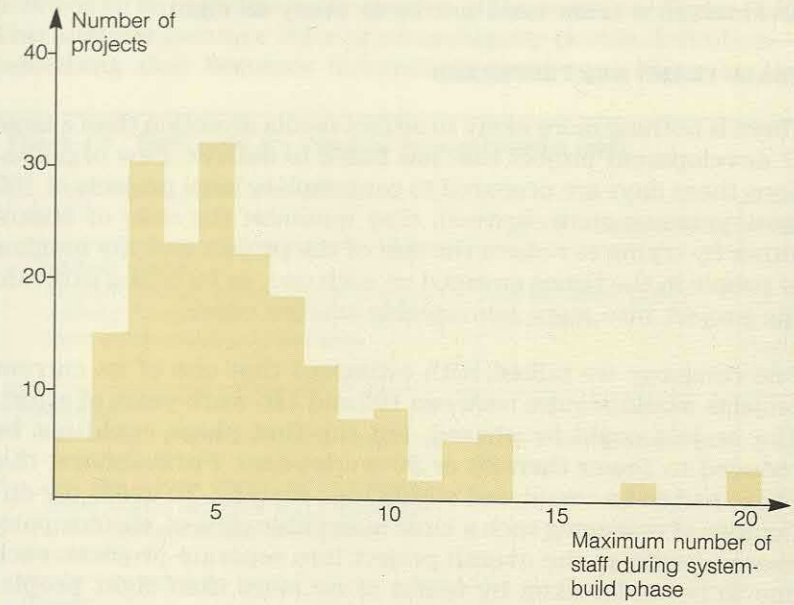
TEAM SIZE OF FIVE OR SIX IS BEST

Our view is that, whenever practical, systems development project teams should be limited to just five or six people. This consensus aligns with the research of Dr Belbin mentioned above. He found that a team of four was the minimum necessary to accommodate the essential team roles effectively. Teams of six were found to be best in terms of their stability and endurance, and their ability to allow either for some overlap in team roles, or for one or two individuals to concentrate on single roles.

Many PEP sponsors already avoid forming large teams

Many PEP sponsors already avoid forming large teams, preferring to use medium to small teams of 12 down to as few as five instead. These organisations have recognised the benefits of using small teams. This may explain why, in our survey, the importance of team size was ranked only seventh from the bottom of all the 84 factors we assessed. Organisations with small project teams no longer perceive team size as an important issue. Figure 4.2 overleaf shows the maximum number of staff used at any one time in the projects recorded in the PEP database. The most frequently occurring peak is five. Seventy-five per cent of projects have a peak staffing of 12 or less.

Figure 4.2 The maximum number of staff used on development projects



(Source: PEP database of business systems development projects)

TEAM COMPOSITION AFFECTS PRODUCTIVITY

Teams go through four stages of development. Each stage makes different demands, compounding the problem of ensuring that the team members form the optimum blend of personalities.

DIFFERENT STAGES OF TEAM DEVELOPMENT MAKE DIFFERENT DEMANDS

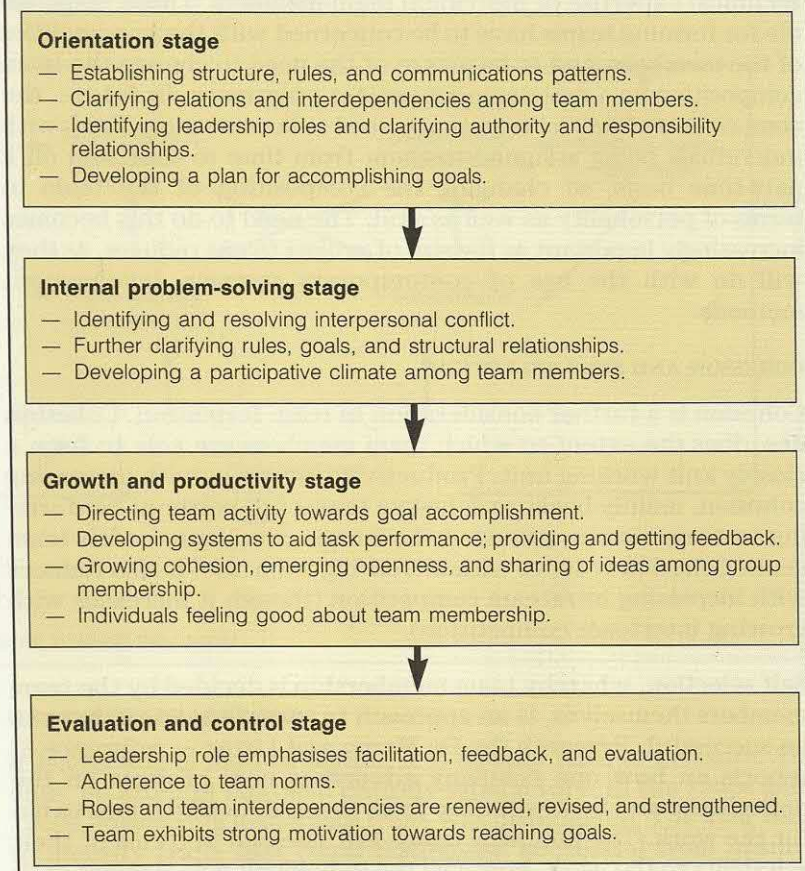
Individuals who are brought together in a systems development team do not immediately form a closely knit unit. Teams go through their own stages of development — known as orientation, internal problem solving, growth and productivity, and evaluation and control — as we illustrate in Figure 4.3. (The stages are, of course, quite distinct from the development phases of the project that the team is working on.) Team performance is heavily influenced by the team-working stage of development that has been reached. Each stage in the team-development process is characterised by different behaviour and team performance.

Team development is likely to stagnate at the internal problem-solving stage, preventing performance from progressing to the high point associated with strong cohesion and alignment of individual and team goals. Moreover, changes in team composition, structure, and leadership can cause team development to revert to an earlier stage. Team leaders need to recognise and reduce the impact of these earlier phases of team development so that the team can progress as quickly as possible to the most productive phases.

TEAM-COMPOSITION REQUIREMENTS DIFFER BY DEVELOPMENT PHASE

Systems development work tends to be more routine in the later development phases. This assertion is based on a study undertaken

Figure 4.3 Stages in the development of a team



(Source: Andrew D Szilagyi and Marc J Wallace — reference 6)

undertaken in 1986 of 68 staff from 20 large-sized firms in the United States (see reference 7). The staff had worked in data processing for five or more years, and most were systems analysts who had worked earlier as programmers. The study participants were asked to respond to questions aimed at assessing how routine the work was at each phase of development. The results, which show that systems development work becomes more routine as the phases progress, are shown in Figure 4.4.

Figure 4.4 Earlier phases of systems development are less routine than later phases

Development phase	Extent of routine tasks (on a scale of 1 to 5)
Planning	2.20
Problem analysis	2.49
Development/testing	2.87
Implementation	3.25
Evaluation	2.96
Operation/maintenance	3.64

(Source: White and Leifer)

Teams consisting of people with similar personality work best on simple routine tasks. Such teams encourage cooperation and communication. Thus teams made up of people with similar personalities will be more appropriate during the later development phases, when the extent to which work is routine is greatest. By contrast, teams made up of unlike individuals work better during the earlier project phases when the amount of routine work is smaller. Such teams are good for problem-solving tasks, and for tasks involving complex decision making because the team members stimulate each other, producing a higher level of performance and quality. Teams made up of unlike individuals can, however, create a great deal of conflict. On the other hand, teams of similar people encourage conformity, which can lead to unproductive activity if the team norms (for work output, quality, working practices, and so on) are not consistent with team goals.

From the above, it is clear that the formation of a balanced team requires that account be taken of considerably more than the technical expertise of individual team members. Those responsible for forming teams have to be concerned with the personalities of the members, and to be aware of the need to change the team composition as a development project progresses. In future, the composition of project teams may need to become more fluid, with individuals being assigned to them from time to time and on a part-time basis, so changing the composition of the team in terms of personality as well as skill. The need to do this becomes increasingly important as the size of project teams reduces, as they will do with the use of contemporary systems development methods.

The formation of a balanced team means taking account of more than technical expertise

COHESION AND SELF SELECTION

Cohesion is a further consideration in team formation. Cohesion describes the extent to which team members are able to form a closely knit working unit. Productivity improves with increasing cohesion, mainly because cohesive teams are better at conforming to team norms, provided the norms are aligned with team goals. Cohesion reduces with increasing team size. It also reduces with increasing intrateam competition (though it increases with growing interteam competition).

Productivity improves with increasing cohesion

Self selection, whereby team membership is decided by the team members themselves, is an approach to team formation that can be successful. Research (by De Marco and Lister — reference 8) reports on how one company advertises new projects on the noticeboard and invites staff to form themselves into teams to bid for the work. The potential teams are assessed in terms of their suitability to the work, how well the individuals complement each others' skills, and the likely disruption to other work. Cohesion between the members of teams subsequently formed was usually high.

TEAM LEADER'S PRIMARY ROLE IS A FACILITATING ONE

Rather than acting as a driving force, the primary role of team leaders is to influence, assist, and motivate team members in their work. The primary way in which team leaders can effectively carry out this role is to adopt an appropriate combination of four behaviour patterns known as participative, supportive, goal-oriented, and organisational.

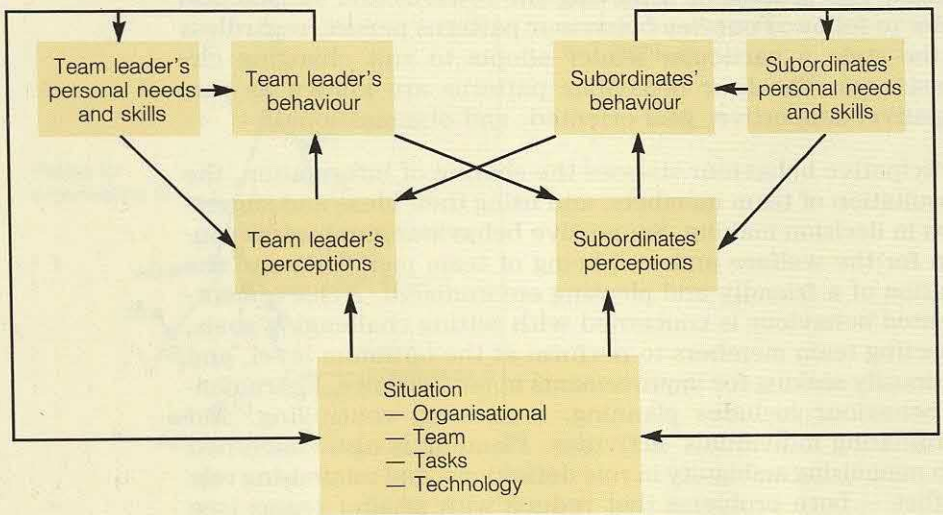
TEAM LEADERS NEED TO ADDRESS MANY FACTORS

Leadership is hard to define. What the many studies of the subject show most clearly is that it defies complete understanding. A composite of the views and perspectives available is shown in Figure 4.5. This figure illustrates that the team leader is only one influence on an individual's behaviour. The team leader's behaviour is likewise influenced by many factors including that of the individuals in the team. Team leaders therefore need to take account of the factors that may be influencing individual performance, and either act to alleviate or change the factors that are causing unproductive behaviour, or act to increase the strength of other influences that promote productive behaviour.

Figure 4.5 Characteristics of team leadership

The team leader is only one of several influences on the behaviour of subordinates.

Note that people's behaviour is not directly influenced by their situation — only by their perception of it. Their own personality and skills, as well as their perception of the work situation, are all influenced by their previous work experience both within the team and organisation and from previous employment.



The arrows represent influences and the directions in which they apply

MEASURING LEADERSHIP

If leadership is hard to define, it is equally hard to measure. To date, no attempt has been entirely satisfactory. In the 1940s and 1950s, measuring leadership traits was fashionable. The idea was to identify traits that could distinguish successful from unsuccessful leaders by looking at physical characteristics, social background, intelligence, personality, and task-related and social characteristics. The results proved inconsistent in terms of a correlation between these characteristics and leader effectiveness. But they did point to the importance of certain characteristics of leaders: alertness, self confidence, personal integrity, self assurance, and dominance; their high need for achievement and responsibility, initiative, and their high task orientation; and their active participation in various activities, their personal-interaction strengths, and their willingness to cooperate with others.

In the 1950s, behavioural theories were concerned with leaders' actions. The theories concentrated on two basic leadership styles, task and employee orientation. Research at that time concluded that behaviour alone was an insufficient explanation of leadership in practice, and that other situational factors needed to be taken into account.

By the late 1960s, situational theories were in vogue. These theories were concerned with results and indicated that leaders' effectiveness depended on their ability first to diagnose a situation, and then to change either the various situational factors or to adopt an appropriate leadership style.

TEAM LEADER'S ROLE

Although the definition and measurement of leadership remains something of a mystery, the requirements of the team leader's

role in systems development are clearer. The role of the team leader is a facilitating one — it is oriented primarily to helping individual team members to increase personal reward and satisfaction by aligning individual goals with team goals and by acting to make the process of achieving the rewards and satisfaction easier to follow. Four key behaviour patterns persist, regardless of the style a particular leader adopts to suit changing circumstances. The four behaviour patterns are known as participative, supportive, goal oriented, and organisational.

Participative behaviour stresses the sharing of information, the consultation of team members, and using their ideas and suggestions in decision making. Supportive behaviour emphasises concern for the welfare and well-being of team members, and the creation of a friendly and pleasing environment. Achievement-oriented behaviour is concerned with setting challenging goals, expecting team members to perform at the optimum level, and continually seeking for improvements in performance. Instrumental behaviour includes planning, organising, controlling, and coordinating individuals' activities. Planning is also concerned with minimising ambiguity in role definitions, and minimising role conflict — both problems that reduce with smaller teams (see page 25). Different team members will respond in different ways to the behaviour patterns of the team leader. An effective team leader will therefore need to adjust his or her behaviour to suit specific situations and individuals.

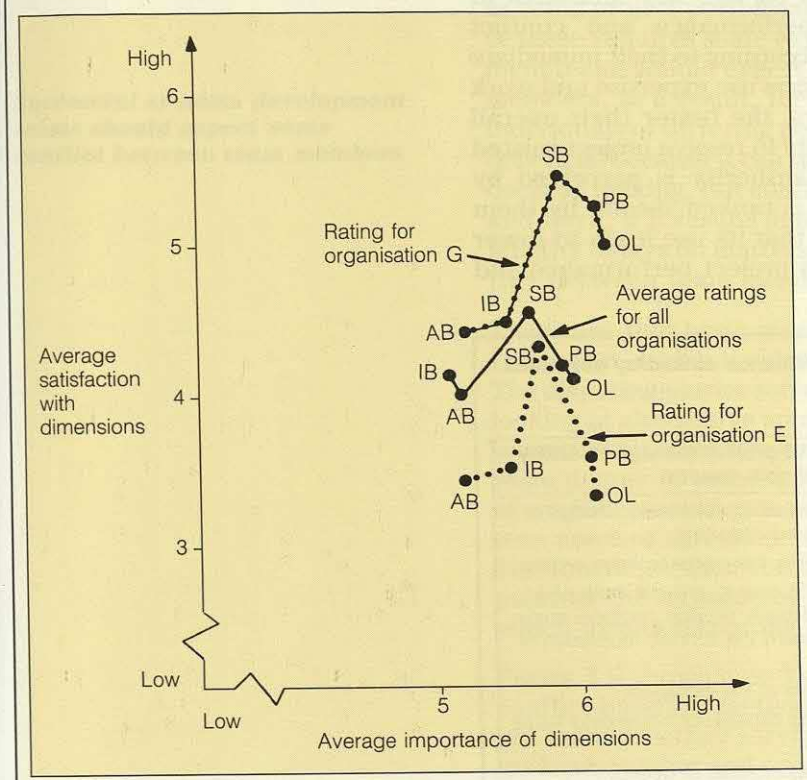
The importance of leadership abilities and styles is clear to development staff

The importance of leadership abilities and styles is certainly clear to the development staff we surveyed. Overall, they ranked the leadership abilities and style of their immediate manager as sixth out of the 84 factors. The extent to which their expectations about their immediate managers' leadership abilities and styles are being met is illustrated in Figure 4.6. The figure shows the average importance and satisfaction ratings across all seven organisations and also the average scores for the staff in two specific organisations ('E' and 'G' in Figure 1.4). In general, there is less satisfaction relative to importance with the immediate managers' leadership than for most other factors studied in our survey. But there are considerable differences between the different organisations. For example, the staff in organisation G rated their satisfaction with their immediate managers' styles higher than those in organisation E on all five dimensions of behaviour, although they had rated the importance of the dimensions very similarly.

A preliminary analysis of the data suggests that at least half of the organisations we surveyed may need to pay some attention to this area. The problem appears to lie mainly in staff not feeling they are being given the opportunity to participate sufficiently in their immediate manager's decision making. Some organisations are already well aware of the need to do this, however. One PEP sponsor, noted for its high systems development productivity, emphasised staff participation in a recent recruitment campaign. This campaign was based on a survey of existing staff, who identified participation as a consistent and necessary theme in their working environment.

Another important characteristic of team leadership is the flexibility to adapt leadership style to suit the circumstance of the moment. Flexibility becomes increasingly important when project

Figure 4.6 The importance of and satisfaction with dimensions of the immediate manager's behaviour



Systems development staff were asked to rate the importance of, and their satisfaction with, various dimensions of their immediate manager's behaviour on a scale of 1 (low) to 7 (high).

Key:
AB Achievement-orientated behaviour
IB Instrumental behaviour
OL Overall leadership ability and style
PB Participative behaviour
SB Supportive behaviour

(Source: Butler Cox survey of PEP sponsors)

and team requirements change from phase to phase of systems development. Flexibility is required for several reasons. One is to handle the changing nature of work in the different phases. Another is to handle the development in team working that takes place between initial orientation and final evaluation (see Figure 4.3). Other requirements of leadership flexibility are to handle different situations and individual team members, and to handle different types of conflict situation — a topic that we consider in the next section.

PERSONAL EXPERTISE IS TEAM LEADER'S STRONGEST SOURCE OF INFLUENCE

To substantiate their position, leaders need a portfolio of strengths, called an influence base. The need for an influence base is recognised by leaders' managers, and is reinforced by research into the effect of influences on leaders' effectiveness in securing project performance, and in resolving conflicts.

INFLUENCE BASE

According to some researchers, there are nine separate sources of influence that can be distinguished within a leader's influence base. It is the relative importance of these influence sources that is particularly interesting.

A survey (by Thamhain and Wilemon — reference 9) has revealed that, according to project managers, the top three influences

are expertise, authority, and work challenge (see Figure 4.7). The research programme of which the survey was a part went on to look at the effect of each influence on two key measures of leaders' effectiveness — project performance and conflict resolution. The research found that, according to their immediate superiors, the more that project managers use expertise and work challenge to influence team members, the better their overall performance and the greater their ability to resolve project-related conflict (see Figure 4.8). Although authority is perceived by project managers to be important (it is ranked second by them to expertise), their superiors believe that its use leads to lower effectiveness ratings in terms of both project performance and conflict resolution.

Figure 4.7 Project manager's sources of influence ranked by perceived importance

Source of influence (in rank order)	Characteristics of project manager's ability to influence and gain support
Expertise	Perceived as possessing special knowledge or expertise considered important.
Authority	Perceived as having the power to issue orders.
Work challenge	Perceived as being able to provide work of a kind that will particularly provide personal enjoyment; oriented toward the intrinsic motivation of personnel.
Friendship	Personally attractive to the individual.
Future work assignment	Perceived as being capable of influencing future work assignments.
Fund allocation	Perceived as being capable of directly dispensing funds.
Promotion	Perceived as being capable of indirectly dispensing valued organisational rewards.
Salary	Perceived as being capable of directly dispensing monetary rewards.
Penalty	Perceived as being capable of directly or indirectly dispensing penalties to be avoided.

(Source: Survey of 100 project managers by Thamhain and Wilemon)

Figure 4.8 Effectiveness of project manager's sources of influence

	Correlation* between source of influence and effectiveness	
Source of influence	Conflict resolution	Project performance
Expertise	+0.25	+0.40
Authority	−0.25	−0.25
Work challenge	+0.20	+0.30
Friendship	+0.10	+0.05
Future work assignments	+0.10	—
Promotion	+0.10	—
Fund allocation	—	+0.15
Salary	—	−0.25
Penalty	+0.35	+0.30

*Kendall rank correlation coefficients, which can range from −1 to +1. Positive correlations indicate that the source of influence has a positive effect on effectiveness.

(Source: Survey of 100 project managers' superiors by Thamhain and Wilemon)

CONFLICT RESOLUTION

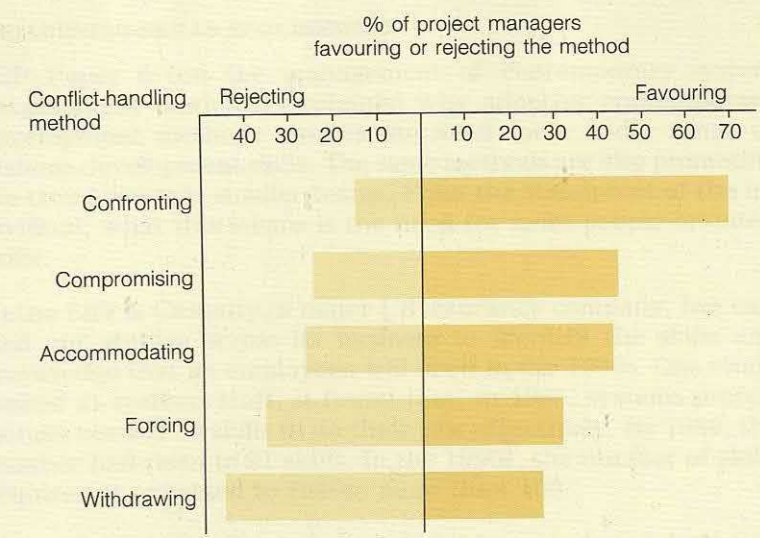
Successful systems development teams should expect some conflict between team members

We have mentioned two key measures of a leader's effectiveness as being project performance and conflict resolution. The second of these requires some explanation. Successful systems development teams should expect there to be some conflict between team members, as a result, for instance, of teams being composed of individuals of differing personality. Up to a point, conflict can be beneficial because it can help to introduce ideas that lead to better decision making. But conflict is destructive if it erodes team effort and spirit, if it results in poor decision making, or if it introduces lengthy delays on matters of insignificance. So the degree of conflict between team members has to be managed.

There are five basic ways of managing conflict. One is by confrontation, which involves a rational problem-solving approach. The disputing parties solve their differences by focusing on issues, looking at alternative approaches, and selecting the best one. The second is by compromising: searching for a solution that brings some degree of satisfaction to all the parties. The third method of conflict resolution is accommodation, which emphasises common areas of agreement and de-emphasises areas of difference. The fourth is called forcing, which involves adopting one viewpoint at the expense of another. Finally, there is withdrawal, which means retreating from the conflict issue.

Figure 4.9 shows how Thamhain and Wilemon's research found conflict-handling methods to be favoured or rejected by the project managers they surveyed. Confrontation was favoured by the greatest number and rejected by the fewest number. Withdrawal was least popular. Project managers that emphasised expertise and work challenge as their most important influences were most likely to resolve conflicts by confrontation, at the same time avoiding withdrawal. Those favouring withdrawal (and compromising) tended to use friendship as their most influential means of managing conflict.

Figure 4.9 Use of conflict-handling methods by project managers



(Source: Survey of 100 project managers' superiors by Thamhain and Wilemon)

Interestingly, Thamhain and Wilemon also found that project managers who emphasised expertise had to deal with increased conflict on technical issues. They concluded that project managers were more concerned about the outcome of a conflict situation and its impact on project performance than they were about the intensity of conflict.

The implication for systems development is that team leaders should be selected on the basis not only of their technical expertise but also their ability to resolve conflicts among team members. Selecting the optimum mix of team members and leaders, however, is not sufficient to ensure productive systems development. It is also necessary to take account of skills requirements, the working environment, and the opportunities that staff have for personal advancement.

Chapter 5

Skills, environmental factors, and personal advancement

So far in this paper we have been concerned with the motivating nature of systems development work, and with staff personality and the effect on team performance of personality mix and team size. In this chapter we introduce a further dimension — the changing skills that are required by systems development staff as a result of recent changes not only in methods and tools, but in the nature and type of systems that are worked on.

These changes herald a need for people of a more generalist nature in systems development — perhaps with personalities less different from those of the world at large. This puts a new emphasis not only on recruitment, but also on training and goal setting in systems development departments. A further dimension affecting productivity is the physical working environment. We examine these points in turn in this chapter. Finally, we explore the importance of providing an opportunity for systems development staff to realise their own personal goals. Providing appropriate opportunities assists with staff retention and motivation, both of which are key elements of productivity.

NEW SKILL REQUIREMENTS POINT TO STAFF WHO ARE BETTER GENERALISTS

Today's systems and methods require systems development staff to have a range of skills that is wider than has previously existed. In particular, there is now a requirement for more people-oriented skills. The changing skills requirement points to staff who can combine areas of specialism with a broad range of general skills.

BROADENING SKILLS REQUIREMENT

The need is for more people-oriented skills

PEP Paper 6 (on the management of contemporary system development methods) explained why adopting contemporary development methods creates the need for a wider range of systems development skills. The same methods are also promoting the trend towards smaller teams. From the standpoint of the individual, what this means is the need for more people-oriented skills.

Aetna Life & Casualty, a major US insurance company, has carried out studies across its business to identify the skills and knowledge that its employees will need in the 1990s. One study looked at systems staff. It found that, in 1985, systems professionals needed 34 skills to do their jobs effectively. By 1988, the number had risen to 91 skills. In the 1990s, the number of skills required is expected to rise to more than 100.

Many of the additional skills are of a business and organisational, rather than a technical, nature. This assertion also follows from other recent studies into skills requirements, particularly those

of systems analysts. In general terms, the studies show that skills can be clustered into groups, and that the groups can be ranked in order of importance as follows: people, the business, systems, society at large, computers, and modelling.

The study of systems staff at Aetna Life & Casualty categorised skills under four headings. The first is technical skills, covering areas such as programming productivity, new analysis and design techniques, new maintenance tools, fourth-generation languages, expert systems, and telecommunications. The second is people skills, including: negotiating with users and suppliers; relating with users, colleagues, and management; setting goals; managing time and stress; and communicating both orally and in writing. The third heading is business knowledge, including general industry and market knowledge, and knowledge about the company's products and services. Finally, the fourth heading is change skills, which are aimed at equipping staff to deal with change and cover topics such as migrating to new technologies, learning to work closely with people in new areas of the company, and understanding organisational behaviour.

What is striking about this list of skills is its sheer breadth. On page 38, we describe how Aetna Life & Casualty is tackling the problem of training its systems development staff.

IMPORTANCE OF NONTECHNICAL SKILLS

According to many researchers, the most important of the many skills needed by systems analysts for the successful outcome of a project are those to do with people. This finding accords with the results of our own survey, which found that systems development staff rank people skills ahead of technical skills, and technical skills ahead of change skills and business knowledge (these last two were equally ranked). Interestingly, this finding at first sight seems to be at variance with what systems analysts actually concern themselves with in practice. According to a study undertaken by Nicholas P Vitalari (reference 10), they place more importance on systems matters than either people or organisational matters (probably, in our view, as a consequence of their personality and skills).

The most important of the many skills needed by systems analysts are those to do with people

Vitalari based his findings on the frequency with which systems analysts mentioned what he called 'knowledge categories' (200 were identified). His contention was that high frequency of mention implied high perceived importance. Systems analysts were questioned individually about how they would determine the requirements for an accounts-receivable system. Twenty of the knowledge categories accounted for as much as 60 per cent of mentions. The next 30 accounted for 15 per cent of mentions.

In an interesting extension of this study, Vitalari examined a further set of knowledge categories in an attempt to isolate the differences in the performance of high-rated and low-rated analysts. He found several common characteristics amongst the high-rated analysts. They were more aware of the interplay between the development process and the characteristics of the business; more concerned about systems outputs than inputs and processes; more interested in gaining user participation in the development process; and more focused from the outset on the later stages of systems development.

T-shaped systems development staff

Systems development staff perform better when they possess strong people and business skills, as well as technical skills. They also perform better when they are equipped to bring a range of different skills into play at different points in time. This is because the ingredients that make for team success in project work — the so-called critical success factors — vary widely from stage to stage in systems development. What this adds up to is a need for systems development staff to be, so to speak, T-shaped — the vertical stroke representing one or more specialisations, and the horizontal bar representing a generalist's ability to perform flexibly in a variety of roles.

The evidence for this assertion comes from a study by White and Leifer (the same study that we mentioned in Chapter 4 on the effect on team characteristics of systems development routine — see reference 7). The 68 systems analysts who participated in the study were asked to identify and rank the factors that led to success in each stage of systems development work. The results are shown in Figure 5.1. What stands out is not so much the overall rank order of success factors (which places technical knowledge at the top overall, and broad perspective at the bottom), but the difference in importance accorded to each factor in each development stage. Analytical skills, for instance, are rated as the most important success factor in the systems development phase and in operations and maintenance, but only ninth in importance during the planning phase.

White and Leifer concluded that a gap exists between theory and practice in systems development. They also felt that the high ranking of communications skills referred to intrateam

Figure 5.1 Project team success factors

Sixty-eight systems analysts were asked to identify and rank the team success factors for each phase of systems development work.

Success factor	Overall ranking	Percentage of analysts identifying the factor, and ranking of the factor, for each development phase					
		Planning	Problem analysis	Systems design	Systems development	implement-ation	Operations/ maintenance
Technical knowledge	1	13.2 (3)	22.8 (1)	19.0 (1)	15.8 (2)	14.3 (3)	15.8 (1)
Good communication skills	2	14.9 (1)	10.5 (4)	13.1 (3)	10.5 (5)	23.8 (1)	15.8 (1)
Analytical skills	3	6.1 (9)	21.9 (2)	17.2 (2)	24.6 (1)	9.5 (5)	15.8 (1)
Knowing the business	4	12.3 (4)	10.5 (4)	11.1 (4)	1.8 (9)	9.5 (5)	7.0 (7)
Initiative and flexibility	5	7.0 (7)	11.4 (3)	5.1 (9)	14.0 (4)	15.5 (2)	3.5 (8)
Good organising skills	6	8.8 (5)	4.8 (7)	6.1 (8)	15.8 (2)	1.2 (10)	10.5 (5)
Experience	7	7.9 (6)	6.7 (6)	9.1 (6)	3.5 (8)	2.4 (9)	3.5 (8)
Creative skills	8	5.3 (10)	4.8 (7)	10.1 (5)	7.0 (6)	1.2 (10)	1.8 (10)
Effective leadership	9	7.0 (7)	3.8 (9)	1.0 (10)	—	3.6 (8)	1.8 (10)
User involvement	10	0.9 (12)	2.9 (10)	8.1 (7)	7.0 (6)	4.8 (7)	—
Tact	11	—	—	—	—	11.9 (4)	0.0 (13)
Dependability	12	—	—	—	—	1.2 (10)	12.3 (4)
Calm under stress	13	—	—	—	—	1.2 (10)	10.5 (5)
Good team process	14	1.8 (11)	—	—	—	—	1.8 (10)
Broad perspective	15	14.9 (1)	—	—	—	—	—

(Source: Survey carried out by White and Liefer)

communications rather than communications with others. Systems development staff seem well aware of the factors that lead to successful working relationships amongst themselves, yet this perception does not appear to extend to their working relationships with users.

TRAINING AND GOAL SETTING CAN HELP MEET THE CHANGING SKILLS REQUIREMENT

Training is one way of helping to bridge the skills gaps that we described in the previous section. Another is more frequent, formal, and directed goal setting and appraisal.

TRAINING SYSTEMS DEVELOPMENT STAFF AS GENERALISTS

From its studies of skill requirements, Aetna Life & Casualty concluded that systems staff should be trained first as generalists and then as specialists. The company believes that general skills should be provided by a core training programme, covering such topics as reasoning, logical thinking, and how to use the technology — personal computers, database technology, telecommunications, online systems, mainframes, expert systems, and so on. In-depth specialist training, the company believes, can follow later once individuals have been assigned to specific areas of work.

Traditional classroom tuition is only one of many training methods used by Aetna Life & Casualty. The company has developed 45 training 'events', ranging from prerecorded video material to week-long seminars.

More and more organisations are turning to training methods other than the traditional classroom style. This is particularly true for established IT training areas such as programming languages, basic skills, and management. The newer training methods (known generically as distance-learning techniques) include videotapes, computer-based training, and interactive videodisc systems. One organisation, for instance, has 15 interactive videodisc stations that are distributed throughout the company to enable training to take place at the convenience of the staff who need it.

More and more organisations are turning to training methods other than the traditional classroom style

The breadth of packaged training material available for in-house use is increasing rapidly, though it is our experience that the majority of systems departments have yet to take full advantage of them. The reason for this is not entirely clear. It may be because of inertia, or because of tight training budgets, or simply because of a lack of appropriate packaged training material.

The great advantage of some of the newer training methods is that they are more readily available when needed — a significant proportion of training investment can easily be wasted if it is not applied as soon as it is given.

Some organisations take account of individual personality profiles when planning their training programmes. One company we met with uses a questionnaire to obtain a profile of the learning style of each individual — whether, for example, the individual prefers to learn by practice, by observation, by course participation, by self study, or by reading. Reinforcing formal training with guides and handbooks can provide valuable post-training support. It does not have to be formal to be effective. One PEP sponsor provides

Figure 5.2 Reinforcing formal training

The following is an extract from Allied Dunbar's 'Guide to Good Management Practice'.

(e) **Foster Team Identity**

Help people see themselves as part of a team and not as isolated individuals. Take every opportunity to get your people working in the same place, training as a team, meeting together regularly and socialising as a group. All this helps build team identity and don't forget that it is also very important to recognise team as well as individual achievement.

(f) **Keep Competition Constructive**

Teams can get very self-centred because of internal loyalty and commitment to team goals. Some competition between teams can be productive, but don't let this get out of hand. Too much competition can lead to deteriorating relationships and wasted time and effort. Always stress that teams need to work together to achieve shared objectives.

10.3 Aim for Organisational Effectiveness

Having built the organisation, you should continually work to develop its effectiveness. To do this, you need to measure how things are going, improve performance and increase the resilience of the structure.

(a) **Measure Results**

Wherever you can, measure the effectiveness of your organisation by developing measures of performance, both internal and external.

The prime external measures are quality of output and client satisfaction. (Refer to 'Managing Quality' on these aspects.) Always check the level of service yourself and ask users for feedback to ensure that your organisation is producing the results required.

Internal measures can also demonstrate how well an organisation structure is performing. You should develop and use appropriate yardsticks, for example:

- Check now and again on how people are spending their time. This can often give a good indication on

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Foster Team Identity

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material of this sort in a style that is both easy to read and highly communicative. A sample from their management handbook is shown in Figure 5.2.

GOAL SETTING AND APPRAISAL

Few would disagree that motivation and performance can be improved when employees know clearly, and are challenged by, the work that needs to be done. Systems departments with formal procedures for regularly setting goals and appraising performance benefit from the productivity improvements that follow. One PEP sponsor, with a typical Productivity Index of 18, prepares work-assignment briefings to cover the next 10 to 20 days of work for programmers, and 30 to 40 days of work for systems analysts. Each work assignment is formally appraised upon completion, and the appraisal is sent to the resources manager. This work-assignment and appraisal procedure takes place outside the six-monthly and annual formal appraisals, which are concerned with training requirements, salary reviews, and career development. A second PEP sponsor with a record of unusually high staff productivity (their projects typically have a Productivity Index of 20) also takes goal setting seriously. In this company, individuals and their managers agree on measurable goals, then formally appraise the results.

Few organisations take goal setting seriously enough

Few organisations, though, take goal setting seriously enough. Staff in three of the seven PEP sponsoring companies that we surveyed for this paper expressed dissatisfaction about the existence or clarity of goals. Staff in all seven expressed concern about appraisal, admitting to a lack of feedback about their performance. Feedback, as we noted in Chapter 2, is a strong contributory factor to job motivation. Moreover, what makes goal setting and appraisal a powerful factor in improving productivity

is not only that work purposes are clearly defined, but also that individuals are challenged to achieve agreed levels of performance — something that systems development staff in general, and those having high GNS measures in particular, should be good at doing, as we explained in Chapter 3.

Of course, realistic goals should be set. How best to do this is a subject in its own right. Suffice it to say that there is wide agreement that effective goal setting entails the involvement of the person assigned to the work, the work supervisor, the designer of the work — and often the customer too.

De Marco and Lister have reported on a goal-setting study undertaken by Michael Lawrence and Ross Jeffrey at the University of New South Wales (reference 8). They studied 103 projects and obtained measures of productivity (similar to Barry Boehm's Cocomo metric) and grouped these according to the basis upon which estimates had been prepared. The results, shown in Figure 5.3, are interesting because they appear to show that when programmers provide the estimate they are more productive than when their supervisors prepare the estimate. When the systems analyst prepared the estimate the resulting productivity was even better. This was put down to the systems analyst's better understanding of what the job entails, compared to the programmer's optimism and the supervisor's political or budgetary biases. The most surprising result was that those projects for which no estimate was provided proved to be the most productive. The implication is that, for these projects, programmers may have been more productive when they were able to work at their natural pace, unconstrained by unrealistically short or long timescales.

Figure 5.3 Development productivity can vary according to who sets the estimate for the effort required

Source of estimate	Number of projects	Average productivity*
Programmer alone	19	8.0
Supervisor alone	23	6.6
Programmer and supervisor together	16	7.8
Systems analyst	21	9.5
No estimate	24	12.0

*Productivity was measured on a scale similar to Boehm's Cocomo metric

(Source: Survey by Michael Lawrence and Ross Jeffrey at the University of New South Wales)

THE WORK ENVIRONMENT AFFECTS PRODUCTIVITY SIGNIFICANTLY

The productivity of systems development staff is affected by a great number of factors. The focus of this paper is on people-related factors, including those affecting motivation, personality, team working, skills, and goal setting. A further factor affecting productivity is the physical environment itself, the effectiveness of which has much to do not only with the nature of the work carried out, but also the kind of people who work within it. There is evidence that the productivity of systems development staff

rises as the workspace dedicated to each person increases to around 100 square foot, when noise levels are kept low, and when at least 40 per cent of the hours worked remain uninterrupted.

WORK ENVIRONMENT AFFECTS PRODUCTIVITY

The office environment in which systems development staff work has a considerable effect on their productivity. We touched on this topic briefly in our survey. The two (out of seven) participating companies that recorded the widest average differences between their assessments of the importance of the working environment and their actual level of satisfaction were also the two with the lowest Productivity Indices (11 and 8 respectively).

Detailed research has been carried out in this field, most notably by De Marco and Lister (reference 8), who surveyed more than 600 systems development staff from 92 companies during the period between 1984 and 1986. The participants were set a standard programming task in the context of their normal working environment, recording the time that they took. The tasks were always undertaken by pairs of staff from within the same company, yet working independently.

The researchers found that the best performance was 2.1 times better than the average, and that the half of the participants who performed above average outperformed the half below by a factor of 1.9. The performance of the top quartile was 2.6 times better than for the bottom quartile. They also found huge differences between the 92 participating companies, the best having 11.1 times the productivity of the worst. The performance of any single pair of programmers differed by no more than 21 per cent, however, so if one member of the pair did well, so did his or her colleague, and if one took a great deal of time, then so also did his or her colleague. Moreover, staff having, for example, more than 10 years' experience did not outperform, on average, those having only two. One-third of the participants completed the exercise with no defects, and on average took slightly less time than those with one or more defects. And there was only a weak correlation between salary levels and performance.

The researchers next gathered data about the participants' working environment. They compared the results for the top-performing quarter with those of the bottom-performing quarter. The results, summarised in Figure 5.4, are convincing: participants in the top quarter reported much more favourable working environments than those in the bottom quarter.

Figure 5.4 Effect of working environment on systems development productivity

Work-environment factor	Top quarter	Bottom quarter
Amount of dedicated work space	78 sq ft	46 sq ft
Is office acceptably quiet? (Yes responses)	57%	29%
Is office acceptably private? (Yes responses)	62%	19%
Can you silence the telephone? (Yes responses)	52%	10%
Can you divert calls? (Yes responses)	76%	19%
Are you often interrupted needlessly? (Yes responses)	38%	76%

Development staff were asked about their working environment. The table analyses the results for the top-performing and bottom-performing quarter of staff, performance being measured as the time taken to perform a standard programming task. The top quarter performed 2.6 times better than the bottom quarter.

(Source: Survey of more than 600 development staff carried out by De Marco and Lister)

Perhaps not surprisingly, more participants were dissatisfied with their working environment than were satisfied. Fifty-eight per cent complained that their workplace was not acceptably quiet, 61 per cent that it was not sufficiently private, and 54 per cent that they had a better workplace at home. Although this study does not *prove* that a better working environment will help people perform better, because other factors may also account for the performance difference, it does suggest that aspects of the working environment may be affecting their ability to work well, and that management should not be complacent about complaints from staff.

In discussions about the working environment, the question of what is the optimum working space usually arises. IBM is reported to have studied this subject in advance of designing its Santa Teresa programming laboratories. The study concluded that 100 square feet of dedicated workspace and 30 square feet of work surface was required per worker, and that staff should be accommodated either in one- or two-person offices, or in partitioned areas using 6-foot high partitions. In contrast, of the 600 participants in De Marco and Lister's study, only 16 per cent had 100 square feet or more, and only 11 per cent worked in enclosed offices or in areas with 6-foot high partitions.

EFFECT OF NOISE AND INTERRUPTIONS

De Marco and Lister went on to study the effect of noise. They found that, beyond a level that varies with the individual, quality and productivity are affected by noise. The participants in this trial were divided into two groups: those who found their workplace acceptably quiet, and those who did not. Workers in the first group were one-third more likely to deliver zero-defect output. The proportion of defective work increased as the noise level increased (or more precisely as the proportion of staff reporting an unacceptable noise level increased).

During its study at Santa Teresa, IBM examined the effect of interruptions on productivity. During the time that staff need to immerse themselves deeply in their work, interruptions (and high noise levels) cause disengagement and consequent loss of time in reverting to the previous immersed state. IBM found that its workers spent 30 per cent of their time working alone, 50 per cent working with one other person, and 20 per cent with two or more people. The time spent working alone, in particular, needs to be protected from interruption. A similar analysis led De Marco and Lister to recommend that, for reasonable working effectiveness, uninterrupted work should be at least 40 per cent of the total hours of work.

Uninterrupted work should be at least 40 per cent of the total hours of work

PROVIDING OPPORTUNITIES FOR PERSONAL ADVANCEMENT HELPS IMPROVE PRODUCTIVITY

PEP assessments measure and compare the productivity of systems development teams working on specific projects. To maximise productivity, it pays to avoid short staff-retention cycles — in other words, to reduce staff turnover. Paying attention to training and improving the working environment are two ways to reduce staff turnover. A further way is to improve the opportunities for staff to achieve their own personal goals in terms both of reward and of career advancement.

STAFF TURNOVER AND PRODUCTIVITY

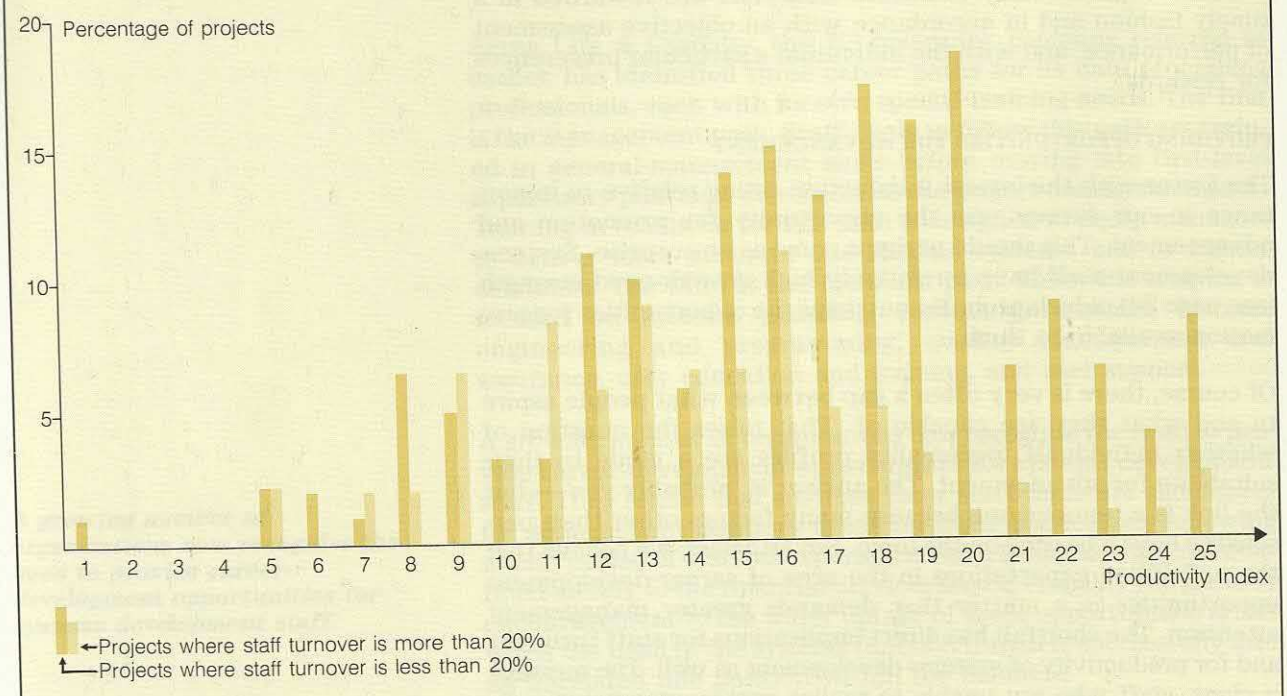
Improved systems development productivity correlates closely with lower staff turnover. As staff turnover for a project increases, so productivity reduces. This relationship is illustrated clearly in Figure 5.5, which charts the distribution of Productivity Indices for projects in two categories: those with a staff turnover of less than 20 per cent, and those with a staff turnover of 20 per cent or more. The average Productivity Index in the first category is 16; in the second category, it is 14. (The statistical significance of the difference is very high.) For the average PEP project of some 70,000 effective lines of code, the value of the difference is about $250,000. Some of this cost is due to turnover caused by staff moving between projects, but the remainder can be attributed to turnover from staff losses.

Of course, some organisations are distinctly better placed than others to attract and keep staff. This is particularly true of some companies in the financial-services sector, particularly where systems are intricately and strategically tied up with the services on offer. Companies of this sort are usually able to offer a wide range of interesting and demanding work. Other organisations are less well placed. Local authorities in the United Kingdom, and particularly those in the London area, are a case in point.

Recognising the problem, one local authority has set goals for retaining staff. Currently, the average period of retention is three-and-a-half years, up from two-and-a-half years, which was the position some three years ago. The current goal is to retain staff for at least four years. The measures adopted by the local authority

Figure 5.5 Effect of staff turnover on development productivity

Projects where staff turnover is less than 20% have significantly higher Productivity Indices.



(Source: PEP database of business systems development projects)

to achieve this goal include: a flexible grading system, distinct from the grading system that is in place in the remainder of the authority; generic titles for all systems staff, to reduce the negative effects of status; and job variety achieved through distributed technical-support roles that enable staff having the appropriate ability to become experts in particular areas whilst also participating in conventional project work.

Other measures that companies are adopting to attract and keep staff include effective training and good physical working environments, precisely along the lines that we have already discussed in this paper. As well as helping to reduce staff turnover, both are ways by which project productivity can be improved. So both offer a double benefit.

REWARD AS A MOTIVATING FACTOR

It is now generally agreed that reward is an important contributor to motivation. The acceptance of reward as a positive factor in motivation theory has arisen from the development of so-called reinforcement theories of motivation.

In this context, reward covers both pay and related financial benefits, and nonfinancial benefits such as status, recognition, and development. All are important. In our survey of PEP sponsors, we assessed the difference between the importance attached to several reward factors by participants, and their ratings of satisaction. Figure 5.6 indicates that, according to systems development staff, matters connected with advancement, opportunities for achievement, development, and recognition rank higher in importancethan pay and fringe benefits.

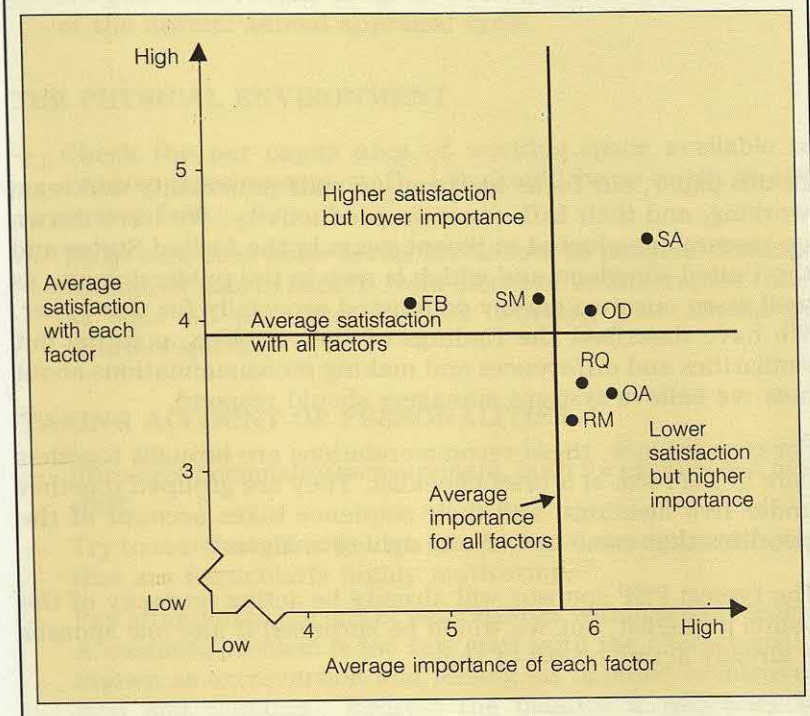
One general point is worth stressing. When combined with the current thinking on leadership, it is clear that a good leader will endeavour particularly to ensure that staff are rewarded in a timely fashion and in accordance with an objective assessment of performance, and with the individual's particular preferences for rewards.

PROVIDING OPPORTUNITIES FOR ADVANCEMENT

The factor with the lowest satisfaction rating relative to importance in our survey was the opportunity for promotion and advancement. This should perhaps come as no surprise. Systems development staff have a relatively high growth-need strength (see page 20), which probably outstrips the opportunities for promotion available to them.

Of course, there is very often a gap between what people aspire to and what they are capable of. That raises the question of whether individuals' personality profiles are a guide to their suitability for advancement. The answer is 'probably yes' — but the link is a tenuous one because many factors other than personality have a bearing on the topic. Nevertheless, we believe that the unfulfilled expectations in the area of career-development opportunities is a matter that demands greater management attention. The shortfall has direct implications for staff turnover and for productivity of systems development as well. The message is clear: staff who are unable to realise career opportunities in their companies will try to seek them elsewhere.

Figure 5.6 Importance of, and satisfaction with, reward and recognition factors



Key to factors:
FB Fringe benefits
OA Opportunities for advancement
OD Opportunities for development
RM Recognition from IT management
RQ Recognition for quality work
SA Sense of achievement
SM Salary in relation to market rates

(Source: Butler Cox survey of PEP sponsors)

Aetna Life & Casualty, the US insurance company referred to earlier, has identified three career paths for its data processing professionals, each with its own special training needs. The first is the management path. Staff likely to follow this path are trained in general-management skills before moving into first-level supervisory positions. The second is the project-management path. Training in readiness for this path is designed to equip managers to deliver more accurate and flexible systems, and to tighter deadlines. The third is the technical path. Here, the training is focused on systems planning, technology transfer, systems engineering and programming, quality management and assurance, user education and training, and user support.

A growing number of organisations now recognise the need to provide career-development opportunities for systems development staff

A growing number of organisations now recognise the need to provide career-development opportunities for systems development staff. They realise that amongst these staff there are candidates for management positions in the business, particularly following a solid period of systems experience. Such businesses are not confined merely to the financial-services sector. Probably the greatest encouragement to the wider uptake of these opportunities arises when the head of the systems function transfers successfully into an unrelated line position within the business.

Chapter 6

Action checklist

In this paper, our focus has been on staff personality and team working, and their influences on productivity. We have drawn on research conducted in recent years in the United States and the United Kingdom, and which is now in the public domain, as well as on our own survey conducted especially for this paper. We have described the findings of the research, pointing out similarities and differences and making recommendations about how we believe systems managers should respond.

For convenience, these recommendations are brought together here in the form of a brief checklist. They are grouped together under five headings, and their sequence takes account of the priorities that came out of our survey analysis.

The typical PEP sponsor will already be acting on many of the points in the list, but we would be surprised if any one sponsor is already acting on *all* of them.

PERSONAL ADVANCEMENT

- Provide every opportunity for systems development staff to realise their (usually high) personal aspirations through advancing their own careers. Many, of course, will fail. The point is that the opportunities must be real and visible.
- Recognise that the range of skills required by systems development staff is widening. Staff should be 'T-shaped' generalists as well as specialists. This has implications for both training and recruitment.
- To help train generalists, introduce a core training programme covering, for instance, topics such as the business, its goals, and how it relates to suppliers, customers, the market, and the competition.
- Do not ignore packaged training products that can be bought off the shelf: the range is widening all the time.

WORK MOTIVATION

- Increase job variety through planned job rotation. Introduce a policy for rotating programmers and analysts at set intervals of time.
- Arrange to enlarge the content of jobs where possible by adding responsibility for defined areas of hardware, software, and user support.
- Improve feedback from customers about the effectiveness of the work produced. Where this is hard to do because of delays that are intrinsic to the job itself, compensate by encouraging feedback from systems development managers.

- Recognise that nonfinancial rewards are an important part of motivation.
- Set goals and review progress at frequent intervals outside of the normal annual appraisal cycle.

THE PHYSICAL ENVIRONMENT

- Check the per capita area of working space available to systems development staff — it should be as much as 100 square feet.
- Make sure that noise levels are as low as possible. Arrange for individuals to benefit from blocks of uninterrupted time: at least 40 per cent of their working time should be uninterrupted.

TAKING ACCOUNT OF PERSONALITIES

- Introduce personality measurement, both for existing and new staff.
- Try to match staff with high growth-need strengths with jobs that are particularly highly motivating.
- Pay attention to the mix of personalities within project teams. A common problem is too few staff with the characteristics known as extroversion and feeling (as opposed to introversion and thinking). Redress the balance if necessary by recruiting the right personalities into the teams from amongst user representatives.
- Deliberately introduce an element of constructive conflict between team members, particularly in the early stages of project development.
- Encourage systems development staff to improve their people, as opposed to technical, orientation. To raise awareness of these issues, introduce behavioural training programmes.

TEAM COMPOSITION

- Make sure that team sizes are kept small: five or six is often ideal. Break up large teams into smaller ones if necessary.
- Introduce staff having generalist skills to supplement the specialist skills that will continue to be required.
- Use self-selection methods for forming teams — but check that the resulting composition accords with the skill and personality-mix requirements that we have already mentioned.
- Select team leaders on their facilitating ability and their ability to resolve conflicts.
- Avoid keeping the composition of project teams the same over prolonged periods, because productivity may suffer as a result. Instead, inject new blood from time to time (this may be part of the job-rotation policy).

Appendix: The survey questionnaire

This appendix lists the staff factors associated with systems development work used in the questionnaire sent to more than 700 development staff. In all, there are 84 factors, in 16 groups.

TRAINING AND SKILLS

Technical skills.

People-relationship skills (for example with team members).

Managing-people skills.

Business knowledge/experience.

Managing-change/implementation skills.

PROJECT MANAGEMENT/LEADERSHIP

Relationships with immediate manager.

Communications with immediate manager.

Opportunities for social contact with immediate manager.

Immediate manager's technical abilities and skills.

Immediate manager's leadership abilities and styles.

Instrumental behaviour: planning, organising, controlling, and coordinating a subordinate's work.

Supportive behaviour: showing concern for the welfare and well being of subordinates, and creating a friendly and pleasant environment.

Participative behaviour: for example, sharing information, consulting, and using subordinate's suggestions in decision making.

Achievement-oriented behaviour: setting challenging goals, expecting subordinates to perform at the highest levels, continually seeking for improvements in performance.

Information received from own line management about the effectiveness of individual performance.

SUPPORT BY TECHNOLOGY

IT support (for example workstations, terminals).

Software aids and tools.

RECOGNITION, ACHIEVEMENT, PERSONAL WORTH

Recognition received from management.

Recognition received from users.

Recognition received from colleagues.

Recognition received for work completed.

Recognition received for achievement of schedules.

Recognition received for quality of work done.

Recognition received for creativity.

Personal sense of achievement.

OFFICE ENVIRONMENT

Location of offices.

General office environment.

Administrative support (for example typing, copying facilities).

JOB FACTORS

Variety of skills and abilities demanded by the work.

Completeness of the work: doing 'whole' and identifiable pieces of work from beginning to end with visible outcomes.

Impact the work has on the lives/work of others.

Freedom, independence, and personal discretion provided in planning the work and in determining the procedures to be used.

Information received from the work activities as they are carried out, above the effectiveness of individual performance.

Overall responsibilities associated with the work.

Time pressures associated with the work.

TEAM FACTORS

Team structure and distribution of responsibilities.

Size of team.

Team members' abilities and skills.

Relationships with team members.

Communications with team members.

Competition between team members.

Opportunities for social contact with team members.

CAREER DEVELOPMENT

Education and training provided to do the work.

Opportunities provided to develop new skills/abilities.

Opportunities to engage in new areas of work/new projects.

Opportunities for promotion/advancement.

Appendix: The survey questionnaire

USER FACTORS

Relationships with users.

Communications with users.

Clarity of definition of user requirements.

Stability of definition of user requirements.

User effort/participation in systems development.

Users' abilities and skills.

Feedback from users about the usefulness of systems in their work.

Feedback about the contribution systems are making to the business.

METHODS

Development methods and approaches used.

Quality assurance/control methods and approaches used.

Project-management methods and approaches used.

Tools and techniques used in support of methods and approaches.

Programming languages used.

Standards pertaining to all the above.

PAY AND BENEFITS

Pay received vis á vis the general market.

Pay received vis á vis others in the organisation.

Other fringe benefits received.

ORGANISATION STRUCTURE AND POLICIES

Structure and distribution of responsibilities.

Stability of systems department's organisation.

General policies of the systems function.

Recruitment/placement policies/procedures.

Appraisal policies and procedures.

Job grading within the systems function.

Job grading vis á vis user staff.

Competition between working groups/units.

Relationships with other systems units.

Communications with other systems units.

SENIOR MANAGEMENT/INTERPERSONAL COMMUNICATIONS

Relationships with senior systems management.

Communications with senior systems management.

Management styles of senior systems management.

Opportunities for social contact with systems management.

GOAL SETTING AND ACHIEVEMENT

Existence and clarity of goals.

Challenges/difficulties associated with achieving goals.

Participation in setting the goals.

Feedback received on achievement of the goals.

Match between personal and organisational goals.

SECURITY OF EMPLOYMENT

Security of employment.

PERSONAL/FAMILY CIRCUMSTANCES

Personal/family circumstances not directly associated with work.

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