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Focus : Innovation & Creativity

Stress and Creativity

Strategising Research for Innovation

Financing Innovation

Quality in Innovation

Partnering Approach to Strategic Alliance

Advanced Quality Planning

Productivity in Indian Manufacturing

Buyer Behaviour in Rural Markets

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Stress and Creativity: Some Research Evidences

D.M. Pestonjee and Prabhat Kumar Mishra

Organisational Behaviour (OB) has been extensively studied to focus on stress and creativity. However, a careful analysis of the studies reveals that very few attempts have been made to integrate the two, especially from the point of view of identifying the particular types of stresses that a creative person may encounter in an organisational situation. In the present paper, the authors argue that stress has become an inevitable part of human life but, contrary to popular belief, it can also have positive effects. The paper further examines the stress potential with reference to the creative managers occupying creative/non-creative roles in creative/non-creative organisations.

D.M. Pestonjee is the Professor and Chairman, and Prabhat Kumar Mishra is an Academic Associate, both working in Organisational Behaviour Area, at Indian Institute of Management, Ahmedabad-380 015.

Concept of Stress

Nowadays everyone seems to be talking about stress. The term is discussed not only in our daily life conversations but also extensively debated through media of magazines, TV, Radio broadcasts etc. Different people have different views about stress as stress is experienced from a variety of sources. The businessperson views stress as frustration or emotional tension; the air traffic controller sees it as a problem of alertness and concentration, and an athlete thinks of it as a muscular tension.

There are many components that make up stress and there are a variety of definitions of stress. The word stress is derived from the Latin word 'stringere', which means to draw tight. According to Hinkle (1973), "in the seventeenth century the word stress was used to describe hardship or affliction" and "during the late eighteenth century, stress denoted force, pressure, strain or strong effort, referring primarily to an individual, to an individual's organs or mental powers". Early definitions of strain and load used in physics and engineering eventually came to influence the concept of how stress affects individuals. According to this approach, external forces (loads) are seen as exerting pressure on an individual, resulting in strain.

Stress is the result of an individual's perceptions that they do not have the resources to cope with a perceived situation from the past, present or future. It is

Stress is the result of an individual's perceptions that they do not have the resources to cope with a perceived situation from the past, present or future.

caused by fear, and the reaction to fear is the instinctive and automatic preparation for 'fight to flight'. In basic terms, stress is an aspect of living that can be beneficial when it motivates, encourages change or inspires, but can be opposite when it does not.

Psychologists of different persuasions have given (a) stimulus-oriented, (b) response-oriented, and (c) interactional definitions of the term 'stress'.

Stimulus-Oriented Approach: Stress is regarded as an external force which is perceived as threatening. Some view threat itself as stress. According to Selye (1956), any external event or any internal drive which threatens to upset the organismic equilibrium is stress.

Response-Oriented Approach: According to this approach, stress can be understood best in terms of the way people perceive and ascribe meaning to stress producing situations, the values they attribute to actions and the way they interact with events. This approach describes how stress is reacted to and how people function under stress.

Interactional Approach: The third approach, the interactional one, expresses the view that stress arises through the existence of a particular relationship between the person and his/her environment. Lazarus (1971) suggested that stress occurs when there are demands on the person which tax or exceed his/her adjustive resources. According to him, it depends not only on external conditions but also on the constitutional vulnerability of the person and the adequacy of his/her cognitive defensive mechanisms.

Similarly, Cox and Mackay (1981) suggested that stress arises when there is an imbalance between the perceived demand and the person's perception of his/her capability to meet that demand. The systems approach treats stress as an intervening variable, the reflection of a transaction between the person and his/her environment. Ivancevich and Matteson (1984) also defined stress in terms of a person-environment relationship wherein the environmental demands are supposed to result in stress.

Stress is essentially an individual phenomenon and must be understood with reference to the characteristics of both the focal individual and his/her environment.

Thus, it is evident from the above descriptions that stress is essentially an individual phenomenon and must be understood with reference to the characteristics of both the focal individual and his/her environment. It is the outcome of a particular combination of the two as shown in Fig. 1.

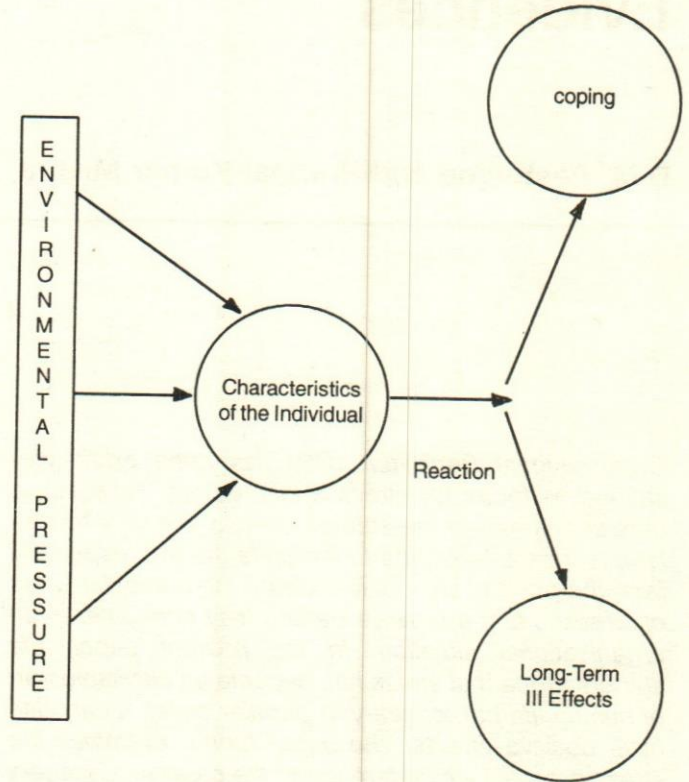


Fig. 1. Stress as an Individual Phenomenon

Source: D.M. Pestonjee (1987). Executive stress: Should it always be avoided?, *Vikalpa*, 12, 23-30.

This person-environment paradigm emphasises the balance rather than the absolute level of either. It accommodates the view that having too little to do (hypostress) is as stressful for the individual as being overloaded with work (hyperstress). Secondly, this paradigm does not assume that return to the preceding steady state is the only beneficial outcome possible. Stress can, therefore, be viewed as a stimulus to growth and the achievement of a new balance.

As an individual phenomenon, stress is a personal response to a certain variation in the environment. According to Pestonjee (1987), there are wide individual differences in response to the same set of stressors, depending upon:

- the nature and magnitude of the strategy,

- the importance of the stressor to the individual,
- the perception of threat element as a component of stressor,
- the personal and social support systems available to the individual, and
- the involvement and willingness on the part of the individual to "do something" about the state of stress.

Negative Effects of Stress

Stress manifests itself in the form of many psychological and physical problems. For example, researchers have found that stress is associated with anxiety, depression, hopelessness, anger, and helplessness. It has also been reported that stressed people are more likely to be psychologically distressed than those who are not (Dua, 1990, 1994 and Nowack, 1990). Stress has also been linked with many types of physical illness or disorders. Disorders such as CHD's, hypertension, gastrointestinal disorders (e.g. peptic ulcer and irritable bowel syndrome), respiratory disorders (e.g., bronchial asthma), skin problems (e.g., eczema and acne), and cancer are said to be associated with stress (Matteson and Ivancevich, 1987). Individuals weakened by chronic stress are far more susceptible to other illnesses and terminal conditions because their immune systems are weakened when their metabolism is in a constantly stressed state. The most common symptom of stress is that people do not feel well and no clinical reason can be found by medical practitioners. In short, the negative effects of stress can be highly visible such as illness, absenteeism, smoking, alcohol abuse etc., but also less visible in the form of bad decision making, negative internal politics, reduced creativity and apathy.

Positive Effects of Stress

Stress is an inevitable part of human life but, contrary to popular belief, it can also have positive effects. Present-day researchers and practitioners visualise the phenomenon of stress in a new perspective. As Kets de Vries (1979) had noted, each individual needs a moderate amount of stress to be alert and capable of functioning effectively in an organisation. Indian scholars like Pestonjee (1992) and Mathew (1985) also agreed with this contention.

Pestonjee (1992) has noted that the stress response has been often misunderstood due to lack of scientific knowledge about it. He opined that it is natural and healthy to maintain optimal levels of stress. Success, achievement, higher productivity and effectiveness call

for stress. However, when left unchecked or unmanaged, stress can cause problems in performance and affect the health and well-being of the organism.

Stress and Creativity

A number of studies have been conducted on stress and creativity dealing with them separately. Very few attempts have been made to integrate the two, especially from the point of view of identifying the particular types of stresses that a creative person may encounter in an organisational situation.

Mathew (1985) has gone to the extent of advocating that particular types of stresses are essential for being a creative manager. In his conceptual paper on role stress of a creative manager, he raised queries pertaining to the relationship between creativity and stressors. He noted that such queries are relevant for two reasons: first, creativity and innovation in organisations have become a top priority for organisational practitioners. Therefore, a creative manager can be better equipped to cope with particular stressors which are identified as associated with creative activities. Second, creativity involves performance of unconventional tasks in the organisational setting by individuals. On the other hand, interaction among various sub-systems of organisations such as person, task, role behaviour setting, physical and social environments are seen as causal factors of stress. It is likely, therefore, that some kinds of stresses are associated with creative work.

Mathew (1985) reviewed the concept and theory of job stress and examined the stress potential with reference to the creative owner/non-owner managers occupying creative/non-creative roles in creative/non-creative organisations. He has also reviewed some relevant studies focusing on the traits of a creative person conducted by Torrance (1965) and Petrosko (1983) and speculated on the type of potential stressors a creative person may encounter in an organisational situation. For example, his independence may involve him in interpersonal conflicts and loneliness, his risk-taking nature may bring in problems of uncertainty tolerance or the complexity of his mind may lead to boredom in a structured situation.

The particular types of organisational stresses associated with creative traits of the individual are summarised in Table 1.

Stress Potential of the Creative Process

Reviewing one of the earlier notions of the creative process, Mathew noted that the transitional stages of

to identify the stresses associated with creative managers in these organisations. Furthermore, reviewing Boyd and Gampert's (1983) survey pertaining to 'benefits and costs' associated with owner-managers (i.e., small business owners), Mathew has identified the following particular stresses associated with owner-managers:

Table 3: Stress Potential for Creative Managers

Type of Managers	Creative Organisation		Non-creative Organisation	
	Creative Role	Non-creative Role	Creative Role	Non-creative Role
Creative Professional Managers	Role ambiguity	Boredom and frustration	Resource inadequacy	Boredom and frustration
	Outcome uncertainty	Self-role distance	Role expectation conflict	Self-role distance
	Exposure to hazards	Role stagnation	Interpersonal conflict	Personal inadequacy
	Task difficulty	Personal inadequacy	Role isolation	Approach-avoidance conflict about job
	Exposure to criticism	Role isolation	Role ambiguity	Interpersonal conflict
	Evaluation anxiety	Approach-avoidance conflict about job	Goal uncertainty	Evaluation and communication anxiety
	Time pressure	Role expectation conflict	Task difficulty Task pressure	
Creative Owner Managers	Loneliness Role conflict Outcome Uncertainty	(Not applicable)	(Not applicable)	(Not applicable)
	Task difficulty Fear of failure Interpersonal conflict Time pressure			

It is important to note that this list of organisational stressors associated with creative owner-managers are not empirically validated but simply Mathew's speculation in the light of characteristics of the creative person, the nature of the creative process and the requirements of the organisational context. He, however, quoted an empirical study conducted by Pamperin (1983) to support his hypothesis that creative managers are susceptible to greater stress than non-creative managers.

Conclusions

Our general feeling is that stress has negative effects in our lives. Popular writers and speakers tend to relate it to unhappiness and lower productivity. Some experts feel that stress is always bad. This needs to be challenged. It may prove also an asset so long as it is tolerable and helps in creating healthy competition. Organisational excellence and individual success are achieved through well managed stresses.

It has been also observed that creative people are not free from stress, however, they manage them well due to their commitment to achieve something spectacular. Challenges in one's career can cause stress, but they also create the strengths to face them and achieve success. It is for this reason that healthy stresses are treated as potential value for an organisation or individual. They may stimulate learning and enthusiasm, leading to a better and more imaginative performance.

Challenges in one's career can cause stress, but they also create the strengths to face them and achieve success.

One can also think of a link between stress and catharsis. Many a time, feelings of depression and anxiety create lot of emotional tension for an individual and this emotional tension then gets converted into a creative urge. Some type of catharsis through sublimation takes place. The strong feelings of depression and anxiety may get sublimated into a creative product or poem or a piece of art. Many creative artists (even scientists) report of a sense of tension and stress during the periods of creative endeavours. This can be classified as 'creative stress' which when sublimated may give the twin benefits of an emotional catharsis or release from emotional tension and also result into some worthwhile product.

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If change masters have to be skilled at developing ideas and building coalitions to back them, it is equally true that the company environment in which they operate has to help clear the way.

— **Rosabeth Moss Kanter**

Entrepreneurial innovation will be as important to management as the managerial function.... and will be more important in the years to come.

— **Peter F. Drucker in
Technology Management and Society**

Creativity in the Organisational Context

Greg R. Oldham and Anne Cummings

The effects of various elements of the organisational context (i.e., design of jobs, work space configuration, supervisory style, and coworkers interaction) on the creative performance of employees have been discussed in the present article. Presented herein is a theoretical perspective that suggests how these contextual characteristics may influence employee creativity. Two individual differences (i.e., employees' creative personality characteristics and problem-solving styles) that may modify the effects of the context have also been discussed.

Greg R. Oldham is Clinton Spivey Professor of Labour and Industrial Relations, Office of Research, University of Illinois at Urbana-Champaign, Champaign, IL 61820 (USA) and Ms. Anne Cummings is Asst. Professor of Management, The Wharton School, University of Pennsylvania, Pennsylvania (USA).

Introduction

Many have recently suggested that the creative performance of employees is an important contributor to organisational innovation, effectiveness, and survival (Amabile, 1988; Scott and Bruce, 1994; Shalley, 1995; Woodman, Sawyer, and Griffin, 1993). When employees perform creatively, they generate novel and useful ideas or products that may provide the organisation with critical raw material for subsequent development and implementation (Amabile, 1988; Shalley, 1991; Sternberg and Lubart, 1996). The implementation of these creative products enhances the organisation's ability to adopt to changes in its environment and, thereby, to prosper, grow, and compete (Amabile, 1988; Cummings and Oldham, 1997; Staw, 1990; Woodman *et al*, 1993). Thus it is imperative to understand the organisational conditions and circumstances that are likely employees' creative performance.

Creative Performance

Employee creativity is basically the production of ideas, products, or procedures that are: (a) novel or original and (b) potentially relevant for or useful to the organisation (Amabile, 1996; Oldham and Cummings, 1996; Sternberg and Lubart, 1996). An employee's contribution is novel when it offers something original or unique relative to what is already available within the organisation's repertoire of products, services, or practices. The contribution is useful to the extent that it is directly relevant to the goals of the organisation and is something from which the organisation can

Employee creativity is basically the production of ideas, products, or procedures that are: (a) novel or original and (b) potentially relevant for or useful to the organisation.

reasonably expect to extract some value in either the short or long-term.

Employees may make creative contributions individually or as members of teams (Cummings & Oldham, 1997). For example, an employee in a professional or clerical role, who provides administrative services to customers or to other employees in the same organisation, may exhibit creativity by providing novel services to those clients or by making suggestions for improving internal processes or procedures (Cummings & Oldham, 1998). Or, in a manufacturing setting, an individual may exhibit creativity by suggesting process improvements via a formal suggestion programme, or by speaking with or writing (a memo) to his supervisor. Alternatively, these employees may develop the same suggestions while working with coworkers and then submit the recommendation as part of a project team or work group. Similarly, a design engineer may write a patent disclosure proposal for her manager's review as a result of her individual work or as part of a team.

In addition, creative contributions may reflect a significant recombination of existing materials or an introduction of completely new materials. Thus, the manufacturing suggestions may involve reorganizing the order in which various steps in the manufacturing process are conducted, or they may involve introducing entirely new steps into the process. And the patent proposal might involve a new adhesive compound, or a new application from recombining existing compounds. Each of these novel and useful contributions is an example of employee creativity.

Following the conceptualizations of Amabile (1988) and Staw (1990), the definition of creative performance is distinct from that of organisational innovation. That is, whereas innovation refers to the successful implementation of new outcomes at the organisation level, employee creative performance refers to individuals' or teams' generation of novel and useful ideas and products, that provide the raw material for subsequent organisational innovation (Oldham and Cummings, 1996).

Creative performance refers to individuals or teams generation of novel and useful ideas and products, that provide the raw material for subsequent organisational innovation.

Theoretical Perspective

Much of the contemporary research addressing the possible effects of contextual conditions on creative performance argues that the context influences creativity via its effects on employees' affective states at work (Amabile, 1996; Baron, 1994; Cummings and Oldham, 1998; George & Brief, 1992). This general perspective involves two, sequential parts. First, certain contextual conditions shape an individual's positive affective states at work—that is, these conditions generate feelings of excitement, elatedness, and enthusiasm. For example, the complexity and challenge of an employee's job may boost his or her enjoyment, enthusiasm, and excitement (Hackman & Oldham, 1980). And supportive, encouraging managers may also enhance such positive affective states as excitement and enthusiasm (Isen and Baron, 1991).

Second, once individuals experience these positive affective states, they are more likely to exhibit high creativity at work. Specifically, when individuals experience positive affect, they make more connections between divergent stimulus materials, use broader categories, and see more interrelatedness among stimuli (Isen and Baron, 1991; Isen and Daubman, 1984; Isen, Daubman, and Nowicki, 1987). When individuals are excited and enthusiastic about their work activities, they are also more likely to take risks, explore new cognitive pathways, and pay with ideas (Amabile, 1996; Amabile, Goldfarb, & Brackfield, 1990). All these activities contribute to enhanced employee creativity.

When individuals are excited and enthusiastic about their work activities, they are also more likely to take risks, explore new cognitive pathways, and pay with ideas.

Creative Performance and Contextual Conditions

If positive affective states influence creativity what characteristics of the organisational context contribute to these states and thereby, enhance creative performance? There are four general contextual conditions; each is empirically linked to creativity in organisations:

Design of jobs—At a basic level, job design refers to the content and structure of the jobs employees perform. The focus of job design research, then, is on the nature of the work itself—that is, on the tasks and activities that employees complete on a daily basis (Hackman and Oldham, 1980; Oldham, 1996).

Most of the contemporary research on Job Characteristics Theory (JCT; Hackman and Oldham, 1976, 1980). In its most general form, JCT considers jobs to be complex and challenging when they have high levels of five core characteristics: viz., autonomy, skill variety, taste feedback, task significance and task identity. Herein autonomy concerns the degree to which job provides freedom and discretion; skill variety is the extent to which job requires variety of different activities needed; feedback is the linkage of an individual job with those of others (information, etc.); task significance has the societal impact and finally task identity is (the degree to which the job requires completion of a "whole" and identifiable piece of work.

JCT considers jobs to be complex and challenging when they have high levels of five core characteristics: autonomy, skill variety, taste feedback, task significance and task identity.

JCT predicts that jobs with these characteristics enhance the psychological well-being of employees as well as their overall work effectiveness (Hackman and Oldham, 1980, Fried and Ferris, 1987c; Kopelman, 1985). Thus, in their meta-analysis of correlational field studies examining JCT, Fried and Ferris demonstrated that when the five characteristics described were present in a job, employees were more productive and satisfied with their jobs. In addition, an analysis of 32 field experiments investigating the effects of enhancing these job characteristics showed that job satisfaction increased in 80 per cent of the studies and that job performance increased in 63 per cent (Kopelman, 1985).

Relatedly, previous research suggests that jobs characterized by these five dimensions often make a positive contribution to the creative performance of employees (Amabile and Gryskiewicz, 1989; Oldham and Cummings, 1996). For example, a recent study by Cummings and Oldham (1998) of several administrative and business offices demonstrated a positive, significant relation between an index of the five job characteristics and a creativity index composed of supervisors' and coworkers' ratings of that employee's creative performance. In addition, Hatcher, Ross, and Collins (1989) found positive, significant relations between an index of job complexity (created by averaging measures of autonomy, feedback and variety) and the number of new ideas employees submitted to a suggestion program. Finally, in a study of two manufacturing facilities,

Oldham and Cummings (1996) assessed the complexity of 171 employee jobs (e.g., design engineer, toolmaker, and technician) according to the five dimensions described above. Correlations between an index of the five job characteristics and three indicators of employee creativity showed that job complexity correlated positively and significantly with rated creativity, but not with the patent or suggestion measures.

Work space configuration—The connection between various characteristics of an organisation's spatial configuration (e.g., the distance between employee workstations and the number of boundaries surrounding workstations) and several work-related responses (e.g., employee performance and job satisfaction) revealed some form of a "social interference" (Oldham, Cummings, and Zhou, 1995). According to his perspective, individuals experience more contact with unwanted others when these others are physically proximate, and when the setting's configuration provides little architectural from them.

The connection between various characteristics of an organisation's spatial configuration and several work-related responses reveal some form of a "social interference".

Sundstrom, Burt, and Kamp (1980) demonstrated that measures of work space satisfaction correlated positively with the distance between clerical employees' workstations and the number of physical boundaries (e.g., walls and partitions) surrounding those workstations. Oldham, Kulik, and Stepina (1991) found that the distance between employee workstations correlated positively and significantly with measures of performance and job satisfaction, while number of boundaries correlated positively with job satisfaction only. Oldham (1988) showed that when employees moved from high spatial density settings (i.e., little average space available to each employee) to low density settings, their job satisfaction increased. And Dean, Pugh, and Gunderson (1975) demonstrated that individuals who worked in dense areas were likely to report low job satisfaction and intention to leave the organisation. Again an association between elements of the work space configuration and individuals' creativity has been found (Aiello, DeRisi, Epstein and Karlin, 1977). In particular, individuals in dense, crowded conditions exhibited lower creativity than their non-crowded counterparts. And the present author showed positive, significant relations between employee creative performance and two spatial variables—the average distance

to coworkers and the number of boundaries surrounding his or her work area.

Supervisory style—The behaviour of a supervisor towards his or her employees is another element of the organisational context that affects employees' productivity and psychological well-being at work (Shamir, House, & Arthur, 1993; Stogdill, 1974), as well as their creativity (Deci & Ryan, 1987; Oldham & Cummings, 1996; West & Farr, 1989). In Particular, supervisory behavior enhances employees' creative performance when it is supportive of employees. When supervisors show concern for employees' feelings and needs, encourage them to voice their own concerns, and facilitate their skill development, etc., they are catalysing enhancement of employees creativity.

When supervisors show concern for employees' feelings and needs, encourage them to voice their own concerns, and facilitate their skill development, etc., they are catalysing enhancement of employees creativity.

Previous research also provides empirical evidence of this connection between supportive supervisory behavior and employee creativity (Stahl and Koser, 1978). West and Farr (1989) demonstrated that health care professionals were most creative when their supervisors provided high levels of social support. Andrews and Farris (1967) showed that teams of scientists produced the most creative work when their supervisors provided substantial freedom and many opportunities to influence important decisions. And although the aforementioned study by Oldham and Cummings (1996) failed to demonstrate statistically significant relations between a general measure of supportive supervision and three indicators of employee creativity, their later study (Cummings and Oldham, 1998) showed a positive, statistically significant relation between an employee's opportunity to participate in decisions at work and an index of rated creativity.

In addition, a few other investigations (Carson and Carson, 1993; Zhou, 1998) have examined a specific element of supportive supervision—positive, informational feedback led to employees exhibiting higher creativity on subsequent trials than individuals who were given no feedback. Again individuals who were given positive, informational feedback on an early trial of a problem-solving task exhibited higher creativity on a subsequent trial than individuals who were given negative feedback or no feedback. Finally,

Cummings and Oldham (1998) showed a positive, significant relation between an employee's rated creativity and a measure of the amount of positive, informational feedback supervisors and coworkers provided that employee.

Individuals who were given positive, informational feedback on an early trial of a problem-solving task exhibited higher creativity on a subsequent trial than individuals who were given negative feedback or no feedback.

Coworker interaction—The nature of employees' interaction with coworkers is also a part of the context that potentially influences their creative performance (Amabile, 1996; Cummings, 1997; Shalley and Oldham, 1997). If employees interact with coworkers who stimulate their interest in their work activities and excite them about their work, their creativity may be enhanced. However, if engaging with coworkers distracts the attention of employees from the work itself, their creativity may be diminished.

Only a few studies of work organisations have examined relations between employee creativity and coworker interaction. Cummings and Oldham (1998) found a positive, significant association between employees' creative performance and positive, informational feedback about work performance from coworkers and supervisors. Besides Cummings (1997) addressed two other dimensions of coworker interaction viz., sharing of technical information and access to social support. Regarding technical information, she found that employees produced more radical, or frame-breaking ideas in an organisational problem-solving context when they received technical information from a variety of coworkers who did not share this technical information with one another. Regarding social support, the more directly these employees could reach their coworkers for social support as needed, the more radical their idea were.

Most of the other research works involving coworker interaction focuses on competition among coworkers, and this work shows generally inconsistent effects of competition on creative performance (Amabile, 1982; McGlynn, Gibbs, & Roberts, 1982; Raina, 1968; Torrance, 1965). For example, in Amabile's (1982) field study, children competed with each other for prizes to be awarded by judges, and results demonstrated that competition adversely affected creativity. In contrast, in Torrance's (1965) study,

children were asked to think of ways to improve a stuffed toy dog, and prizes were also awarded for the best ideas, but competition in this case had a positive effect on creativity. Finally, a recent laboratory study by Shalley and Oldham (1997) and a field study by Cummings and Oldham (1997) demonstrated that competition did not have a consistent effect on various indicators of creative performance.

Summary

The present review suggests that several elements of the organisational context generally positively affect employees' creativity. Specifically, when individuals work on complex jobs (characterized by high levels of autonomy, task feedback, task significance, task identity, and skill-variety), they typically exhibit high levels of creative performance. In addition, when employees work in areas that provide them physical distance from their coworkers and that are architecturally protected, their creativity is enhanced. Finally, when supervisors are supportive of employees' efforts, allowing them to participate in decision-making, and providing them constructive feedback about their work performance, employee creativity is enhanced.

Specifically, when individuals work on complex jobs (characterized by high levels of autonomy, task feedback, task significance, task identity, and skill variety), they typically exhibit high levels of creative performance.

The evidence is less robust with regard to the effects of coworker interaction on creativity. Whereas creativity seems to be boosted when coworkers offer positive and constructive feedback about employees' task performance, when employees receive technical information from coworkers who do not themselves share such information, and when they can easily access social support from their colleagues, the results regarding coworker competition and employee creativity are mixed. That is, some studies show positive effects of competition on creativity, while other show on effects or negative effects. We discuss one explanation for these mixed results in the section immediately below.

Individual Differences and Creative Performance

So far in the present article the direct effects of a variety of contextual conditions on employee creativity have been focused. And although these results indicate

that many of these conditions consistently affect creativity, the effects of competition were quite mixed. This suggests that under some circumstances competition may enhance creativity, whereas under other circumstances competition may inhibit creativity.

One such collection of circumstances is the individual difference characteristics that employees bring with them to the organisation. That is, individuals with certain personal characteristics may respond positively to competition and other contextual conditions, whereas other individuals respond less positively or even negatively to the same conditions. Recent research (Cummings and Oldham 1997; Oldham and Cummings, 1996) suggests two particular individual differences that modify the effects of the context on creativity. One of these is the set of "creative personality characteristics" the employee possesses. Also highly creative people are generally self-confident, attracted to complexity, tolerant of ambiguity, and intuitive (Barron and Harrington, 1981; Martindale, 1989). As a result of these studies, several instruments were developed for measuring these characteristics, including the Creative Personality Scale (CPS; Gough, 1979). In this instrument, individuals check the adjectives that describe them: high scorers endorse adjectives such as "self-confident" and "interests wide", whereas low scorers check "conventional" and "interests narrow."

Individuals with certain personal characteristics may respond positively to competition and other contextual conditions, whereas other individuals respond less positively or even negatively to the same conditions.

A second individual difference is the style with which individuals characteristically approach decisions or problems. Of particular interest here is how individuals' styles differ on an adaptive-innovative dimension (Kirton, 1976). According to Kirton, people with adaptive styles work incrementally on problems within established rules and frameworks, to generate new and useful outcomes that generally reinforce the given paradigm of the problem. Employees with innovative styles, on the other hand, are more likely to ignore established frameworks, reframe the problem, and therefore to generate more frame-breaking outcomes. Kirton (1989) developed an instrument that reliably assesses problem-solving style, the Kirton Adaption-Innovation Inventory (KAI), and studies using it provide support for its validity (cf. Keller and Holand, 1978). Cummings and Oldham (1997) ex-

amined the impact of (a) competition and (b) employees' scores on the CPS and the KAI on two indicators of creative performance (supervisor's rating and number of accepted recommendations to a suggestion program). They argued that the stimulation and excitement produced by competition may be especially beneficial to employees with high creative potential (i.e., those with more creative personality characteristics and innovative problem-solving styles), further enhancing the considerable focus and persistence they already possess, and resulting in higher levels of creative performance. On the other hand, employees with fewer creative personality characteristics or adaptive styles may not experience competition as stimulating, but rather as a distraction or a threat that requires them to depart from the comfort of their established routines and incremental progress in the given paradigm. As a result of this discomfort, the focus and creativity of employees with less creative potential may suffer under highly competitive conditions.

The stimulation and excitement produced by competition may be especially beneficial to employees with high creative potential.

Results were consistent with these arguments and showed that individuals scored highest on both creativity indicators when they worked under highly competitive conditions and had creative personalities and innovative styles. In all other circumstances (i.e., when employees possessed fewer creative personality characteristics, had adaptive problem-solving styles, or worked under low competition conditions) creativity was significantly lower (Cummings and Oldham, 1997).

Individual differences may also moderate the relations between employee creativity and contextual conditions other than competition. Although no study has yet examined the joint moderating effects of scores on the CPS and KAI on these relations, Oldham and Cummings (1996) did examine the effects of one of the individual difference measures (CPS) on relations between job complexity, supportive supervision, and employee creativity. Results were consistent with those for competition—employees produced the most creative work (i.e., more patents, more creative recommendations to a suggestion program and higher supervisory ratings) when they (a) had creative personalities, (b) held complex, challenging jobs, and (c) were managed by supportive, non-controlling supervisors.

Future Research

Further studies regarding the effects of the organisational context on employee creativity might fruitfully proceed in several ways. Herein studies are needed to examine whether employees' problem-solving styles (KAI) combine with CPS to influence their creative responses to additional contextual conditions. For example, creative personality characteristics and problem-solving styles may moderate the effects of employees' work space configurations (e.g., number of boundaries and distance to coworkers), access to social support, and feedback from coworkers. Specifically, more research is needed on the general impact of coworker feedback on creative performance, and on the particular way that feedback is delivered to employees. Following Zhou (1998), positive coworkers feedback that is delivered in a constructive, informational fashion may enhance creativity more than positive feedback that is delivered in a controlling fashion (i.e. "You did well, just as you should"). And it may be that individuals with high CPS and KAI respond particularly well to the challenge such feedback provides.

Creative personality characteristics and problem-solving styles may moderate the effects of employees' work space configurations, access to social support and feedback from coworkers.

In addition, this research needs to more explicitly examine why individuals with creative potential respond differently than those with lower potential. It is argued that high potential employees more highly value the freedom and challenge provided by complex jobs, competition, and informative feedback, but future research needs to test the notion that these individuals are in fact more stimulated, focused, and challenged than employees with less creative potential. Again contextual elements are likely to enhance employees' creative performance by boosting their positive affective states. Yet only one study has directly tested this possibility (Cummings and Oldham, 1998), and this study focused only on a few contextual dimensions (i.e., job complexity, participation in decision-making, feedback from supervisors and coworkers, distance to coworkers, and number of boundaries). Results were generally supportive of the earlier arguments, suggesting that the contextual dimensions contributed to states such as enthusiasm, elation and excitement which, in turn, enhanced employees' rated creativity. But future research needs to focus on additional contextual elements and examine the mediating role of positive affect on their effects. In

Contextual elements are likely to enhance employees' creative performance by boosting their positive affective states.

In addition, such research might clarify why Oldham and Cummings (1996) failed to find a positive correlation between generally supportive supervision and employee creativity. One possibility is that generally supportive supervisory behavior did not effectively induce the positive affective states necessary to enhance employees' creative performance. It may be that more specific measures of supportive supervisory behaviour (i.e., participative decision-making, informative feedback), on the other hand, do produce the necessary psychological states.

Further research might also address the effects of the overall structure of the organisation (e.g., number of hierarchical levels, centralization of authority, and size) on employee creativity. Most of the research we have reviewed in this article examines the effects of elements of the departmental or work unit. And although evidence suggests that characteristics of organisational structure are associated with organisational level innovation variables (Aiken and Hage, 1971; Kimberly and Evanisko, 1981), we know little about the effects of such characteristics on employees' creativity.

Finally, future studies might also productively examine the joint contributions of elements of the context to individuals' creative performance. For example, it may be that informative feedback from coworkers has more positive effects on creativity when individuals work in architecturally protected spaces that permit them to fully focus on and use that feedback, than when they work in areas without boundaries. Similarly, employees may respond more positively to supportive, nurturing supervision when the spatial configuration of the organisation encourages interpersonal contact with that supervisor. In addition, although these examples suggest one contextual condition amplifies the effect of another contextual condition, some contextual conditions may actually reduce, or temper the effects of other contextual conditions (Cummings and Warren, 1998). For example, a controlling confidentiality policy may actually diminish the positive effects on employee creativity of supportive supervisory behavior. A better understanding of how contextual conditions combine to influence a variety of objective creativity indicators (e.g., patents) will allow organisations to fully take advantage of the raw material employee creativity provides.

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Managing Creativity: A Socio-Critical Analysis

Sorab Sadri and Dhun Dastoor

Competitive environment in industry forces companies all over the world to cut their costs and retain profit margins. This needs a thorough introspection of the managerial functions with the need to enhance creativity in the organisational set up. The present paper examines in depth all aspects of creativity in an organisation and in particular, stresses the roles of power and influence processes. The key question is whether creativity furthers the overall goal of organisations or merely a legitimising device for the emerging or existing hierarchies. The authors conclude that there are some truths in either points of view.

As the battle for competition intensifies, companies are forced to cut their costs and retain their margins. If in the process they fail to develop, they face the possibility of being overtaken or even swallowed up. And, as organisations develop so do the pressures placed upon them. Under these circumstances the manager of the company is called upon to be creative in his policies, methods and behaviour. Innovation which was seldom if ever encouraged at school and college, is a trait demanded of him increasingly today. The pressures placed upon the manager and the organisation are tremendous. Hence, organisations are being driven to observe managerial practices that provide them with a competitive edge. In the current era of globalization where the size of the world is fast shrinking, organisations the world over are focusing on creative ways of bringing down costs, improving quality and expanding their market shares. The management is moving from well defined hierarchies to more adaptive modes of functioning where the operating units are in close touch with the environment. However, this strategic change being sought to be brought about is not in the exclusion of the human relations dynamics that marks the internal environment of the organisation. This paper makes an attempt at examining the power and influence processes that have a bearing upon the various practices of creativity in an organisation and vice versa.

Sorab Sadri is Head, Human Resource Management, ISIBARS Limited, Navi Mumbai and Dhun Dastoor is Associate Professor of Human Relations, National Institute of Industrial Engineering, Vihar Lake P.O., Mumbai-400 087.

In the current era of globalization, organisations the world over are focusing on creative ways of bringing down costs, improving quality and expanding their market shares.

Consequently the prime emphasis here has been on demystifying the social relationships and consequently the structure that creativity in practice engenders. Social

sciences, at this particular juncture are very well equipped to do so. Subalternism, Deconstruction, Lacanian Psychoanalysis, Neo-Marxism, Foucault (and discourse analysis) and Feminism are a few of the post-modernist perspectives which offer promising insights. This paper conducts investigations in the area of creativity under modern contest with a view to substantiate and validate the question:

Does the practice of creativity further the overall goal of the organisations only or does it also serve as a legitimizing device for the emerging and/or existing hierarchies?

Theories of Creativity

Associationism

According to this theory new ideas are developed on the basis of old ones through a process of trial and error. It is based on the principle that thinking is the associating of ideas, derived from frequency, recency and vividness. Creative thinking is the activation of mental connections and continues until the right combination is discovered or one gives up. Creative associations occur through resemblance, either directly or through a mediating idea, as in analogical thinking.

Gestalt Theory

Gestalt theory views creative thinking as a process which deals with the reconstruction of gestalts or patterns that are structurally deficient. The problem in the process is grasped as a whole including the dynamics and tensions. By following the lines stress the problem of solver arrives at a solution that restores harmony to the problem. However, this theory does not provide any explanation to the task of finding the problems.

Gestalt theory views creative thinking as a process which deals with the reconstruction of gestalts or patterns that are structurally deficient.

Psychoanalysis

Freud (1933) suggests that creativity originates in conflict with the unconscious mind (the ID). Sooner or later, the unconscious mind produces a solution to this conflict. If the solution reinforces the activity intended by the unconscious it will issue a creative behaviour. If it

is at odds with the ego it will repressed altogether or will emerge as a neurosis. In Freudian psychoanalysis, much of the creative behaviour is the continuation of the play of the childhood. Creativity can be diminished by anxiety with which the creator awaits the approval of others on his/her work. A healthy ego requires the acceptance and communication of the creative idea. The shortcoming of the Freudian approach is the assumption that all mental states are derived from those of childhood and the society is fundamentally repressive towards all creative behaviour.

Neo-Psychoanalysis

Creativity is viewed as a product of the pre-conscious rather than the unconscious mind. The unconscious mind is open to recall when the ego is relaxed. Creative thinking occurs when the ego withdraws temporarily only to control it later. The preconscious is the source of creativity because of its freedom to gather, compare and rearrange the ideas. This is hindered by the conscious which lacks the flexibility to associate ideas other than the conventional.

The unconscious mind is open to recall when the ego is relaxed. Creative thinking occurs when the ego withdraws temporarily only to control it later.

The term *practice of creativity* here encompasses all the ongoing practices in organisations aimed at developing/honing the creative ability of the members, either in groups or as individuals. *Legitimizing device* refers to all the methods whereby any issue, (pertaining to organisational policy and practice overtly or covertly) is made to appear rational, and mutually agreed upon or comes to be accepted by the members in a routine. The term "*emerging/existing hierarchies*" has been taken to denote the relations emerging out of powerful/more powerful – powerless/more powerless interactions which in turn are borne out of differential distribution of authority and autonomy in separate but interrelated roles. The amount of power built into these roles may either be spelt out formally or may come into play during the execution of the said roles.

Creativity refers to the use of one's intellect to produce novel, meaningful ideas. Guilford (1956) developed a battery of tests out of which came the concepts of convergent and divergent thinking. It is the domain of divergent thinking which is closely and critically linked with the concept of creativity. Divergent thinking includes autistic thinking (which in turn consists

of varieties of thoughts and highly personalized symbolic thinking) and some convergent thinking.

Perspectives on Creativity

Creativity has within the standard literature been defined from the following viewpoints:

- the product of creative behaviour such as inventions, theories, literature, music
- the process of creative behaviour, which involves perception, thinking, learning and motivation
- characteristics of the individual who creates, such as temperament, personal attitudes and habits
- environmental and cultural influences that affect creative behaviour
- the role of creative thinking in problem solving

Elements

Creativity is a blending of knowledge, imagination, and evaluation. The process occurs through rearrangement and association of knowledge in new ways. It could be broken down in terms of sensitivity, synergy and serendipity which can then be defined as follows:

Sensitivity : awareness to discover problems and invent solutions.

Synergy : behaviour of the total system that is unpredicted by the behaviour of the individual components. It is often lacking in conscious thought.

Serendipity: refers to awareness of the relevance of accidental happenings.

Creativity is a blending of knowledge, imagination, and evaluation. The process occurs through rearrangement and association of knowledge in new ways.

Modern Theory of Creativity

Guilford (1950) views creativity to be an outcome of thinking abilities partitioned into the categories:

Cognitive : Recognition and awareness of information

Productive: Use and generation of new information

Evaluative : Judging whether the outcomes are correct or meet the requirements.

Productive abilities consist of convergent and divergent thinking. The former focuses on one direct solution while the latter focuses on a number of outcomes. Guilford lists the following factors under *divergent thinking*:

Word fluency-ability to produce words fulfilling specific symbolic requirements; *Ideational fluency-ability* to call up many ideas in a situation relatively free from restrictions where quality of response is unimportant; *Semantic spontaneous flexibility*—the ability or disposition to produce a variety of ideas when free to do so.

Figural spontaneous flexibility—ability to perceive alternative visual figures; *associational fluency*—ability to produce words from restricted areas of meaning; *expressional fluency*—ability to give up one perceived line or organisation to see another symbolic material; *originality*—ability to produce uncommon remotely associated responses; *elaboration*—ability to supply details to fill up the gaps in a skelton; *symbolic redefinition*—ability to redefine the purpose of the symbols; *semantic redefinition*—ability to shift the purpose of an object; *sensitivity to problems*—ability to sense the existence of problems.

Pioneering Studies

The Getzels and Jackson (1962) study sought to bring out the difference between the intelligent group and the creative group in the school setting.

- the high creativity group equalled the high IQ group in terms of scholastic achievements despite having a lower IQ score.
- the teachers appeared to approve more of the IQ group.
- the high IQ group valued qualities that they considered to be conducive for success in adult life.
- one of the qualities that the creative group valued was a sense of humour.
- later attempts at replicating these findings have yielded ambiguous results. (Even with other measures of creativity such as Mednick's Remote Association Test).

For example, Edwards and Tyler as well as Hasan and Butcher have conducted studies, the results of which have been completely at variance with the prior

more ambitious claims. It was Wallach and Kogan's study which restored, at least partially, the findings of the Getzels and Jackson's study. Their findings pointed out that:

- High creativity-high IQ group could exercise within themselves both control and freedom, both adult-like and child-like behaviour.
- High creativity-low IQ: These were found to be in angry conflict with themselves and with their school environment, however they can blossom forth cognitively.
- Low creativity-high IQ: These children can be described as addicted to school environment. Academic failure would be perceived by them as catastrophic.
- Low creativity-low IQ: Basically bewildered, these children engage in various defensive maneuvers (intensive social activity or passivity, psychosomatic symptoms etc).

A recently study attempted to identify the characteristics of the creative person. In doing so the researchers found that the following traits were agreed upon most by the instructors of creativity:

- Imagination, Openness to experience, Inquisitiveness, Intuition, Idea finding, Tolerance for ambiguity, Independence, Innovation, Insight, Internal/External openness, Illumination/Insight, Problem finding and Imagery.
- The results of the study also bring to the fore a few traits which have not found their way into the existing literature on creativity.
- The reader is cautioned here and reminded that the IQ test is in itself not an accurate measure of creativity and/or potential.

Social Influences on Creativity

Three studies have been conducted to examine the effects of rewards on child and adult creativity. The primary hypothesis was that explicitly contracting to do an activity in order to receive a demand will have negative effect on creativity, but receiving no reward or only a non-contracted-for-reward will have no such negative effects.

According to the Skinnerian classical position, reinforcement is the heart of behavioural control. If desired behaviours are rewarded, the likelihood of occurrence of these behaviours will increase. Around 1970, the researchers began to seriously question that reward will

always enhance all behaviours. Intrinsic motivation theorists suggested that reward can undermine certain type of behaviours under some conditions. Several studies have demonstrated the overjustification effect. Offering a reward for enjoyable behaviour can decrease the likelihood that the behaviour will be performed under subsequent non-rewarded conditions. According to self-perception theorists, the subjects who perform their tasks in order to meet the extrinsic contingency infer that the task was motivated by the extrinsic constraint and not their own interest. The cognitive evaluation theory proposed that the salient external constraint on performance causes a shift in that perceived locus of causality from internal to external. Thus there are at least three ways in which the intrinsic motivation may be changed to extrinsic motivation:

- Salient reward may be offered for engaging in intrinsically interesting tasks.
- The task can be made to appear as a means to an end in some other way than the offer of the reward.
- The task can be directly presented as work rather than play. Creativity appears to result from just that sort of risk taking, uninhibited exploration and playful combination of old into new patterns. Based on these notions, the intrinsic motivation theory proposes that intrinsic motivation is conducive to creativity whereas extrinsic motivation is detrimental. All the studies provided support for the above mentioned hypothesis. The evidence was strong enough to be generalized across different subject populations, reward types, reward presentations and creativity tasks Amabile (1983)
- The Getzels and Jackson study suggested that children with high IQ came mostly from intellectual occupational backgrounds whereas the high creativity group come from business background. They also found that the mothers of the high IQ group tend to be less secure and at ease with themselves than those of the high creativity group. The overall impression of the high IQ family was one in which individual divergence was limited and risks minimized and that of high creativity family was one where individual divergence was permitted and risks accepted.
- One of the traits of creative thinkers is Guessing which is often discouraged as a form of laxness by the teachers. Teachers should be able to recognize the good error and the bold intuitive leap, if they wish to encourage creativity in children.

According to self perception theorists, the subjects who perform their tasks in order to meet the extrinsic contingency infer that the task was motivated by the extrinsic constraint and not their own interest.

Creativity in Management

The increased complexity in the management environment has evolved the personalities and expectations of the decision makers and other members of the organisation who, consequently, are changing the way problems must be solved. Managers are not only moving towards more participatory decision-making but are also responding to the need for the decision maker to be more creative and innovative. Creativity results in something new that has value.

As society changes—technologically, socially, economically and politically—and as customers and competitors change, the need for creative solution increases. There are two other reasons for becoming more creative and innovative in problem solving: First, today the computer does the number crunching. The problem solvers no longer have to spend so much time on the machines of the process. They learn how to use information creativity to make better decisions. Second, an intuitive individual who also uses rational and analytical approaches has an advantage over someone who is simply rational and analytical. Especially in complex problem solving situations, the intuitive and creative person generates better decisions than those produced by the single-mindedly rational individual. Personal creativity within an organisational setting can be increased in two ways: Most people have been socialized against being creative. Overly burdensome rules, regulations and attitudes opposed to new ideas dominate most organisations. Employees need to be re-socialized to overcome negative attitudes and non-creative habits. Second, several techniques can be used to develop intuition and improve creativity.

In complex problem solving situations, the intuitive and creative person generates better decisions than those produced by the single-mindedly rational individual.

Self Esteem and Creativity

A recent study explored the relationship between creativity and self esteem. The sample consisted of 290 managers from ten work organisations. The results obtained showed a hierarchy in the order of strength with which self esteem was related to the various dimensions of the creativity process. Interestingly, both were found to be mutually reinforcing variables. In fact, a scrutiny of literature reveals that as early as in the 1950s researchers were pointing to the tendency that creative persons display strong self acceptance and positive evaluation of themselves.

Managing Highly Creative Executives

Blockages

Herein perceptual blockage would prevent the person from seeing the problem or the information needed to solve the problem. This may be due to (a) difficulty in isolating the true problem. This could be because of too little or misleading information. It can also arise from being too solution minded; (b) adding artificial constraints and assumptions to the problem and (c) inability to see the problem from various viewpoints.

Some of the emotional blocks are fear of making mistakes or taking risks, inability to tolerate ambiguity, desire for security and order, a preference for judging ideas rather than generating them, inability to relax and put the problem aside for a while, lack of imaginative control, and the inability to distinguish reality from fantasy.

Again there are cultural, environmental, expressive and intellectual blockages to creativity. Cultural blocks come into the picture when certain stereotypes in the social and physical environment prevent creativity in individuals—for example, an autocratic boss. The other types of blocks occur with the use of inflexible problem solving strategies, inefficient choice of mental tactics, lack of correct information or inadequate language and skills.

Creative Climate

External factors that are conducive to creative thinking include providing freedom to do things differently, encouraging risk taking, encouraging self initiated projects, providing assistance in developing ideas and providing time for individual efforts.

- Maintaining an optimal amount of work pressure, providing a non-punitive environment, using a low level of supervision, providing realistic work goals.

In the perspective of power dynamics, creativity can be viewed as the exclusive preserve of the ones already in power.

Organisations now have moved into the post-industrial phase where expertise forms the new axis of power. Technical expertise has hitherto wielded authority and power in the hands of role incumbents who are responsible for strategic decisions. And more often than not, they happen to belong the top and middle managerial ranks. As the markets become more competitive and complex, the flexibility the organisation has to imbibe in its strategic decision-making and functioning, has eroded into the traditional power bases. Power and its possession is more contingency and criticality oriented. It is but natural that this dialectic spawns a search for new means for legitimization of the waning authority. So, the current trend towards the assessment of creativity and its management within organisations is on a subconscious level, a support for status quo. In essence then, the whole body of existing academic literature on creativity and management is a veiled attempt to prop up the older power groups and perpetuate "false consciousness".

Before setting out on a postmodernist reading of the select text on creativity in general and creativity in management in particular, we need to consider another perspective—the *Symbolic Interactionist School* which can in a way be logically linked with the social critical model. The symbolic interactions school in sociology lays emphasis on the individuals in society and their definitions of the situations, meanings, roles, interaction patterns and the like in interpreting social reality. Symbolic interaction sensitizes us to the importance of shared meanings and definition attached to objects and behaviours.

Becker, a symbolic interactionist, puts forward the *Labelling Theory*, applying it to a path-breaking etymological model for the explanation of social deviance. His theory is primarily concerned with how some behaviours are labelled as deviant and how being given such a label influences a person's behaviours. Forms of behaviours on their own do not differentiate deviant from non-deviations; it is the response of the conventional and the conforming members of the society who identify and interpret behaviour as deviant which sociologically transforms persons into deviants. As a consequence, the labelled people tend to see themselves as deviants which leads them to continue their so called deviant behaviours.

Another crucial consequence is that they lose their status in society and their label assumes the master status relegating all other statuses or roles to the background. It is not too abstract an idea to examine the phenomena of interplay between creativity and power dynamics within an organisation in terms of the *labelling theory*. People who are identified as creative within an organisation (obviously through valid, rational procedures like performance assessment or psychometric tests) come to be labeled as such. This leads to the risk of others interacting with these people in terms of their master status of being creative people. However, in this case, the person so labelled comes to wield at least some power and influence over others. This is in contrast to Becker's original context of argument where the deviant is at a disadvantage due to such a label. But the process quintessentially remains the same; people defining some people in a situation in a certain way and consequently responding to or interacting with them in terms of this definition or label only. The question "Who labels whom?" assumes significance here.

The postmodern perspective (or the social critical model in this study's context) seeks to answer this question. Arguing in the context of deviance, conflict sociologists and some social-psychologists maintain that the ones who own and control the means of production also control the definitions of deviance in general and the power to impose it on the powerless. The fact that someone is creative or not is immaterial. What is significant is the fact that within the organisational setting, some people are identified through standardized procedures as creative and are processed and labelled as one. Thenceforth, other people's reactions to the person so labelled are fashioned in terms of this newly acquired status.

There exists a workable amount of agreement about the personality traits that seem to be associated with creative ability.

- One of the most frequent observations is that creative people, and perhaps especially creative scientists, tend to display and require a stubborn intellectual autonomy and independence of judgement which makes them less willing than most to be influenced by group opinions and pressures (Roe 1953; Barron 1955; Cattell 1957)
- They prefer complexity and come degree of apparent imbalance in phenomena (Morgan *et al*, 1986).
- They are more complex psychodynamically and have greater personal scope (Morgan 1986).

- They are more self assertive and dominant (Morgan *et al* 1986).
- They reject suppression as a mechanism for the control of impulse (This implies that they forbid themselves fewer thoughts), dislike policing themselves or other, and are disposed to entertain impulses and ideas that are commonly taboo (Barron 1965).

Creative people tend to display and require a stubborn intellectual autonomy and independence of judgement.

One implication of the above-mentioned traits is that creative people need greater autonomy, independence, complexity and authority in their jobs if they want to optimize their creativity on job. This naturally places them higher in the organisational hierarchy, at least in practice. Another area which is open to social critical reading is the issue of difference between Creativity and Intelligence. Though the results are slightly ambiguous, the weight of evidence is slightly in favour of there being a difference between creativity and intelligence (Getzels and Jackson, 1962). Thus creativity becomes the new device of tool for legitimization of a new form of *stratification* (or is it not the perpetuation of the older hierarchical order?).

In the corporate sector, the *Meritocratic thesis* is a little more valid than elsewhere. The *Functionalist* school in sociology (Parsons, Davis and Moore being the typical representatives) insists that talent/merit is sure to find its way to the top in the fair competitive world as there exists an equality of educational opportunity in society. This of course has been logically, and empirically refuted (Sugarman, 1969; Bowles and Gintis, 1976; Bourdieu, 1988). That the Marxist method in social science is both superior and sufficient is no longer an issue of debate. But it is relatively silent on the question of creativity.

The meritocratic thesis is a little more valid in the corporate/private sector because the disadvantaged or socially deprived groups are eliminated to a large extent as the corporate world entertains employees who are able to sustain themselves through specialized qualifications. So in terms of aptitude and intelligence (which have a greater contingency on environment than creativity), there is a considerable amount of homogeneity within an organisation (in comparison to the larger society). This invests the catchword "creativity" with tremendous potentialities.

It can be and is put forward to justify the existing/upcoming authority structure or to use the classical *Marxian* terminology, perpetuate "false consciousness".

Dwivedi and Dwivedi (1993) emphasize that the executives with high creative orientation must be tolerated and respected by their fellow executives and seniors rather than being perceived as deviants and amoral. This statement is open to varied interpretation. From the Marxian point of view, the study is probably nothing more than a tool of intellectual 'hegemony' or a product of what Althusser calls the '*ideological state apparatus*' which is aimed at intellectually justifying the superiority of the ruling class (in this case, the managerial cadre as a whole or the powerful elite or subgroups within these).

Conclusions

A postmodernist reading of selected literature on creativity and creativity in management has been attempted here to reveal the "oppressing theme of creativity in management". No perspective is without its pitfalls. So here too has been the risk of being overtly and covertly biased in interpretations. An ideal-typical version of postmodernist reading would probably try to refute all the research literature available in this area as fallacious and "veiled status-quoist" theories.

So harnessing postmodernist ideas and consequently methodology requires flexibility and tact of interpretation. The interrelated issues borne out in the preceding discussion can be succinctly related as follows:

- In the current dynamic, competitive and ever changing corporate scenario, the older hierarchies have been eroded considerably and have become blurred.
- Such a situation becomes a breeding ground for newer hierarchies or newer ideas/company values/mission for legitimization of older hierarchy and authority to develop.
- Creativity is one such concept which serves as the new legitimizing device.
- Some people are labelled as creative and accepted by others as such.
- The creative people are provided with more autonomy and power. They come to wield more power over others.
- Creativity is endorsed as the "catchword" by the ones already in power because in recent times it has emerged as a crucial element in strategic decision making.

- Whatever the initial reason for inculcation of creativity in the organisation, it activates power dynamics once it comes into play.

Ostensibly, whatever rationally thought out process goes on in an organisation, it is in order to ensure the organisation's survival and prosperity. But the processes also bring the individual's or subgroup's need to the fore. For example, need for power leads to a series of manipulations. It is this need for power which lends some amount of latency of intent and purpose to the major issues with which the organisation concerns itself. Power can be held by some only at the cost of exclusion of others from it. Creativity is one such rationalizing principle or ideology whereby concurrence regarding superior-subordinate relation and its validity can be obtained.

Creativity is one such rationalizing principle or ideology whereby concurrence regarding superior-subordinate relation and its validity can be obtained.

The managerial practice needs to be informed by the ongoing research in this area but at the same time it should guard against the exploitative context that such theory based practice may assume. Arguments developed in this paper need to be substantiated further through empirical research. This will serve a two fold purpose viz:

Orientation of the "human assets" towards the environment (both external and internal) will be facilitated greatly because there is more to managing creativity than meets the eye. Brushing the half-recognized and acquiesced-to detrimental consequences under the carpet can lead to frittering away of "assets and resources" of an organisation.

Even if the hypotheses generated from this text are not validated fully, it would, rather than erode drastically into the axial principles of this viewpoint, only underline

the need to interpret arguments developed within a particular framework judiciously.

As it is, there always exists the need to hear both sides of the story and this has been a scholastic attempt to explore the other—less apparent—side of the story.

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Strategising Research for Technological Innovation

Madhukar Shukla

The ability to generate and utilize knowledge accruing through strategic research is fast becoming the principal way to effectively manage an industrial enterprise in the present era of global competition. There is also a growing realisation that under the changed circumstances, technological innovation is a key to corporate survival and growth. The main hurdle in India for implementing technological innovations is the typically low investment in R&D by companies. The present paper strongly advocates for a better R&D investment and identifies some of the critical strategic and organisational prerequisites which make the R&D activities more innovation-focused. It also puts up a case for a co-producing concept in research.

Madhukar Shukla is Professor of Organisational Behaviour and Strategic Management at XLRI, Jamshedpur.

Contemporary transformation of the business environment has increased the competitive pressures on Indian organisations. Since the beginning of this decade, Indian companies are increasingly facing an entirely new set of competitive threats: superior technology owned by foreign competitors, impacts of major shifts in product or process technology, changes in preferences of customer segments, etc. The ability to generate and utilise knowledge is becoming the only way to effectively manage through the emerging competitive environment. There is also a growing realisation that under the changed circumstances, technological innovation is a key to corporate survival and growth. That is, companies need to put greater emphasis on their research and development activities. A well-known hurdle in achieving technological innovations is the typically low investment in R&D in India companies. Numerous studies (e.g., De, 1997) have noted that Indian companies are less innovative because they invest only a fraction of their sales turnover in research (indeed, in most Indian companies, the R&D departments were established, not with the intent to innovate, but to save taxes). On the other hand, innovating companies are known to have a large budget for research. For instance, ABB spends about 7 per cent of its sales revenue for research; Intel invests 15.4 per cent of its revenue in R&D; Hitachi's research budget is \$4 billions; Motorola's R&D expenditure is \$1.8 billion, or 19 per cent of its revenue; Siemens spends 10 per cent of its sales on research; Sony's research budget is \$1.5 billions, which is 5.7 per cent of its revenue, and so on (Shukla, 1994). Similarly, Kodama (1992) found that in 1986, the total R&D spending of 50 top Japanese firms was greater than their capital expenditure.

It is important to note that the reverse is not true. That is, merely a large research budget does not guarantee innovation. An analysis of 143 companies found that there was no correlation between companies' innovativeness and their R&D expenditure in terms of percentage of sales (O'Reilly, 1997). The critical issue in

technological innovation, thus, is not the quantum of expenditure in research, but how the research function is managed and leveraged by the company. It appears that companies which innovate tend to manage and deploy their R&D resources more strategically and effectively than others.

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In particular, there is very little literature on the (Schoen, 1969) total process by which companies translate a technological advance, an idea, or an invention into products, processes, or services.

This paper aims to identify some of the critical strategic and organisational prerequisites which make the R&D activities more innovation-focused. Based on the study of some of the innovative Indian and foreign companies, the paper discusses the factors integral to innovative technological research.

Vision to Innovate

Like most other activities in an organisation, the vision of the top management plays a major role in innovation. A clear vision at the top, which envisages innovation as company's focus, provides a direction to the research and development activities, and supports innovative efforts in that direction. As Quinn (1985) noted:

"Continuous innovation occurs largely because top executives appreciate innovations and manage their company's value system and atmosphere to support it..."

After studying 84 innovations, Langrish *et al* (1972) concluded that support by a person in top management position is critical to the success of innovation. Moreover, inability of top management to recognize the potential of the innovation was found to be one of the major factors delaying or inhibiting the innovative process.

In fact, most innovative companies have enduring visions, which are futuristic and emphasise need to build and innovate. For instance, the vision at 3M—one of the most innovative companies in the world with more than 60,000 products in its portfolio—al-

ways emphasised new product development and diversification as an essential to corporate growth. Similarly Sony defined its "purposes of incorporation" as the:

"Establishment of an ideal factory—free, dynamic and pleasant—where technical personnel of sincere motivation can exercise their technological skills to the highest levels... Making rapidly into commercial products, the superior research results... which are worth applying to daily lives of the public."

Correspondingly, the company developed the 'Sony Spirit', which was described by one of its senior executives as (Quinn, 1988):

"Most companies make profit the first priority. Sony's first mission is to produce something new, unique and innovative for the enhancement of people's lives."

An interesting Indian example of an enduring vision is the vision which led to development of the first indigenously developed Indian Car by Telco. In an interview given by J.R.D. Tata in 1978 (Business India, 1993), he had said:

"We might have made a car. If Telco had been allowed to develop as it should have been, I have no doubt we'd be making a car in India."

This intent at the top provided support to many activities in Telco, which were necessary to achieve it, e.g., establishment of a full-fledged R&D department of gear box technology, initial talks with Honda for a tie-up during mid-eighties (the government did not allow it), entry into the passenger car market with the launch of Tata Mobile in 1990 and so on. After twenty years of incremental efforts, Telco unveiled an indigenously built car, the *Mint*.

A top management vision which supports technological innovations, however, also presupposes presence of certain amount of technical expertise among the top executives.

Frohman (1982), after studying 9 companies with varying degree on emphasis on technology development, found that in companies which placed high stress on technology development, a majority of top managers had technical education, and were comfortable and fluent with technical topics. The study concluded:

"If the top management is to invest more heavily in technology, it must place technology development in the hands of an administrator who is comfortable wielding it."

R&D – Strategy Link

The top management vision only sets the preconditions for innovations to take place. In companies, however, innovation does not just happen—they are planned and are made to happen. Making innovations happen, on the other hand, largely depends on how closely the R&D activities of the company are linked to the achievement of its vision and strategy. "Formulation of a strategy for R&D to ensure that the work of R&D department is integrated with corporate strategy" is an important prerequisite for technological innovation.

For instance, in mid 1980s, Arvind Mills changed its product-market strategy from that of being a player in the domestic commodity textiles market to become a high-volume global denim producer. For the company to compete in the global market, it was essential to keep its costs low, while at the same time, provide high quality denim. This strategic focus could be realised only by translating it into an R&D agenda (Arvind spends 5 per cent of its turnover in research), and led to many technological innovations in its operations technology. While the rest of the industry was using projectile looms for making heavy weight denim, Arvind modified the airjet looms to produce the same weight of fabric, but with better quality and with 50 per cent less capital cost. Similarly, instead of using the conventional and highly capital-intensive rope-dyeing technology, it developed techniques for using slasher technology for dyeing operations. This helped in reducing the normal four-stage process to a single-stage operation, thereby, making heavy savings on operational costs (Kelkar, 1995).

A clear link between corporate strategy and R&D is essential for defining the focus of company's research strategy. According to Kodama (1992): "The difference between success and failure is not how much a company spends on research and development, but how it defines it."

Companies often fail to leverage their technological strengths, because of a lack of balance in their research strategy. To have a planned innovative process, the R&D activities need to strike a balance between the radical, "breakthrough" research activities—which focus on long-term results—and the incremental, developmental research efforts—which are necessary for solving immediate or short term commercial problems. In most research establishments (both

private and government-owned), these two foci of R&D activities contradict, rather than complementing each other. Often they also come to represent the differing priorities of the fund-providers (corporate HQ or the government), which emphasize the need for quick commercial results from research, and those of the research scientists, whose aspirations and temperament makes them biased towards long-term technological breakthroughs.

R&D activities need to strike a balance between the radical, "breakthrough" research activities—which focus on long-term results—and the incremental, developmental research efforts.

An integration of R&D with the corporate strategy is critical in defining this balance, so that resources can be systematically deployed across different kinds of projects. For instance, Monsanto's strategy clearly differentiates between three different class of research projects: Class I projects are those which are expected to give results within a year or two; Class II projects have time-horizon of up to five years; and, Class III projects aim at major breakthroughs, and are supposed to provide viable products in eight to ten years. Similarly, at 3M, the R&D budget is broadly divided into four kinds of projects: 10-15 per cent of the money is spent on relatively elementary work on existing products (e.g., product improvements and extensions); another 10-15 per cent budget goes into joint projects with manufacturing with the aim of improving/innovating production method; about 50-60 per cent is aimed at finding new products, both related and unrelated to 3M's existing lines of business; and, the remaining about 15 per cent is marked for long-term projects, which will give the company a technological edge (Labick, 1989).

On the other hand, in the absence of a clear research strategy, often the short-term concerns of the research fund-providers start determining the R&D agenda through lop-sided resource allocation.

Because in most laboratories many projects continue through several budget periods, a high proportion of funds available in the current year have been earmarked for on-going projects. Thus the amount remaining for new projects, which can change the balance of portfolio, is likely to be limited. This restricted freedom to manoeuvre means that it is not possible to respond speedily to changes which have been identified as desirable without causing severe dislocation to the existing programmes.

Market-Driven Research Agenda

An obvious implication of integration of R&D and corporate strategy is that the former's activities and focus should be determined by the market and user requirements. There is enough evidence which suggests that among the innovative companies, "the market drives the R&D agenda not the other way round" (Kodama, 1992). In a study of innovation, Freeman *et al* (1972) examined twenty nine pairs of industrial research projects. In each pair one project was successful, while the other had failed or was less successful. They found that consistently the successful innovators had a better understanding of the user needs, were better at marketing, and were more open to ideas from outside the company.

There are many ways in which the R&D activities can be made market-driven and focused on users' needs. Mainly this requires creating better linkages between the R&D department and the customers. At Pune-based Praj Industries (the largest supplier of technology to distillers and breweries in India), for instance, the R&D works in close collaboration with the Business Development group (marketing) and with customers (Karnani, 1993; Majumdar, 1995). The business development managers at Praj scan and identify potential customer needs, and also shortlist the latest available technologies. These are then passed on to the research centre. Following this lead, the researchers visit prospective client sites to find out the applicability of the technologies, clients' exact needs, adaptations which would be required to meet these needs, and so on. Thus, customization of technology to customer's needs starts even before the selling process had started.

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Such interface between research and customer helps Praj not only in swiftly responding to clients' needs, but also in innovating new technologies to meet customer requirements. For instance, it innovated technologies for using materials other than sugar molasses (e.g., tapioca, potato, corn, etc.) for producing alcohol. Similarly, understanding clients' need to control pollution, it developed a machine called Spranhillator, which not only completely incinerated the spentwash, but was also energy-efficient since it did not need additional heat input.

A customer-orientation for research may not be limited to only the external customers. More innovative research departments also treat the line functions (e.g., production, marketing, etc.) as their customers. In fact, some of the innovative companies (e.g., General Electric) even go the extent of creating systems, whereby the research projects are funded by the user divisions (O'Reilly, 1997). At Mukund Iron & Steel, the annual research plan is drawn up on the basis of discussions with the plant executives about the problems they are facing, feedback from the marketing department about customer complaints and rejection rates, the market development plan, etc. Interestingly, the R&D department does not have a regular metallurgical lab, since the company treats the shopfloor as the lab. This focus on the needs of internal and external customers enabled Mukund to produce many innovations, e.g., design casting for its Russian customers which can withstand repeated impact at sub-zero temperature, 21 per cent lighter castings for Indian Railways with the same load-bearing capacity, technology to reduce the normal annealing cycle (prolonged heat treatment) required for alloy steel from 32 to 22 hours, indigenous technology for producing coloured stainless steel, and so on (Kanavi, 1994).

Obviously, putting researchers face-to-face with the customers does not automatically make R&D activities more innovative. The customer requirements need to be restated in terms of focused research agenda. R&D departments can do this only if they have well developed systems and skills for translating often vague customer demands in terms of specific research projects. According to Kodama (1992), "Converting demand from a vague set of wants into well-defined products requires a sophisticated translation skill – demand articulation. Articulating demand is a two-step process: first, translate market data into a product concept; and second, decompose the concept into a set of developmental projects."

One way of facilitating this "demand articulation" process is by co-opting the customer into the innovation process. According to John Sealy Brown (1991), the head of Xerox's Palo Alto Research Centre (PARC), "The research department's ultimate innovation partner is the customer." Microsoft Product Support services, for instance, provides a telephone number – "206- 936-WISH" – on which the customers can offer their ideas about new features and applications, which they would like to have on Microsoft products (Bogan and English, 1994).

Involving the customer directly in the R&D innovation process is necessary for two reasons. Firstly, the formal market research data, which is the main source of new research ideas in most market-focused com-

panies, deals only with existing products. Moreover, it assumes that customers know their needs, and can articulate them clearly. Direct involvement of the customers in the innovation process helps in overcoming these limitations of the formal market feedback. It enables the research efforts to focus on products and services that do not yet exist and on needs that are not yet clearly defined. By helping the customers to become aware of their latent needs, it becomes easier to customize offerings to meet them (Brown, 1991).

Involving the customer directly in the R&D innovation process is necessary because the formal market research data deals only with existing products.

For instance, when Citibank started investing in Automatic Teller Machines (ATM) in 1971—six years before it deployed them on a large scale—it set up “the lab” in the basement of a New York office building, and co-opted customers to understand how they would respond to, and what they expect from a non-human teller. These experiments with customers, helped Citibank to make the ATMs more user-friendly, and to attract the less gadget-prone customers (Shukla, 1997).

The second reason for involving the customer in the innovation process is that often, to meet their own specific needs, customers innovate their own improvisations in the offering. One study, for instance, found that 67 per cent of the new process machines used by the semiconductor industry, and 80 per cent of the new instruments manufactured by the scientific instrument companies were developed by the users/customers (von Hippel, 1982). Similarly, Utterback (1974) in his study of 157 successful innovations in US firms, found that 98 of these were based on ideas picked up from outside the company. Since most such innovations are made to serve a local need of the customer, they often also contain the seeds of a larger breakthrough, which can effect the product portfolio of the organisation. By involving the customers/users in the innovation process, the R&D department can supplement their improvisations by greater developmental efforts, so as to cater to the needs of the larger customer base.

Coproducing Research

The history of technological innovations during the last few decades shows two very distinct patterns. Firstly, recent innovations have come not from radical breakthroughs, but from a number of small, incremental

improvements on an existing idea or technology, each building on the others. secondly, these innovations are based on integrating the advances in different technological of scientific fields. A good example of such innovations is the videotape recorder: it was built on advances in disciplines as diverse as magnetic theory, electronics, magnetic recording, frequency modulation, control theory, chemistry, and material sciences. One can see similar trend in the innovation of the first commercially viable LCD for pocket calculators by Sharp in early 1980s by blending the electronic, crystal, and optic technologies. Or in incremental innovations which changed the vacuum tube radios to transistor radios to stereo pocket radios to compact discs to optical discs with computer memories, and so on.

The implications of this trend for research management are multifold. Foremost, it implies that companies aiming at innovation through research, must shift their R&D strategy. The conventional focus of R&D has been on replacing old generation of technology or products with new one. It is a linear, step by step strategy of substituting the existing product or technology. This approach, however, focuses R&D too narrowly, ignoring the possibilities of new combinations.

Instead, companies need to adopt a “technology fusion” approach (Kodama, 1992)—which focuses on combining existing technologies and functional expertise into hybrid research outcomes—in formulating their research strategy. This means the company must redefine research as a complementary and cooperative (and not a specialised individual or functional) activity, which aims at blending incremental technical improvements from several previously separate fields of technology to create new products and technologies.

To derive innovative outcomes from the technology fusion approach, it would also be necessary to have a relook at the composition of the research project team. Underlying this approach is also the assumption that innovations come not just from the efforts of R&D, but from a teamwork between research and other functions. Nonaka (1997), for instance, found that many of the Japanese major product innovations (e.g., Canon’s mini copier, Honda’s City, NEC’s PC8000, Matsushita’s automatic home bakery, etc.) were made by project teams which were cross-functional, consisting of people from disciplines as diverse as research, production, purchase, service, marketing, etc. He also found that core members of these teams had followed a career path, which exposed them to three to four different functional areas. Such collaboration between the research scientists and the functional executives (who normally treat each other with contempt) is possible only when it is supported by new mindsets. As Brown (1991) observed,

"Research must "coproduce" new technologies and work practices by developing with partners throughout the organisation, a shared understanding why these innovations are important..."

For innovative outcomes from the technology fusion approach, it would be necessary to have a relook at the composition of the research project team.

An interesting example of such a collaborative approach is the introduction of calcium-enriched Citrus Hill orange Juice by Procter & Gamble (Labick, 1989). The idea for the product came from the researchers in the Health Care division of P&G, who while developing drugs for bone disease, found that calcium deficiencies was on increase among American adults. This was an opportunity for product improvement for the P&G's Food and Beverages division. But the problem was how to add calcium to orange juice and still retain a palatable taste. They could find solution from the researchers at the Laundry & Detergent division, who had long developed a technique for suspending calcium particles in liquid soap products.

Such collaborative efforts, however, are possible only if the top management treats innovation and research as an organisational activity, and not just something limited to R&D. As was discussed earlier, the top management vision is an essential precondition for innovation. It becomes more so, when the company adopts a technology fusion approach. In fact, technology fusion is not just a research strategy; it encompasses the very basis of how the company is managed. As Reich (1987) noted, "Competitive advantage today comes from continuous, incremental innovation and refinement of a variety of ideas that spread throughout the organisation. The entrepreneurial organisation is both experience-based and decentralised, so that every advance builds on previous advance, and everyone in the company has the opportunity and capacity to participate..."

This organisation-wide coverage of the research function can be seen in the functioning of some of the highly innovative corporate research centres, such as Xerox's PARC or Sony Corporate Research group. Sony Corporate Research, for instance, is an umbrella organisation, which coordinates the efforts of 23 business groups and hundreds of project teams. Every year it organises 3-day annual exposition—open only to employees—in which Sony's engineers and scientists

display their latest inventions. Since most stalls are manned by the investors themselves, this event helps in cross-pollination of ideas among various business groups, and at the same time in eliminating redundant research projects. The Research Group also ensures that the exposition is also visited by the top level manager, so that the innovators can find a sponsor who is willing to invest in the development of their projects (Schlender, 1992).

The scope of collaborative research, however, is not limited to the boundaries of the organisation. Smart companies are open to picking up ideas from outside—or even sponsoring or outsourcing research to outside agencies. For instance, in late 70s when Monsanto decided to shift from bulk commodity chemical business to the sunrise field of biotechnology, it did not start investing in in-house research in the new field. Instead, it invested heavily into start up ventures such as Genetech, and planted seed money for research in biotechnology in universities and institutions (Labick, 1989). Similarly, AT&T Bell laboratories supported 120 fiber-optics researchers at General Physics Institute in Moscow, and in 1992, H-P sponsored Russia-wide competition on theories of computer recognition of speech and printed characters (Business Week, 1992).

Such a strategy (which permits a variety of tie-ups, such as licensing agreements, joint ventures, research consortia, etc.) is particularly useful for innovations in fields which are still untested, or which may jeopardize the ongoing research projects (Olson, 1990). For instance, for pharmaceutical companies, e.g., Merck and J&J, it makes sense to have arrangements with many young biotech companies to do R&D and produce biotech drugs, because bio-technology is completely different than their staple business, which is making chemical compound-based drugs (Tully, 1993). Moreover, young firms with an entrepreneurial culture are often more adept at managing higher risks than the established companies.

Conclusions

As the competition grows more knowledge-based, it is becoming imperative for Indian companies to effectively develop and deploy their knowledge-generating assets. In the changed scenario, many companies are experiencing the need to become technologically innovative—and therefore, are realizing the need to provide a more central strategic role to their R&D function. Unfortunately, in spite of this realisation, few companies are able to strategise their research activities. One of the reasons is that often the research strategy is still defined in classical academic terms, which aimed at finding radical solutions to replace the existing products or technol-

ogy. The image of the lone innovator, working against the constraints built by the establishment, still dominates the mindset.

If the intention is to integrate research with the mainstream business activities, it is necessary to reinterpret the role of R&D within the company. Building linkages between R&D and the organisation's vision, strategies, customers, and other stakeholders is a critical precondition for redefining this new role. Only then, it would be possible to use research as a source of innovative business ideas, instead of a mere—if at all—troubleshooting agency. To be innovative, the role of R&D cannot remain limited to merely building prototypes of new products or technology; it must, to quote Brown (1991), "prototype new mental models of the organisation and its business."

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Financing Innovation

Mathew J. Manimala and Alan W. Pearson

Technological innovation, although vital for sustenance of a large firm against fierce global competition, presents a problem for micro-economic theory especially to finance innovation. In particular, budgeting decisions in R&D and innovation at the firm level do not conform to customary neo-classical approach; this is partly because of the inherent uncertainty and unpredictability of innovation process. Again financing of innovation for large organisations is basically a different proposition than for a small and medium enterprises (SME). Not with standing relative abundance of resources in large organisations, allocations for R&D are perennially inadequate. Moreover, financing of R&D of SMEs is also problematic due to difficulty of identifying appropriate market for the new products. All these aspects are reviewed in the present paper.

Mathew J. Manimala is a Senior Member of Faculty, Administrative Staff College of India, Bella Vista, Hyderabad and Alan W. Pearson is the Director, R&D Research Unit, Manchester Business School, Manchester, UK.

Introduction

Innovations, by their very nature of being new and experimental, are unlikely to attract wholehearted support from one and all. Financiers' lack of interest in innovations is attributed to various factors, the most important of these being the higher degree of risk and uncertainty associated with the successful commercialisation of a new idea.

One of the paradoxes about the innovative process is that the generation of a new idea is often an individual process, but its implementation invariably depends on the collaboration and support of several individuals, groups and agencies. The individual who strikes the new idea may be working independently or with an organisation. In the latter case, one of the first options would be to persuade one's own organisation to invest in the new idea. If the organisation takes up the further development of the new idea, financing becomes easier. This is one of the major advantages that large organisations have over entrepreneurial startups (Rothwell, 1986, 1994). However, it can be enormously difficult for a new idea to travel through the bureaucratic procedures, past different pressure groups and levels of evaluation and approval to reach the final stage of sanction. For this reason, many innovators start their own enterprises for implementing their new ideas. It is therefore not surprising that some researchers have found that more innovations take place in small and medium enterprises (SMEs) especially new start-ups (Cooper, 1970; Rothwell, 1985; Dearden *et al*, 1990; Acs and Audretsch, 1988, Pavitt *et al*, 1987).

Financing Innovation in Large Firms

Technological innovation at the firm level presents a problem for microeconomic theory. When an industrial or commercial organisation undertakes R&D, it can be presumed to make fairly rational judgements about its expenditure—it will, at least in theory, incur just as much as it thinks will, over a period, add as much to its profits as will other forms of investment. If the rational (in the

compared to the small funds that would be invested. Besides, investors normally look for immediate returns, whereas inventors and innovators are on the look out for 'patient' funds which would be willing to bear with the time-lag between invention/development and commercialisation.

- Most entrepreneurs have a need to retain full control over their enterprises. In fact, in many cases, it is the need for autonomy and independence that drives them to an entrepreneurial career. Such entrepreneurs tend to avoid external funds for fear of losing control over their enterprises. This attitude on the part of the entrepreneur may not often be stated explicitly. One of its manifestations is the entrepreneurs' unwillingness or inability to provide all the information sought by investors. The situation of "information asymmetry" thus created would finally lead to the denial of funds sought by the entrepreneur.
- Investors also have their own limitations in understanding innovations especially new technologies and products and therefore they fail to seek appropriate information, which also is a cause of "information asymmetry".
- Investors' prior experiences with SME entrepreneurs may also act as a deterrent to providing funds. Innovative projects by their very nature carry greater risks of failure, and so the prior "adverse selections" are likely to be high. Similarly, unlike in large organisations, there is a greater likelihood of funds being 'misappropriated' in SMEs. Entrepreneurs generally look for more flexibility for the funds available with them. For these reasons, investors tend to develop an extremely cautious approach towards SME innovators.
- Under the circumstances described above, governments have become a major source of funds for the SME innovator. However, as the government and public institutions are extremely slow in processing funding proposals, their funds do not arrive in time for the support of innovations involving fast changing technologies and high rates of product obsolescence.
- The "research-led" policy followed by governments in the past has restricted government funds primarily to the initial research up to the stage of prototype development. There is therefore very little support for the commercial development. Moreover, such a policy also

tends to exclude a large number of innovations that arise outside the domains of formal research.

- In recent times, there are severe cuts in the government funds available to support SME innovators. Several factors have contributed towards this situation, such as (a) the emergence of the market ideology and deregulation as the guiding principles of economic governance, (b) slow economic growth especially in the developed world and the consequent reduction in government revenues, (c) emergence of regional and global regulations/agreements restricting subsidies and government grants and (d) the internationalisation of R&D output because of which national governments lose interest in supporting such research whose benefits might immediately go outside the country.

Stimulating Flow of Private Funds

Faced with the twin problems of reluctance on the part of private financiers and reductions in the government funds, financing of innovation in the SME sector is at the cross-roads, looking for new directions and developments. In many countries, particularly the developed ones, national and regional level policy initiatives have been launched with a view to getting new support systems developed for funding innovations (Bailey *et al*, 1987; Mowery, 1992; Preston and Staelin, 1994; D'Andrea-Tyson *et al*, 1994). The major thrust of national policies has been to offer government support to innovative projects in such a way that it stimulates and attracts the flow of private funds into these projects. Fiscal and other policies are also designed to facilitate such flows. Fahrenkrog and Boekholt (1994), in a survey on public mechanisms in European countries to mobilise private funds for innovation, have found four types of support mechanisms:

- (i) Mechanisms to reduce the potential loss to investors, which are operated through (a) equity guarantee schemes or (b) innovation insurance schemes. The Business Investment Capital for NTBFs (BJTU) of Germany and the Equity Guarantee Scheme for Private Investment Companies (PPM) of the Netherlands are examples of schemes to protect the innovators'/investors' equity capital. Experiments in insuring innovators' equity capital have been largely unsuccessful because of the hesitation on the part of insurance companies.
- (ii) Mechanisms to increase liquidity and rewards for investors, which consist essentially of

facilitating exit from less attractive investments and entry into promising ones at later stages. Instruments of investment designed with this objective in view enables the investors to sell their investment under conditions of buy-back, management buy-outs, placement with other financial institutions, and so on.

- (iii) Mechanisms to reduce the scale or cost of investment, which include co-investment by public bodies, provision of tax-reliefs, assurance of some minimum interest payments, etc. for investments in innovative projects. Public bodies can also form a consortium for assessing the commercial feasibility of the innovative projects so that the investor could save on such initial expenses.
- (iv) Mechanisms to elicit the interest and awareness of different kinds of potential investors, which is basically a task of creating a general awareness about innovative projects and of developing the appropriate contacts and networks. Business angels networks and institutions for brokering financiers to innovative projects are examples of such mechanisms.

As explained above, the government schemes are intended primarily as a stimulant for encouraging private capital flow, not as a substitute for it. Traditional and non-traditional sources of funds are used by innovators depending on the needs of the enterprise as well as the mutual acceptability of the source and the enterprise. The most important of these sources are as follows (cf: ACOST, 1990; Bowers, 1992; Deakins and Philpott, 1994; Hughes and Storey, 1994; Mason and Harrison, 1992 and 1994; Roberts, 1991; Sharp, 1992):

Business Angels

The term refers to private investors who are usually wealthy individuals coming forward invest in high-risk high-return projects. They contribute small amounts particularly in the pre-competitive or early entrepreneurial stages of the innovative enterprise. Business angels are particularly attractive to innovators because, unlike the institutions, there are no bureaucratic procedures and

Business angels are particularly attractive to innovators because, unlike the institutions, there are no bureaucratic procedures and levels of screening and approval.

levels of screening and approval. It is only a matter of convincing one individual (cf: Haar *et al*, 1988, Harrison and Mason, 1992; Maruca, 1993; Wetzel, 1993).

Venture Capital

There are two main sources of venture capital available to the innovator, viz. (a) Private venture capital companies, and (b) Government venture capital funds (cf: Dixon 1989, Florida and Smith 1990 and 1993, Gaston 1989, Ooghe *et al*, 1991, Pratt 1990, Timmons and Sapienza 1992, Tyebjee and Vickery 1998).

Private Venture Capital Companies: The typical private venture capital company has very clear norms about the selection of enterprises for providing funding support and has very rigorous screening procedures. They look for high return projects (yielding about 30-50 per cent), which have new products with limited competition and a competent management team. Needless to say that innovators often fail to satisfy all these conditions. Hence the chances of their getting funds from private venture capital companies is very limited. Sweeting (1991) looked at the way in which UK-based venture capital funds operate and concluded that venture capitalists put in a good deal of effort to develop good relationships with the operating business managements but they were not slow in acting decisively and proactively to protect their investments when they saw them being threatened fundamentally. There was also some evidence which suggested a slackening of interest in innovative, technology-based businesses, particularly those in their early states of development.

Government Venture Capital Funds: Venture capital funds made available under government schemes are intended to serve a "pump-priming" function. Innovators can make use of these funds primarily for developing and demonstrating their potential so that they can attract funds from other sources. The success of government venture capital funds vary from country to country and scheme of scheme. USA, for example, has a few successful schemes, one of which will be discussed below in a later section.

Non-Financial Companies

Large manufacturing corporations which are interested in acquiring a new product or technology being developed by an SME may provide financial support to the latter. Such funding is provided only to those innovations whose viability has already been established. It is therefore a source for funds at the growth stage rather than at the product development stage. Funding at an earlier stage, however, is not ruled out; particularly if the larger company is interested in supplementing its own

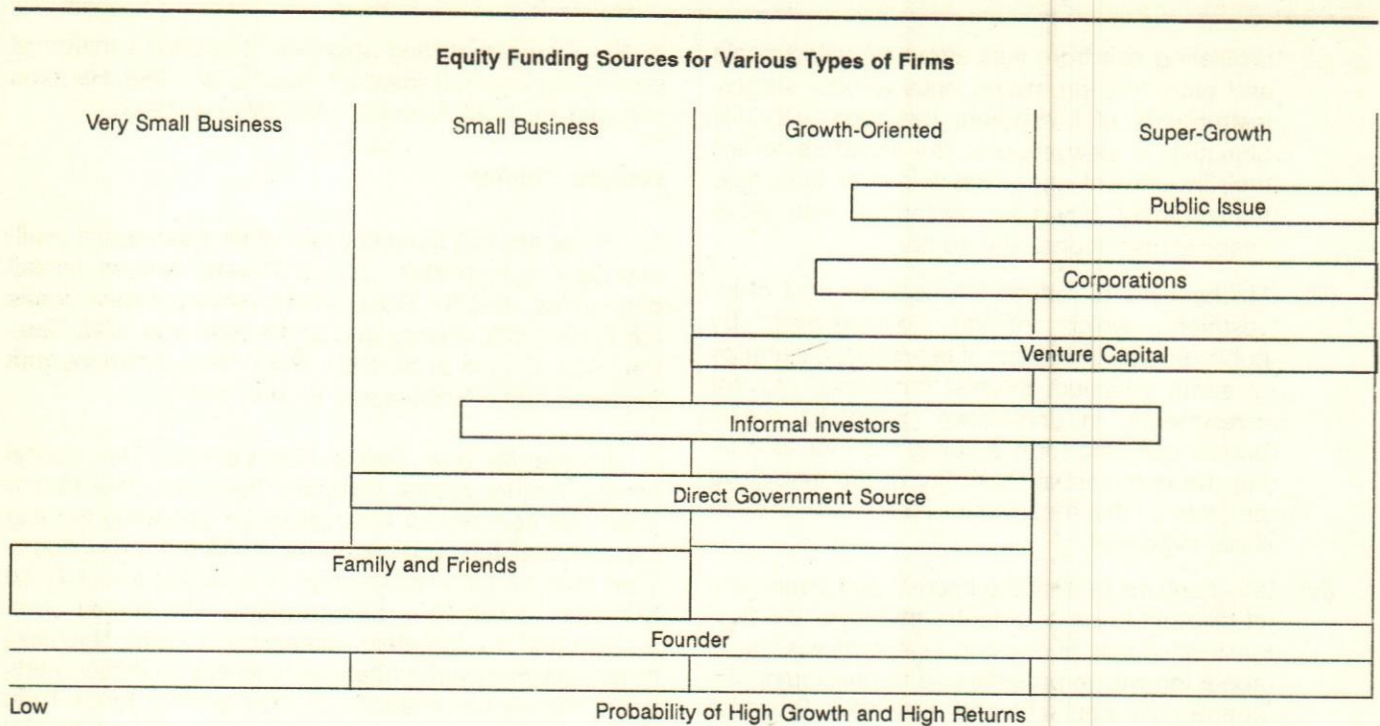


Fig. 1. Model for SME Equity Funding Sources

R&D at a lower cost (ACOST, 1990; Pratt, 1990; Mast, 1991; Winters and Murfin, 1988).

Mergers and Acquisitions

Merging with or being acquired by another company (usually a larger one) is an occasional strategy used by the innovator to tide over financial problems. The acquiring company gets the ownership of the innovation, and the innovator may make some capital gains. However, the deal may jeopardise the future of the innovation because the acquiring company may not fully understand the potential of the innovation and therefore may fail to create organisational structures and systems to further exploit the innovation (ACOST, 1990; Bruno *et al*, 1992, Garnsey and Cannon-Brookes, 1993).

Capital Markets

Most SME innovators use capital markets only as a last resort for raising funds. This is primarily because of the risk-averse nature of the investing public, who are not generally willing to invest in innovative but risky ventures. Besides, a public issue may not be economically viable for the small amounts required by SMEs. Thus capital markets will be suitable only for the relatively large and fast growing enterprises among SME innovators (cf: Buckland and Davis, 1989; Bowers, 1992; Hutchinson and McKillop, 1992; Standeven, 1993). More recently it has been suggested that option pricing theory might be

adopted for use in valuing start up ventures; however it has not been extensively used (Willner, 1995).

One of the obvious inferences from the discussions in this section is that there is no single best source of financing suitable for every SME innovator. The choice would largely depend on the type of the firm and the stage of its growth (Roberts, 1991; Standeven, 1993). A model Fig. 1 developed by Standeven (1993) for the equity funding sources and types of enterprises in the context of new technology based firms would equally apply to SME innovators as well. This is depicted in Fig. 1 Standeven, 1993; Mason and Harrison, 1994).

Practical Examples

SBIR

Small Business Innovation Research (SBIR) is a scheme (Nelson, 1995) of the US Government based on the Small Business Innovation Development Act of 1982, which was enacted to provide funding support for SME innovators who are normally ignored by venture capitalists. SBIR therefore created a \$500 million fund using a 1.25 per cent set-aside of Federal agencies' contract R&D. R&D projects in US small firms are assisted with the help of this fund. Funding is provided in two phases. During phase-1 a project gets under \$100,000/- for developing a prototype based on a new concept and during phase-2 another \$100,000/- or less

for developing it commercially. After phase-2, the government funding stops. The government does not demand any equity participation or repayment, but retains the right of royalty-free use of the final output. As the project progresses, the entrepreneur is supposed to attract private capital to supplement the government funds.

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The SBIR scheme is reported to have had several successes in commercialising new products as well as attracting private capital towards innovative projects. Some of the features of the scheme that contributed to its success are as follows:

- (i) Granting of exclusive commercial rights on the output to the firm concerned.
- (ii) Choice of firms with less than 20 employees who have the maximum potential for growth.
- (iii) Limiting of the maximum funding available per idea, per period, and per firm.
- (iv) Funding only pre-competitive ideas and demanding more and more matching funds from private investors as the idea matures.
- (v) Spelling out the project objectives clearly and ending support if the project fails to achieve its objectives.

SWORD

Stock Warrant off-balance-sheet Research and Development (SWORD) is an innovative instrument (Solt, 1993) for raising equity funds, designed by small and medium sized biotechnology firms for supporting further R&D work. Such firms, being small, do not have internally accumulated funds. Nor do they have the capability to attract external funds. The new instrument, SWORD, compensates for these disabilities.

Stock Warrant Off-balance-sheet Research and Development (SWORD) is an innovative instrument for raising equity funds, designed by small and medium sized biotechnology firms for supporting further R&D work.

Under SWORD, the parent company sets up a new company for undertaking the specialised R&D project. The new company will have the property rights to the R&D output. However, its financial results will have no impact on the parent company. The financing of the new company is from the sale of units to the public. Each of these units have two components: (1) one share of the new company's common stock that can be called by the parent company at any time; and (2) one warrant to purchase one share of the common stock of the parent firm.

The implementation of the SWORD scheme is enforced by a few agreements:

- (i) Technology licence agreement, by which the new company get the rights over any technology already developed by the parent company in related areas.
- (ii) Service agreement, under which the parent company provides management and administrative services to the new company throughout the development process.
- (iii) Development contract, under which the new company can use the existing facilities and specialists of the parent company, besides getting the parent obliged to secure patent protections on behalf of the new company.
- (iv) Licence option agreement, under which the parent can get the licence for the new products developed by the new company by paying a prescribed royalty to the latter.
- (v) Financing agreement, under which the parent company can exercise the call option and the investors can exercise the option to purchase the shares of the parent company.

Even though SWORD was originally developed by the SMEs in the biotech area it can be successfully employed by other firms: (1) for whom new product development is critical for survival but risky because of the uncertainties involved in the nature of technology (2) whose size is small and so there is shortage of internal funds and proportionately higher costs and risks in new product development, and (3) where the control over manufacturing and marketing rights of the new products is crucial to the viability of the firm.

Conclusions

Financing of innovation, almost by definition, cannot be approached by any single or simple method. The uncertainties inherent in the process argue for

variety and flexibility. Large organisations, if they manage it formally, tend to take a portfolio approach but many recognise the value of informal methods essentially based on bottom up initiatives. Small firms do not have this luxury and entrepreneurs often have to make major commitments and take risks which can have very serious consequences if their judgement proves to be incorrect. There are ways and means of reducing such risks, and also of sharing them with others. However, the evidence suggests that despite much research in this field and the availability of a variety of support mechanisms, the failure rate remains high and the levels of innovative activity which is supported is lower than what is warranted by its potential merits.

In developing countries like India innovation or R&D has not been a serious concern for the industry until the launch of economic liberalisation in 1991. Seven years after the realisation of the importance of R&D for the development of its economy, the country still remains far behind the industrialised West in terms of its R&D activities. It is estimated that India spends as little as 0.7 per cent of its GDP on R&D, whereas in the US the R&D expenses are 2.8 per cent of the GDP (Jalan 1998). This disparity in the absolute amounts is much more glaring when we consider the disparities in the GDPs of the two countries. The fact remains that in spite of all the talk about the importance of R&D in a globalising economy, there is very little increase in R&D activities. Even the little that is being done is focused on trouble-shooting and at the most on process adaptation. There are very few genuinely new products being developed in Indian R&D laboratories. The culture still is that of borrowing new products and technologies from abroad. One of the excuses given for the low levels of R&D activities in the country is the shortage of resources. This argument carries an implicit assumption that there are abundant resources allocated for innovation in developed countries. This is indeed a myth which is amply clear from the struggles that they undertake and the innovative schemes they design for raising resources for innovation. The fact is that no one can or will provide unrestricted resource support for a new idea, product or project. As the Indian economy slowly emerges as a player in the international market, it will have to support

Seven years after the realisation of the importance of R&D for the development of its economy, the country still remains far behind the industrialised West in terms of its R&D activities.

innovation in a hitherto unprecedented scale. Financing of innovation will then become an important concern for the Indian industry too when some of the innovative schemes operating abroad might help India in designing their own schemes for the purpose. In other words, innovativeness is the critical factor for success in every field including that of financing innovation.

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Industrial Training, Skill Development and Innovation

G.D. Sandhya and N. Mrinalini

In the present economic order of technological developments, there is a shift in the perception of resource of a country, from natural resource to human capital as a resource. The most significant factor of management of human resource is enhancement of skill that in turn is the most crucial aspect of innovation. An innovative organisation would organise itself in such a way so as to be able to develop firm-specific skills to get certain competitive advantage in contrast to its non-innovative counterpart. This has to be achieved through enhancing the skills of the workers. More so in the face of international competition and development of standards such as ISO 9000, firms have to modify the existing skills by either recruiting new people or retraining their old staff. This paper deals with what determines industrial training and what explains variations in the innovative activities. The variations in levels of training have been explained in terms of the size of the firm, nature of technology, firm being a part of the network, etc.

G.D. Sandhya and N. Mrinalini are Scientists at the National Institute of Technology Development Studies (NISTADS), CSIR, Pusa, New Delhi-110 012.

Introduction

The process of innovation has undergone several changes over the years. If earlier it was the linear model of innovation which implied a linear movement from invention, innovation to diffusion with all stages being very distinct, now it is overlapping of several stages which move together. Since product life cycles are changing fast, what is required by the firms is to acquire generic capabilities, newness in the management of firms, operational effectiveness (performing similar activities better than the rivals perform), etc. In other words it requires a flexibility to respond to new markets, benchmarking, outsourcing effectively and efficiently and nurturing few core competencies (Porter, 1996).

In this scenario, if one looks at how the process of innovation is exhibited in Indian enterprises, they seem to be occurring at the levels of improved processes, changed raw materials, inventory reductions, improvements in material movement, productivity improvements (of man, materials, machines and methods), enhanced capacity utilization, quality improvements, wastage reductions, energy conservation, effective utilization of the manpower, cross functional teams, more of outsourcing by the firms, managing their vendors very effectively so as to elicit the same level of improvements from them, continuous benchmarking, better management structures. Concepts that have emerged in this scenario relate to concurrent engineering, TQM, JIT, benchmarking, etc.

Two of the leading auto manufacturers such as Maruti and Eicher, for instance have subcontracted out nearly 80-90 per cent of their activities from mid 80's mid 90's. The good linkages have resulted in a large number of innovations. The result of these relationships is a network of nearly 300-400 small and medium enterprises. Many of them have even become groups of large number of vertically integrated enterprises. A feature that is very typical of this network is *skill enhance-*

ment through training which is a joint effort of the buyer as well as the suppliers. The cooperative efforts or good linkages between the buyers and suppliers have helped both in attaining operational returns on efforts.

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The results are based on a broader study which dealt with developing indicators for measuring innovative activities of Indian enterprises in and around the National Capital Region (NCR) of Delhi. This paper deals with industrial training and skill development. The objective is to find out what determines industrial training in the context of skill development.

Skill Development and Training

Firms can improve their performance and be more innovative through organisational innovations and be more competitive. The success attributed to Japanese enterprises has its genesis in the higher organisational capabilities than the US enterprises (Lazonick, 1991). These organisational capabilities stem from planned human resource development for developing skills, the weaknesses in which, for instance led to the erosion of organisational capabilities of the US enterprises. In UK also, for instance, the poor economic performance had its genesis in low skill base of human resource. On an average British firms spent only a fifth of that in Japan (Dolton, 1993). It is skill development that has played an important role in the catching up process of Singapore (Cheah, 1997). The crux of the argument is that competitiveness, technological capability or the organisational capability resides in human beings who manage the organisation as well as the technology. An organisation can be said to contain a reservoir of knowledge, created around individuals. An innovative organisation should manage this resource very effectively for generating innovations. These skills of individual worker can transform the usage of machines, alter sequence of various stages, use them more effectively. The human resource that a firm has can be managed through either skill creation or acquisition from outside, involving both codified and tacit knowledge. How can this be managed? An organisation acquires the manpower, train it through formal and informal means and nurtures their capabilities for further growth. There is a distinct relationship between training and skill development (Gospel, 1991). The technology can be integrated into

the organisation only by training the people who will operate it. Training supports the process of development and building up of skills required for operating the technology. The absorption of technology is facilitated by high education and higher skills (OECD, 1994). It is skill development that has played a very important role in the transition of labour intensive manufacturing to skill intensive manufacturing (Godfrey, 1997).

An organisation can be said to contain a reservoir of knowledge, created around individuals. An innovative organisation should manage this resource very effectively for generating innovations.

These skills can be specific to the firm or individual or even technology, e.g., primitive and mature technology, new technology, sophisticated technology. The way these skills would be required and nurtured or developed would depend on type of organisation, the nature of technology, as well as in the management of organisation of technology. Training and skill development provide a basis for innovation. There is a distinct relationship between the two. Coming to why skills have become so important to the process of innovation?

Modes of production have undergone changes from craft to mass to automated production (Humphry, 1997). Though the shift from craft to mass production led to deskilling in workers, the shift from mass to automated has reversed the trend in favour of upgradation of skills.

There is a shift in the orientation of trade strategies of most of the countries from inward to outward oriented strategies. This shift has forced the firms to manage their human resource very effectively. It is also noted that the economies which have pursued outward oriented trade strategies have developed their human resource more effectively (Cassen. Robert, 1997). The firms, in order to survive the international competition invest more in training. In Brazil also, for instance of the fall outs of liberalizations was that firms invested heavily in training (Humphry, 1997). Also the success of most of the industrialized countries tells us that the acquisition of technological capabilities is nothing but creation and nurturing of the skills of the workforce through training (Fransman, 1984; Enos, 1991). The success of Japan's industrialization can also be attributed to assimilation of the imported technology by putting more emphasis on skill development and training. Whether the in-

dustrialization had its genesis in outward oriented strategies or inward oriented strategies, both ways the success can be attributed to upgradation of the skills.

India has embarked upon a series of liberalisations by adopting more of outward oriented trade strategies. The concepts of TQM and JIT which have made the business organisations in technologically advanced countries save space, reduce inventory costs and lower the defect rates have very much become part of the Indian enterprises too. This has been achieved through enhancing the skills of the workers. More so in the face of international competition and development of standards such as ISO 9000, firms have to modify the existing skills either by recruiting new people or retraining their old staff.

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There are differences in firms in terms of their requirements for training and thus levels at which trainings are imparted. Size of the firm is an important determinant of training that is related to skill development and innovation (Cassen, 1997). The nature of technology whether high or low, is also an important determinant of the incidence of training. Another factor that affects training is education. Networking also explains the variations in training. As seen in case of Germany, the cooperative network between companies also influenced incidence of training.

Determinants of Industrial Training

The factors taken into consideration for analyzing industrial training include, training internal or external, personnel mobility and On The Job Training (OJT). This is to understand what sort of arrangements the firms have within and outside for enhancing the skills. The authors have tried to explain the differences in training by various firms in and around the NCR region of Delhi. The analysis is based on 53 firms that responded to study out of 200 firms that were visited. The information thus sought is both from the questionnaire and interviews of the senior management. The sample has a higher concentration of firms in the automobiles sector.

The emphasis on training in a firm can be explained by size of the firm, nature of technology, i.e.,

whether high or low, its affiliation to a network. We have categorised firm on the basis of size into six types (Table 1). For the analysis, only 47 firms have been considered as sales figures were not available for 6 firms.

Table 1: Policy on Quality and Training in relation to Firm Size

Size	Number of firms	ISO	Explicit policy on training	Personnel Mobility	Training man-hours
< 1 crore	8	Nil	20%	20% at (1)	over 100 hrs
upto 5 crore	13	30%	70%	50% at (1,2,4)	
5-10 crore	8	37%	100%	only 10% at (1,2,4,5)	36 hs/m/yr, 150 mds
10-50 crore	6	33%	90%	50% at (1,2,5)	208 mhs, 200 mds
50-100 crore	7	55%	90%	70% at (1,2,3,4,5,6)	250 mhs
> 100 crore	5	100%	100%	60% at (1,2,3,4,6)	641 mhs, 20 10 hrs, 110 mds, 17 hrs

- 1-Vendors/suppliers 5-Network partner in marketing or servicing
 2-Technical collaborator 6-Network partner in local industry
 3-Partner/Consultant association
 4-Joint venture partner

In the tiny sector, only 20 per cent of the firms have tried to train their people. These firms are mostly in low tech profile. The 20 per cent of the firms which have trained their people are those which are a part of a network. One of the factors that has resulted in increased emphasis on training is, compulsions from the buyers on quality. The people in a tiny firm are trained at the buyer's end. None of the tiny firm has ISO 9000. Only one firm is a part of self certification of the buyer. Thus here the training emphasis can be mainly explained by the presence of a network.

A look at the automotive sector, in which nearly all the firms are a part of network, however would reveal that more than 70 per cent of firms have ISO 9000. Then, a section has been under the self certification scheme as well. As a result more than 90 per cent of firms have an explicit policy on training. Their people are trained for a definite period through internal as well as external training. In case of Maruti, for instance 80 per cent of its supplies go straight to the line and thus require quality maintenance. Here the buyer organises training programmes for its suppliers very regularly. Suppliers themselves also undertake regular training programmes for their workforce.

The small sector (upto 5 crores) has laid more emphasis on training. Nearly 70 per cent of the firms have trained their workers. 50 per cent of them are also a partner in a network, and nearly 45 per cent have trained their people at the buyer's end. 30 per cent of the firms have an ISO 9000.

In the next category between 5 to 10 crores all the firms have an explicit policy on training and 37 per cent of them have ISO 9000 as well. There is a deviation in terms of personnel mobility, for only 10 per cent of the firms send their people for external training. It is expected as most of the firms are in the engineering sector, where technology is indigenous and firms are trying to maintain their competitiveness by training people internally for minor technical as well as productivity improvements. The percentages of firms having ISO and a policy on training do not change much as we go from 10 to 50 crore company but what changes is external training which increases up to 50 per cent.

With a further increase in size, the ISO certification increases upto 55 per cent and also training by 90 per cent. The emphasis on external training increases further and people are trained externally at the end of vendor or supplier, technical collaborator, joint venture partner, network partner in marketing and consultancy. Another differing feature which changes with size is the incidence of external training at R&D partner's end as many of these firms have a clear-cut emphasis on R&D, and have DSIR recognized R&D units. These firms even have alliances with other institutions.

All the firms in more than 100 crore category have ISO and have a clear-cut policy on training internal as well as external. These firms have been paying increasing attention to training by sending their employees even outside for external training. Training is imparted by both, insiders as well as outsiders in case of 17 firms, whereas in case of 8 firm the training is imparted only by insiders. This goes beyond even the first level of vendors. For instance firms such as Maruti, Sona, Lumex, etc., organise training programmes not only for its vendors but also to the vendors of vendors.

To mention another case, Eicher, in the last 10 years is able to double its production with the same manpower through human resource development, retraining its staff, value engineering and value creation, offloading certain unproductive activities. In Eicher, for instance suppliers are trained for TQM and JIT. Apart from training its own workers for 200 hours, Eicher regularly trains its vendors for Total Quality Management (TQM), Human Resource development (HRD), management, technique related such as metal-

lurgy, foundry, etc. At times the concerned experts from outside visit suppliers site. Series of residential programmes of three days have been arranged by Eicher for its suppliers in the last two years. As majority of supplies go straight on line, quality has to be maintained. A vendor modernisation to upgrade started in 1989. Eicher has a scheme of self-certification under which once the supplier has become self-certified, its supplies can go straight to the assembly line. Eicher also helps its suppliers in achieving operational efficiencies achieved through value engineering and value creation.

The development of industrial training is affected by even the source and nature of technology and also the type of firm. One can classify this production manpower to be trained, into workers with less than ITI industrial training, ITI trained manpower and engineers. Usually in a tiny enterprise operating an outdated technology and a small turnover, workers are taken not even at ITI level. They are available in the market at low wages and trained on the job. Their easy availability in the market and low legal liabilities makes the firm not to make serious investments in their training. As a result the labour turnover is high in these firms. Obviously the emphasis on training will be less in such firms. Whatever little training is imparted is marginal. Thus the incidence of OJT increase if the firm has higher percentage of ITI trained manpower.

One can classify production manpower to be trained, into workers with less than ITI industrial training, ITI trained manpower and engineers.

In small, and medium enterprises, however people are taken at all the three levels. Both internal and external training programmes are organised at various levels. In many a firms, firms themselves have sent people for training at ITI's. Such trainees are called to the concerned firm for industrial training and then they go back. Finally they are absorbed in the firms. Such people are normally retained by the firms or rather they stay with the firm.

Following factors establish the relationship between an innovative firm and training.

1. An innovative firm has a *clear-cut policy of training* its manpower. Out of 53 firms of the NCR region 36 have a clearcut policy for OJT. Of this 50 per cent already have ISO 9000. Nearly 17 firms already have ISO 9000 and many are in the process of getting it.

2. An innovative firm will train its manpower for a definite period through *internal as well as external training*. The people are trained at the end of, *buyer, collaborator, R&D partner, joint venture partner, network partner in marketing and local industry association*.

In Maruti, for instance every year 120 workers go to SMC for training. Maruti regularly organises training programmes for its suppliers. These are on, gauge and inspection equipment calibration, ISO 9000, statistical quality control QS 9000 System, failure mode and effect analysis, sheet metal working. Maruti started with the ISO assistance for its suppliers in order to help them obtain ISO 9000 certification. Maruti started with 50 suppliers and 21 of them have already been certified for ISO 9000. Maruti also organises training for its suppliers at its collaborator's suppliers end. Thus Maruti suppliers visit Suzuki's suppliers at Japan to learn. Maruti has initiated a programme for improving process capability. 12 suppliers are initiated into this. There is a programme underway on Business Improvement Programme with 5 of its vendors in consultation with Bywater plc., UK.

When the technology is sourced from outside the firm or even from abroad, then the firm sends people for training at the collaborator or the joint partner's end. 4 firms have sent their people to their technical collaborator and joint venture partners (Data is only for 4).

Roughly 15 firms have sent their 2-25 per cent of people to be trained to their vendors. Only in few cases firms have sent their people for training to their R&D partner. 3 firms have sent their employees to network partner in marketing and local industry associations.

3. The development of industrial training is affected by even the source and nature of technology and also the type of firm.

4. Experts impart OJT and they use multimedia and expert system for OJT. Multimedia is in case of 4 firms and 8 firms use expert systems for imparting training.

5. *Specific hours devoted to training* manpower at the end of the vendors, technical collaborator, joint venture partner, network partner in marketing or servicing and local industry association (Table 1). In Maruti for instance, the annual targets for people who have been trained during 1994 and 1995 were 2 hours and 17 hours respectively.

6. Training specific to the skills of individuals. Firm in most of the cases train people in skills that are close to their existing skills.

Following factors influence industrial training in the context of skill development,

- Size of the firm
- Nature of the technology,
- Quality policy,
- Network,
- Education.

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Corporate Success Through Total Quality Innovation

Sunil Sharma

Several distinguishing characteristics make R&D processes distinctly different from manufacturing processes. It follows that management of R&D and innovation need approaches different from those applicable in manufacturing situations. However, the concept of Total Quality (TQ) is relevant in corporate innovation activities too. The present paper delineates the key elements of Total Quality in managing innovations. It traces the changing focus of innovation strategies over the years from marketing to technology and stresses the importance of customer focus in innovation strategies. The five C's of innovations management are also touched upon.

Sunil Sharma is a Senior Lecturer, at Faculty of Management Studies, University of Delhi South Campus, New Delhi-110 021.

Introduction

Total Quality (TQ) could be most precisely defined as continuous improvement in meeting customer's requirements through product and process improvements at optimum cost through everyone's commitment. Corporate innovations which convert ideas into commercial reality require Total Quality (TQ) like any other corporate function. In Indian setting, corporate innovations need specific skills and approaches to manage. Leading world corporates have followed systematic introduction of TQ in their product development programmes in a phased manner with focus on:

- Objective measurement and benchmarking of result-areas.
- Managing high-talent personnel.
- Inculcating team spirit and
- Developing creative and entrepreneurial R&D personalities.

Some of the companies worldwide, which have amply demonstrated introduction of TQ in their corporate functions are Unilever, Du Pont, Xerox, AT & T, Shell, ICI, Esso, Rolls-Royce, B.P. and Sony.

Differences Between Manufacturing & R&D Processes

The differences between manufacturing & R&D processes give rise to unique strategies to manage innovations. The typical differences are given in Table 1.

These differences make it obvious that innovations require altogether different approaches for management whether it is organising, goals planning, process performance, control or improvement.

Table 1:

Manufacturing Process	R&D Process
Short cycle time	Longer cycle time
Defined & visible	Poorly defined and not clearly visible.
Clear ownership, clear line of authority	Extending across organisations, Unclear Ownership & line of authority.
Roles, responsibilities and objective (RRO's) clearly defined.	RRO's not clearly defined.
Data Collected on process performance.	Little data collected on process performance.
Objective measurements of performance possible.	Objective measurements of performance very difficult.
Improvements can be followed and implemented.	Improvements difficult to be followed & implemented.
Control maintenance easier	Control maintenance difficult.

Key Elements of TQ in Managing Innovations

Holt (1983) defines innovation as a process that covers the use of knowledge of relevant information for creation and introduction of something that is new and useful. Knight (1967) defines innovation as the adoption of a change which is new to an organisation and to the relevant environment. Zaltman (1973) defined an innovation as 'any idea, practice or material artifact perceived to be new by the relevant unit of adoption'.

The key elements while introducing TQ in innovation management are:

- (i) Empowerment of R&D staff and creating innovation climate.
- (ii) Objective measurements and Benchmarking in R&D.
- (iii) Anticipating (Internal & External) – Customer needs.
- (iv) Quality Improvement Projects (QIP's).
- (v) Managing High Talent Professionals' creativity and Motivation.
- (vi) Installing the Product Champion.

Let us examine each element to some detail:

Empowerment of R&D Staff & Creating Innovation Climate

It refers to greater involvement of all staff and thus increasing confidence level of employees to contribute and accept responsibility and accountability at the individual and team level. For empowerment, top management has to inculcate autonomy inducing beliefs amongst individuals. An empowered person does not feel incapable of doing the things that he/she considers important for well-being of organisation. Empowerment could be facilitated by giving subordinates important tasks to do and freedom to choose projects of their choice especially in R&D. For this, a proactive approach is required which favours greatness over routine work and courage and conviction over caution. For this, research managers should create right innovation climate.

Innovation Climate

Some elements of right innovation climate are:

- * Freedom of Idea Generation.
- * Clear project identification.
- * Assigning person with company wide reputation as product leader.
- * Product leader to drive programme of product development to conclusion.
- * Management support and vision guidance from top management.
- * Project and concept harmony in R&D, marketing & sales.
- * Team approval.

Objective measurements and Benchmarking in R&D

- * Some of the measurements for R&D tasks could be:
- * Percent Products delivered on deadline.
- * Percentage products completed within budget.
- * Number of patents issued.
- * Productivity, Reliability & Maintainability of new products.
- * Lab employees turnover.
- * Morale and satisfaction level of Lab employees.
- * Clients/cust omers-internal and external—whether they are more satisfied with new products researched and developed.
- * Average product development cycle time.

What cannot be measured, can not be improved and continuous improvements as a part of TQ approach have to be rationalised with reference to benchmarks. According to American Productivity and Quality Centre (APQC), benchmarking refers to systematic and continuous measurement and comparison of an organisation's business processes of leaders anywhere in the world to gain information which would help organisation take action to improve performance. MC Nair & Leibfried (1992) describe benchmarking as an external focus on internal activities, functions or operations in order to achieve continuous improvement. Xerox and Westinghouse have been leaders in benchmarking. Benchmarking starts as a product oriented reverse engineering to evaluate design characteristics and then aims for competitive product analysis. This then continues to process level benchmarking followed by benchmarking at strategic and global levels. So for excellence in any innovation process, benchmarking is a must at all levels to give that technological edge to the company.

What cannot be measured, can not be improved and continuous improvements as a part of TQ approach have to be rationalised with reference to benchmarks.

Anticipating (Internal & External) Customer Needs

The key output of R&D/innovation is information, which is in form of knowledge, understanding, design and prototypes. Horsman of Unilever Research centre, describes the information requirements of Internal & External customers to R&D department as follows in Table 2.

Table 2:

Customer	Information Requirements
Board of Directors	Innovative options for company strategy.
Marketing	Reliable translation of phenomena into technical options.
Production	Process description.
Engineering	Defined equipment needs and design requirements.
Purchasing	Defined technical and material alternatives.
External customer	Perceived needs converted to technical alternatives.

Introduction of Total Quality (TQ) in R&D should provide for a closed loop mechanism through which feedback from customers (internal & external) should form the basis for potential ideas for new products and proposals for undertaking new R&D programme. Also concurrent engineering is a must for validating RMP (Reliability, Maintainability and Producibility), safety and value factors of new products developed. Logistics should also be a considered in concurrent Engineering for new product development exercises. Hence, innovation management has wider role to play.

Quality Improvement Projects (QIP's)

Most companies which want to introduce TQ in R&D, carry out specified Quality Improvement Projects (QIP) in areas having scope for improvement. The QIP's basically operate on basis of team spirit with top management commitment. Some of the QIP's are facilitated by designated TQ facilitators. QIP are preceded by continuous education and training (E&T) to all employees concerned with QIP's. For QIP's effective organisation of teams and their implementation is must. Teams could be organised in the form of quality circles/cross functional/internal-department teams. Most QIP's are undertaken immediately post-training. Most of the QIP's should relate to people issues and more efficient work patterns. QIP's result in:

- (a) Continuous improvement in everyday's work.
- (b) Mapping and managing processes.
- (c) Giving focus on support staff and their participation in providing cost effective research programmes e.g. information services, computing, value analysis etc.
- (d) Time-saving benefits.
- (e) Improved communications with professionals in every field.
- (f) Brainstorming to yield a set of alternatives/technical options.

Managing High Talent Personnel

Hinrichs (1966) carried out extensive work on motivation of high talent personnel required in R&D environment. He described high talent personnel as:

'... individuals with a great deal of innate ability, valuable specified knowledge and experience and a high degree of personal motivation and drive to achieve their goals within the organisational framework'.

It emphasises two important requirements:

- (i) High capacity for productivity within the business (entrepreneurial) context.
- (ii) High tendency to employ one's talents towards self fulfillment.

In other words, the high-talent employees must have high levels of both creativity and motivation in addition to formal training. The creativity present in an individual's performance generally is considered to be a product of both inherent abilities and environmental factors external to the individual. The former concerns a person's ability to abstract concrete situations, transform knowledge from one area of application to another and conceive unique and pragmatic solutions to problems. When these abilities are blended with inspired dedication, creativity becomes an inventive art. This proves to be a valuable asset across the entire spectrum of technical endeavour. Little can be done to infuse the inherent creativity among employees, attention must be concentrated on the individual's creative development within the context of R&D team.

The creativity present in an individual's performance generally is considered to be a product of both inherent abilities and environmental factors external to the individual.

Environmental factors can be important to the venting or suppressing of one's creative abilities. In terms of the working engineer or scientist, one important requirement is the need for adequate equipment and other job related facilities, such as working environment suitable to think in a broad, unencumbered manner and to question the obvious; technical and administrative support. However, it is not enough for high-talent employees to have adequate facilities at disposal. According to Meltzer (1956), if the conditions under which the scientist works do not allow him intrinsic job satisfaction, then providing him with the finest equipment and facilities may not stimulate him to transform his ideas into working models or end results.

On the other hand, even the most motivated of scientists are not likely to accomplish much if they are hampered by a severe lack of facilities to work with. This is analogous to Herzberg's description of motivational factors as is clear from Table 3.

It is clear that organisational attention should focus on reinforcing satisfiers not on neutralizing dis-

satisfiers. Surprisingly, Shepard (1956) referring to individual creativity among members of R&D teams reported that research performance rises to a peak in mid-thirties and declines thereafter and is affected by group average age rather than chronological number age. So an older research person can often increase his creative output by being placed in a younger group. So R&D manager can help foster an environment which encourages creativity and serve his staff by stimulating them, assisting them with routine details and encouraging their creative activities.

Table 3:

Satisfiers (Motivators)	Dissatisfiers (Hygiene factors)
Achievement	Company policy & Administration
Recognition	Technical supervision
Work itself	Salary
Responsibility	Interpersonal relations
Advancement	Working conditions.

Creativity and Motivation

As pointed out earlier, creativity is strongly related to motivational factors which drive the high-talent technical employee toward achievement. Hinrichs (1966), developed following hierarchy of motivating goals in case of higher talent employees.

Top Level: Personal success and achievement, Intrinsically challenging work, Company identification.

Middle level: Work in a congenial atmosphere, upward influence in organisation, Money, contributing to company objectives.

Low Level: Authority and power goals, Maintenance of status quo. Management efforts should be best spent nurturing highest factors at the same time not ignoring middle and low level factors.

Hinrichs also made a list of motivational factors affecting high talent employee's jobs performance. It was found that challenging work rates high among high talent employees over a wide spectrum of age and professional achievement.

In another survey, Spitz (1970) listed following factors contributing to work challenge in order of importance to the respondents (high-talent employees):

Creative work	Group participation
Broad area	Specialize

Diverse assignments	Work-alone
Flexibility to select assignments	Supervisory responsibility
Work with things	Routine work.
Work with people	

The job pressure in high-talent individuals also affects motivational behaviour. Job pressures are not always harmful. They could be beneficial to professional development particularly in R&D environment. Hall and Lawler (1971) gathered data on specific job pressures among high talent employees. The distribution of pressure was reported as follows:

Time	:	53 per cent
Financial responsibilities	:	28 per cent
Quality	:	19 per cent

However, job pressure due to quality are rising nowadays even in Indian R&D climate. In an environment for creating innovations, while financial responsibilities and quality pressures are useful to both researcher and organisations, time pressure is virtually unrelated to effectiveness. Time pressure involves both the meeting of deadlines and continuous and effective use of time. Most high talent employees may not operate at not more than 10 per cent efficiency as a result of such factors. In fact, some best creative minds do not want to work toward fixed deadlines especially older people who should be motivated by providing jobs challenges, job advancement and promise of reward.

Installing the Product Champion

Product champions are managers who can integrate diverse skills and focus the creative face of a small group toward the development and launch of a single product idea. They are the idea supporters and behave like entrepreneurs. Too often a new product concept dies because there is no champion to direct it. Product champions have to have a thorough knowledge of the market, the process and the organisation to foster cooperation throughout the company. The other Jobs of a product champion could be:

- (i) Overcoming internal resistance to a new product.
- (ii) Encouraging experimentation.
- (iii) Instill harmony, trust and confidence amongst high-talent employees.

- (iv) Internal as well as external selling of product concept.

In technology leader companies like Sony, CEO's could also serve as product champions. Many of the most successful companies encourage new product champions to promote new product concepts through the development process.

Innovation Strategies

Innovation strategies during 1970's focussed on marketing. 1980's witnessed an upsurge of interest in technology dimension. Recently there has been growing emphasis on strategic implication of technology. Brownlie (1987) has argued for a balance between marketing and technology. In words of Hodock (1990), an R&D focus without customer focus is a recipe for disaster. Urban, Hauser and Dholakia (1987) have differentiated proactive product strategies from reactive product strategies. Two important proactive product strategies which link marketing and technology are:

- Conducting future oriented Research & Development (R&D) activities.
- Developing entrepreneurial capabilities-Realising the idea by generating enthusiasm and mobilising resources.

Five C's of innovations management have been coined by Biemans (1990). These are:

Cooperation with other organisations such as users, competitors, research institutes, Scientific Community, suppliers and distributors.

Coordination of various activities like jobs rotation, joint customer visits, project teams, Joint review meeting, proximity of work centres and joint development contracts.

Communication with cooperation partners as well as at internal level i.e., departmental, functional and personal levels.

Creativity ingrained into all key activities.

Chaos innovation processes are irrational and not ordered.

According to Booz, Allen and Hamilton (1982), the innovator companies undertake following strategies under the overall umbrella of initiating change through competitive leadership as is clear from Table 4.

Table 4:

Innovators	Followers
Thrust Initiate change through proactive strategy: competitive leadership	Maintain low-risk profile by responding to competition.
<ul style="list-style-type: none"> ● Build technological advantage ● Show willingness to invest ● Undertake pre-emptive competitive strategies 	<ul style="list-style-type: none"> ● Generate 'me-too' copies of competitor products. ● Develop 'second but better' improved products. ● Alter marketing mix variables—pricing advertising, distribution

(Booz, Allen & Hamilton, 1982)

Conclusion

So, companies can develop ability to manage innovation by support of top management, right compensation practices, quality leadership and a flexible and flat organisation structure promoting team spirit, trust and confidence among high-talent employees. The importance of creativity and motivation cannot be undermined. Companies that create right innovation climate, right culture and product champions who are willing to accept risks, are successful in innovation management. Such companies should encourage their researchers to use flexibility in choosing the projects for new product development. Only those companies willing to experiment, to learn, to change and to fail and ultimately succeed would be the leaders in innovation.

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Innovative Linking of Robust Design with Multi-Criteria Decision Making

P.B.S. Reddy, Ken Nishina and A. Subash Babu

Quality has become global and no longer travels under any single national passport. Continuous improvement of product/process quality is the central focus of business strategy. This paper discusses a study carried out in a plastic industry to improve product quality of washing machine agitator. A detailed preliminary study was carried out to understand the problem and associated causes. This study showed that there was a large variation in the manufactured product dimensions. To optimize the multiple responses of this process, an innovative approach is developed by linking goal programming and AHP methodologies to Taguchi's robust design methodology. The motivation for linking these approaches and the logic adopted for integration is explained in this paper. The results demonstrate that this approach is capable of optimizing multiple responses simultaneously without resorting to trade-offs as observed with robust design methodology.

P.B.S. Reddy and Ken Nishina are at the Department of Systems Engineering, Nagoya Institute of Technology, Nagoya-464, Japan and A. Subash Babu is at the Department of Mechanical Engineering, Indian Institute of Technology, Mumbai-400 076.

Introduction

The industrial world has at last become aware of the importance of quality and in particular strategic quality management after decades of warning and pleading by people like Juran, Deming, Crosby, Feigenbaum and Ishikawa. At the same time, globalization, government economic reforms, liberalized industrial policies and consumer awareness have forced the organisations to develop high quality products at low cost which is challenging. One of the cost-effective methods to improve product quality and operational performance is to use of Taguchi's robust design methodology. Robust design methodology combines engineering ideas with statistical techniques in a novel way and offers tremendous potential for quality improvement with minimum cost. It has been successfully used in many areas of engineering (Nair, 1992). However, much of the reported literature on this method is limited to single response. In fact, very little attention has been given to multi-response optimization in the quality engineering literature.

Robust design methodology combines engineering ideas with statistical techniques in a novel way and offers tremendous potential for quality improvement with minimum cost.

Most of the manufacturing processes produce output with multiple quality criteria. When several responses are considered simultaneously, an investigation of one response should not be carried out independent of the other responses especially when the responses are correlated. There are a few publications on multi-response optimization in this direction. Myers and Carter (1973) proposed dual response approach. Vining and Myers (1990) presented a methodology for

optimization within the framework of Taguchi's methodology using RSM and dual response approach Del Castillo and Montgomery (1993) demonstrated that non-linear programming solution i.e. generalised reduced gradient (GRG) algorithm can lead to better solutions than those obtained with dual response approach. Del Castillo (1996) further enhanced its applicability through constrained optimization theory. Texts such as Myers and Montgomery (1995) and Khuri and Cornell (1996) point out the prevalence of multiple criterion products and the acute need for new methods of dealing with them. Ames *et al* (1997), Artilles (1996) and Tai, Chen and Wu (1992) made an attempt to optimize multi-responses using Taguchi's quadratic loss function. Loss functions provide conceptual framework for combining different criteria into a single objective function. Tong and Su (1997) developed a systematic procedure via the application of fuzzy set theory to optimize multi-response production processes.

Multi-criteria decision making through methods like Goal Programming and Analytical Hierarchy Process (AHP) are extensively used in the area of business management (Satty, 1994). But its potential is not much explored to the quality engineering problems. In this paper, an approach is presented to integrate Goal Programming (GP), Analytical Hierarchy Process and Taguchi's methodology to optimize multi-responses simultaneously using a real life case study.

Case Study

The company under consideration manufactures a wide range of plastic mouldings from household to large industrial products suitable for different applications. The product under investigation is an agitator used in washing machines. It is responsible for the movement of clothes inside the washing tub. The product is moulded in plastic which in this case is polypropylene and is fitted on to a serrated shaft-spline and locked in position with a screw. The washing action is imparted by four flexible vanes, which gently beat the clothes and water. However, the company received a lot of complaints from its customers. For instance thin clothes (sarees and dhoties) would slip through the gap between the agitator and the steel tub, and thereby get entangled with the motor shaft. In some cases, the agitator rim rubbed against the perforated steel tub.

Preliminary Study

Table 1 shows the results of the preliminary study carried out of this problem. It was observed that it was mainly one of maintaining the product quality dimensions—outer diameter, height and pull-out strength. The

outer diameter was always more than 329 mm. It varied from 329 to 330 mm. This created the rubbing problem. An attempt was made to reduce outer diameter from 329.0 to 328.5 mm, by increasing the overall shrinkage. This resulted in a pull-out strength increasing beyond 2.5-3.0 kg/cm², on account of reduced spline internal diameter, which was not acceptable. To minimize the variance and bring the process on to the target, an integrated approach is adopted using Taguchi's robust design, goal programming and Analytical Hierarchy Process (AHP). The motivation for this integration is explained below.

Table 1: Results of Preliminary Study

Response	Design specifications	Range	Average	Standard deviation
Outer diameter (mm)	328±1.0	329-330	329.50	0.3197
Height (mm)	114+0.5	113-114	113.49	0.3381
Pull-out force (kg/cm ²)	< 1.8	1.6-2.5	2.00	0.3364

Multi-response Optimization

This is based on Taguchi's methodology. His methods have been successfully used in optimizing multi-responses. Sometimes, while using Taguchi method for multi-response optimization, one witnesses some conflict in selecting optimum conditions for the process. The levels obtained for one response are not completely compatible with those of other responses. In such situations, the usual recommendation is left to trade-off using experience of the people and process knowledge. It is not always possible to resolve these conflicts using only the experience of people. Whenever human judgement is involved in the decision making process, it increases the uncertainty in the results obtained. Hence, a new approach is essential to optimize multi-responses simultaneously without resorting to compromises. Hence, an attempt was made to unify this approach (involving goal programming) with Taguchi's methodology. Critical analysis of the results, revealed the possibility to improve the unified approach from the quality engineering point of view. The unified approach

Whenever human judgement is involved in the decision making process, it increases the uncertainty in the results obtained.

simply assumes that deviation from the targeted goal for each response is of the same (equal) significance. Besides, for each response, both the negative and the positive deviation are of the same significance. For a process, some of the deviations may be of more critical in nature than others. To incorporate the relative importance of responses with respect to the over all objective, the method of Analytical Hierarchy Process (AHP) has been used. This results in the development of a novel method by integrating Robust Design (RD), Goal Programming (GP) and Analytical Hierarchy Process (AHP).

The unified approach assumes that deviation from the targeted goal for each response is of the same (equal) significance.

Integrated Methodology

The methodology consists of three phases. Each phase of output becomes the input to the next phase. The entire approach is formulated within the framework of Taguchi's methodology. The three phases are:

- (i) optimization using Taguchi's robust design methodology
- (ii) unification of Taguchi's robust design methodology with goal programming and
- (iii) integration of AHP with robust design and goal programming.

The first two phases have been detailed in an earlier paper (Reddy *et al*, 1997). However, summary of the above two phases is given below as a preamble to third phase.

Optimisation using Taguchi's robust design methodology

From Table 1, the results of preliminary study showed that there was a large variation in the responses obtained. To minimize the variation, and achieve target values for the responses, Taguchi's methodology was used to optimize the injection moulding process as depicted in flow chart in Fig. 1. The output responses considered for optimization were outer diameter, height and pull-out force. The factors and levels that were considered are shown in Table 2. Herein the so called L_8 orthogonal array was selected because of its perfect size and its suitability for the present case.

Table 2: Factors and Levels

Factors	Units	Levels	
		1	2
Mold temperature (X1)	°C	35	50
Injection pressure (X2)	Kg/cm ²	110	150
Hold on pressure (X3)	kg/cm ²	70	120
Injection time (X4)	sec.	30	50
Hold on time (X5)	sec.	23	33
Cooling time (X6)	sec.	50	100
Fill time (X7)	sec.	7	17

Table 3: Summary of Responses

Expt. No.	Outer Diameter		Height		Mean Pull-out Force (Kg/cm ²)
	Mean (mm)	S/N Ratio (dB)	Mean (mm)	S/N Ratio (dB)	
1	329.30	65.88	113.21	52.99	3.00
2	329.41	65.08	114.07	58.83	1.66
3	329.45	64.02	113.20	43.26	1.69
4	329.48	66.89	113.54	45.17	2.12
5	329.68	60.29	113.88	47.79	2.77
6	329.45	67.89	114.05	50.21	1.48
7	329.43	72.12	113.85	52.21	2.13
8	329.60	69.57	113.72	52.75	2.58

The goal was minimizing the variance of the height and outer diameter of agitator while keeping the mean on target. Hence, Nominal-the-best case (NTB) was identified suitable for calculating S/N ratio for these two quality characteristics. The other response namely the pull-out force should be as less as possible. So Smaller-the-Best case (STB) was considered suitable for this. Using the experimental results of the L_8 layout, S/N values were computed for these three output characteristics as shown in Table 3. To find optimum conditions, analyses were carried out using ANOVA for S/N ratio and ANOM for mean of the responses using Taguchi's two step optimization procedure (Phadke *et al*, 1983). A summary of the above analyses for all the three responses is shown in Table 4. The factors are categorised based on these results as:

Control Factors: X₂, X₃, and X₇

Adjustment/Signal Factors: X₁ and X₆

Control and Adjustment Factors: X₄ and X₅

As can be seen from Table 4, the results reveal that optimum levels obtained for factor X₂, X₅ and X₁

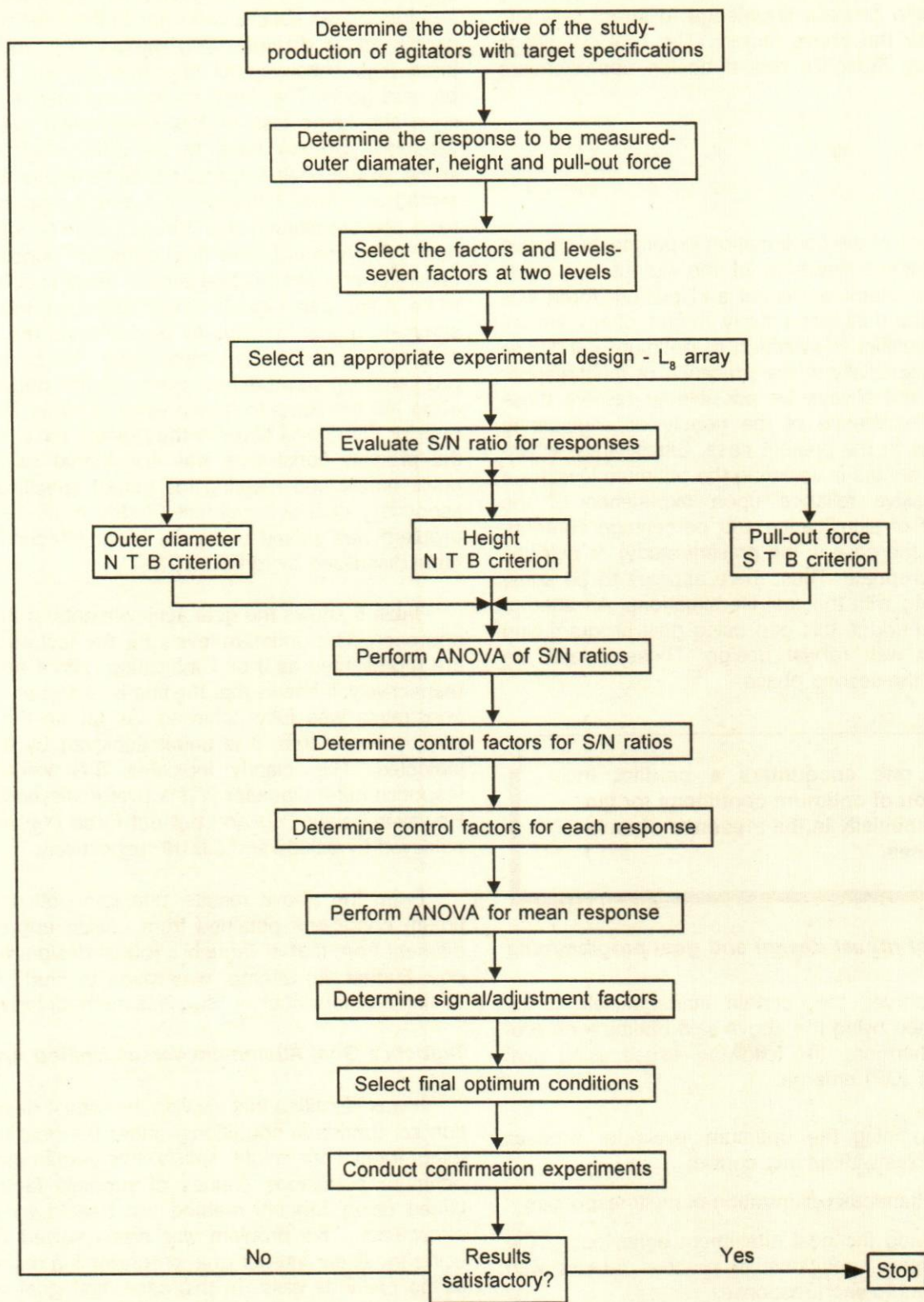


Fig. 1. Robust Design for Optimization of Injection Moulding Process

are different from response to response. To resolve this conflict, trade-offs were made using engineering judgement and process knowledge to select optimum conditions for the above factors. The final conditions derived using Taguchi's robust design approach are given below:

Factor	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇
Best level	2	1	1	2	2	2	1

The results of the confirmation experiments showed that the standard deviation of the output responses namely, outer diameter, height and pull-out force was 0.085, 0.11 and 0.22 respectively. In fact, often, one encounters a conflict in selection of optimum conditions for factors, especially in the presence of multi-responses. It may not always be possible to resolve these using only experience of the people or engineering judgement as in the present case. Significantly, whenever conflict occurs in selecting the optimum level for a factor, excessive reliance upon experience of the people, level of significance and percentage contribution (as was the case in the present study), is perhaps not very appropriate. Thus, there appears to be some gap in dealing with the real life situations. An attempt was made to bridge this gap using goal programming methodology with robust design. These details are presented in the second phase.

Often, one encounters a conflict in selection of optimum conditions for factors, especially in the presence of multi-responses.

Unification of robust design and goal programming

It is observed that certain inadequacies in the results obtained using the above said optimization procedure. Furthermore, the following issues using goal programming (GP) emerge:

- Determining the optimum levels for process variables without any conflict
- Simultaneous optimization of multi-responses
- Studying the goal attainment behaviour of the optimum conditions of process factors with respect to each response.
- Testing the sensitivity of robust design conditions, as far as the goal attainments are concerned.

Essentially, the objective of this study was to find suitable levels for the process parameters to meet the required output specifications for all the three responses namely outer diameter (Y_1), height (Y_2) and pull-out force (Y_3). These output specifications are essentially process goals. The deviation from the output specifications should be less (output constraints). All process variables (factors) have to be within their specified levels. In the unified approach, factor levels are represented as 0 and 1 instead of 1 and 2 respectively for ease of computation and for selection of appropriate goal programming. The final optimum conditions obtained for process must be either 0 (level 1) or 1 (level 2) to be in line with Taguchi's methodology (process constraints). This is identical to zero-one models or linear zero-one goal programmes used in certain goal programming approaches. Here, all the decision variables are restricted to take a value of either Zero (level one) or One (level two). In the present case, satisfying the process constraints was considered as first goal achievement and meeting the output specifications as secondary goal achievement (Reddy *et al*, 1997). This problem was solved using the linear integer GP algorithm discussed by Ignizio (1976).

Table 5 shows the goal achievements of the unified approach. The optimum levels for the factors X_1, \dots, X_7 are represented as 0 or 1 indicating level 1 and level 2 respectively. It shows that the first goal namely, process constraints was fully achieved. As far as the second goal is considered, it is under achieved by 0.1214 as indicated. This clearly indicates S/N value of the response outer diameter (Y_1) is over achieved by 0.917. However, height (Y_2) and pull-out force (Y_3) are under achieved by 0.0602 and 0.0612 respectively.

From the above results, one can notice that optimum conditions obtained from unified approach are different from that of Taguchi's robust design methodology. Further, an attempt was made to study the goal attainment behaviour of Taguchi's methodology.

Taguchi's Goal Attainment Versus Unified Approach

It was identified that viewing the robust design solution set (optimum conditions) under the goal programming framework might satisfy this requirement. The optimum conditions (values of process factors) obtained using Taguchi method are treated as *process constraints*. This problem was again solved (Table 5) using the linear integer goal programming algorithm as in the previous case. In this case, first goal was fully achieved and second goal namely, output responses was under-achieved by 4.9275 from the targeted S/N values. Thus optimum conditions derived using goal programming in conjunction with the robust design

Table 4: Summary and Analysis of Results

Factors	Outer diameter			Height			Pull-out force					
	G	B	C	C	B	D	F	B	C	E	G	
Control factors	G	B	C	C	B	D	F	B	C	E	G	
Optimum levels	1	2	1	1	1	2	1	1	1	1	1	
Percentage contribution	22.18	20.91	20.39	66.92	19.22	7.95	29.0	27.26	18.4	7.77	5.33	
Adjustment/signal factors	A	G	C	F	A	D	E	B	F	F	D	C
Optimum levels	1	1	1	2	2	2	1	2	2	2	2	
Percentage contribution	34.38	29.27	12.50	12.50	32.5	22.73	19.47	11.37	9.67	69.8	16.9	9.81

Table 5: Optimum Conditions and their Goal Achievements

S. No.	Case	Optimum conditions of process variables							First goal achievement	Second goal achievement			
		X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇		Total under achievement	Y ₁	Y ₂	Y ₃
1.	Unified method of goal programming and robust design	1	0	0	1	1	0	0	0	0.12	0.91	-0.06	-0.06
2.	Robust design	1	0	0	1	1	1	0	0	4.92	1.27	0.68	-4.92
3.	Sensitivity analysis (Best setting)	1	0	0	1	1	0	0	0	0.12	0.91	-0.06	-0.06

Optimum conditions derived using goal programming in conjunction with the robust design method have better goal attainment properties compared with that of robust design alone, thus justifying the investigation.

method have better goal attainment properties compared to that of robust design alone, thus justifying the investigation. The results corresponding to the GP solution and the GP view of the robust design solution differed in their goal attainments in addition to their parameter setting (combination). These results revealed that there could be some combinations which may still lead to the best goal attainment behaviour considering all three responses. For the above purpose, sensitivity analysis has been carried out. These details are given below.

Sensitivity Analysis

Herein, the condition corresponding to the robust design solution was considered as the starting point. Then, systematically the conditions were changed and

for each condition, the goal attainment behaviour was assessed through GP Viewpoint as discussed in previous section. In the results shown in Table 6, column 1 indicates the trial related to the set-up characterised by a specific combination, which factors (X₁ to X₇) take. Column 2 indicates the level of the factor that is different from that of the robust design solution. For example, in the first trial, factor X₁ has been changed from high level to low level (From X₁ = 1 to X₁ = 0). Then corresponding to each combination (process constraint), the goal attainment behaviour of each of Y₁, Y₂ and Y₃ is presented in columns 3, 4 and 5 respectively of Table 6. In column 6, the sum of absolute values of the deviation variables (under achieved) is presented for each set-up. From this, it can be seen that the value corresponding to 'set-up 6' is the least and has been assigned the best rank of 1. Similarly, each set-up has been ranked as shown in the table.

The above exercise helped a great deal to facilitate viewing any given process conditions in GP framework. Moreover, it helped to investigate goal attainment behaviour of number of process conditions (settings). It offers wide range of alternatives to the process managers. It is possible to choose the most satisfying condition considering which response is relatively more critical in terms of S/N ratio.

values N_{ij} from the deviation variables a_{ij} , AHP uses the following three concepts.

- (i) If $a_{ij} = 0$, then the corresponding $N_{ij} = 1$
- (ii) If $a_{ij} < 0$, then N_{ij} specific i is given in equation (2).
- (iii) If $a_{ij} > 0$, then N_{ij} is given in Equation (1).

Table 11: Results of AHP with N_{ij} 's for Positive a_{ij} 's Multiplied by 2 (Method 4)

Setup	Diameter	Height	Pull-out force	Priority	Rank
0	1.2444	0.0000	0.7415	0.6413	33
1	0.8702	0.9653	0.6043	0.8676	6
2	0.0000	0.7923	0.4397	0.4031	52
3	0.7792	0.6172	0.4780	0.6629	29
4	0.8847	0.8646	0.6222	0.8343	10
5	1.5503	0.9391	0.7995	1.1735	2
6	1.4615	0.9970	0.9965	1.1920	1
7	0.7752	0.0000	0.5556	0.4145	50
8	1.9290	0.7227	0.3291	1.1664	3
29	0.7031	0.3055	0.0927	0.4385	49
44	0.5039	0.1354	0.0000	0.2685	59
53	0.5183	0.7212	0.8297	0.6534	31
54	0.4725	0.0393	0.0852	0.2286	61
59	0.2136	0.3040	0.5933	0.3123	58
60	0.4469	0.0000	0.3667	0.2464	60
61	0.0000	0.2345	0.4826	0.1757	63
62	0.3453	0.0619	0.3181	0.2219	62

Here, it is quite likely that a negative a_{ij} and a positive a_{ij} can assume the same value for N_{ij} , since the deviation variable under consideration is essentially either an under-achievement or an over achievement of the corresponding S/N value from the target S/N value. If the goal is only to achieve this target, then these three concepts logically satisfy the requirements. However, the fundamental objective defined through the robust design method is to maximise S/N value, in which case, a negative a_{ij} and a positive a_{ij} taking the same N_{ij} value is not very convincing. A positive a_{ij} is more desirable than a negative a_{ij} . To realise this effect, the values of N_{ij} corresponding to all positive a_{ij} 's have been multiplied by two (a typical value) and the respective P_j 's have been found as shown in Table 11. The corresponding ranks using this method are also shown in this table (Method 4). To facilitate meaningful analysis, the ranks obtained through all these methods are furnished in Table 12.

The results furnished in the above table offer a good scope for meaningful study. In column 6 of this table, average of the ranks obtained using these four methods is presented, whereas, in the next column, the range (Max Rank - Min Rank) is furnished. The ratio of Minimum Rank to Maximum Rank is provided in the last column. The 'Mean' value indicates the performance capability of each process condition whereas, the 'Range' indicates a measure of variability. The 'Ratio' provides an extra insight about the consistency of the process condition. These performance indicators are essentially in terms of how good the achievements are, corresponding to various process condition especially in the point of view of realising the targets specified as a measure of S/N ratio for each of the output responses.

Important Observations

These results render scope for comparing each process condition (set up) using the ranks obtained by treating the information on deviation variables. The following observations are made:

- (1) It is observed that for the process setup 6, all the methods provide the same rank 1, the best one. It can be noted that process setup 6 has maximum goal attainment properties compared to other process setups. It is also evident that the ranking obtained for other process setups differ from method to method.
- (2) It is observed that, there is a wide variation between mean of rank and the individual ranking of various methods for many of the process setups.
- (3) The range is varying between 0 and 49. It is observed that process setup 6 has no variation in ranking and hence its range is zero.
- (4) The ratio of minimum ranking to maximum ranking obtained using four methods for each process setup is shown in column 8 of the Table 12. If this ratio is nearer to one, then the corresponding process setup will have minimum variation in the ranking using these four methods.

In Table 12, 'setup 0' refers to the process conditions related to the results obtained using robust design method. It is interesting to see that using the four methods, the rank obtained for the conditions corresponding to the robust design method is not attractive. However, method 1 leads to the rank of 4, somewhat closer to the best rank possible. Method 1 obtains the rank by simply adding the absolute values of all deviation variables. However, when the ranking pro-

Table 12: Comparison of various Process Setups using different Ranking Methods

Setup	Method 1	Method 2	Method 3	Method 4	Mean rank	Range rank	Min/Max ratio
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
0	4	48	53	33	35	49	0.08
1	11	9	2	6	7	9	0.18
2	20	50	51	52	43	32	0.38
3	38	30	29	29	32	9	0.76
4	15	11	7	10	11	8	0.47
5	3	7	5	2	4	5	0.29
6	1	1	1	1	1	0	1.00
7	16	49	49	50	41	34	0.32
8	29	23	15	3	18	26	0.10
29	54	54	48	49	51	6	0.89
44	62	62	59	59	61	3	0.95
53	27	21	31	31	28	10	0.68
59	53	53	58	58	56	5	0.91
60	59	59	60	60	60	1	0.98
61	60	61	63	63	62	3	0.95
62	61	60	62	62	61	2	0.97

cedure changes, this condition becomes very unattractive, especially, using methods 2 and 3 namely, AHP and modified AHP. It reveals that consideration of normalised value N_{ij} for the deviation variables seems to be affecting the preference of this process condition. Corresponding to $j = 0$, that is robust design condition, the values of deviation variables (a_{ij}) are: 1.2768, 0.6864 and -4.927. While normalising, for negative values equation (2) and equation (1) for positive values are used.

This normalisation process reduces the attractiveness of the robust design condition as these N_{ij} values assume less significant values when compared to the corresponding a_{ij} values. This reduction in significance need not be reflected by the numerical strength but the relative disposition in their respective sets of values. This fact can be realised from the results furnished in Tables 6 and 9. It is because, the values of a_{ij} for robust design condition are somewhat closer to Max a_{ij} or Min a_{ij} , as the case may be.

Though robust design attempts to maximise S/N, there is no target for this objective. However, when GP is used, appropriate targets are used as goals and the focus is on minimising the deviation variables. This is precisely why setup 6 (corresponding to GP solution), always stands out as the best condition.

Thus, it is pertinent to bring out the fact that the robust design method helps to obtain the best process conditions when one tries to maximise S/N ratio. However, when one is encountered with the problem of realising the target (signified by mean), it may not always result in the best condition. This is truer when there are multiple responses as the output.

From the results presented in Table 12, one more important behaviour becomes evident. When the process condition changes from that of the robust design solution, there are considerable changes in the ranks obtained by the four methods. This is clearly indicated by the results pertaining to, Mean Rank, Range-Rank and the Ratio furnished in Table 12. In order to capture certain pertinent facts, a part of this table is reproduced in Table 13. Here, a total of eight setups are considered. For each setup, the description of process condition is also given in terms of the combination of values which X_1 to X_7 take. In the last three columns, Mean Rank, Range-Rank, Range-Rank and Ratio are furnished. The 'setup 0' corresponds to robust design solution and is considered as the base. By changing the level of one factor in this base condition, the other conditions are obtained. For example, 'setup 1' differs from 'setup 0' only in terms of factor X_1 (that is $X_1 = 1$ with respect to base is changed from $X_1 = 0$). Similarly,

Partnering: An Innovative Approach to Strategic Alignment

Greg Bounds and Al Cole

In the dynamic world of business of sophisticated products and services, creativity and innovation have risen since 1990s to a strategic importance. The trend will continue as global competitors time and again improve their products, business systems, etc. In the present paper taking the case of TRW Systems, proprietary and innovative concepts, methods for accomplishing strategic alignment among customers, etc. are dealt with. In particular, it is realized that developing and executing a successful business strategy is never easy especially in the present era of intense global competition.

Greg Bounds and Al Cole are Senior Partners of Partners International Inc., 441 Roselawn Place, Charlotte, North Carolina-28211, USA.

Introduction

Creativity and innovation have risen to strategic importance in the dynamic world of business in the 1990s. This trend will continue into the next millennium as global competitors continuously improve their products, services, and business systems. In previous articles, the authors have described a new paradigm for management (Bounds and Fausz, 1993) and organisational cultures (Bounds, 1994, 1996a) that promotes continuous improvement and re-engineering. These concepts are popular academic topics, but they are also truly powerful strategic weapons when properly implemented.

Shared in this paper are some proprietary and innovative concepts and methods for accomplishing strategic alignment among customers/stakeholders, core capabilities, organisational architecture. How these ideas are proven in practice, and powerful in their impact are also illustrated.

The Importance of Strategic Alignment

In developing a strategy, a business must not just anticipate the moves of their competitors and launch counterattacks as in competitive games or wartime battles. Certainly, managers must watch competitors. However, they are more likely to come up with superior strategies if they are primarily customer-focused, seeking to create their own futures, and not being obsessed with

In developing a strategy, a business must not just anticipate the moves of their competitors and launch counterattacks as in competitive games or wartime battles.

what competitors do. In a customer-focused approach the primary competition consists of the next level of customer expectations and yourself, not other businesses. Organisations must strive to overcome their own internal standards and self-perceptions to set and meet new levels of aspiration. In order to compete in today's business environment, they have to be both competitor-focused and customer-focused. Ignoring either one or the other dimension can get you into trouble.

Another important limitation one faces is internal creativity. By using creativity, we can create new markets with innovative products and services, and improve the way we market, produce and deliver them. Businesses must develop a culture that fosters creativity and change. Otherwise stagnation will prevail.

By using creativity, we can create new markets with innovative products and services, and improve the way we market, produce and deliver them.

Organisations today face complex and changing business environments. They all have diverse stakeholders that they are trying to serve, including customers, investors, employees, suppliers, the community, and other business partners. The partnering process described below helps establish a plan for balancing the interests of these stakeholders. It also helps to integrate the activities of all specialized units, functions, and departments within the business (Bounds and Lamb, 1998).

Partners Process: A Creative Approach

The Partners Process described here helps to align the three critical elements shown in Fig. 1.

- Customer value consists of the benefits and sacrifices associated with using a product or service. (The term customer and stakeholder may be used interchangeably.)
- Organisational architecture consists of the structures and systems that are used to do work and achieve the mission of the organisation.
- Core competencies are the distinctive capabilities or assets that an organisation can use to provide value to customers. A core competence may be a core product (protected by patent or proprietary position) or a core tech-

nology (a combination of unique know-how, hardware, and software).

These concepts may blur together in practice. As business environments increasingly demand nimbleness, an organisation's architecture may actually be a source of competitive advantage. Thus a core competence may be your company's ability to quickly configure and reconfigure organisational architectures to pursue market opportunities.

Core competencies are the distinctive capabilities or assets that an organisation can use to provide value to customers.

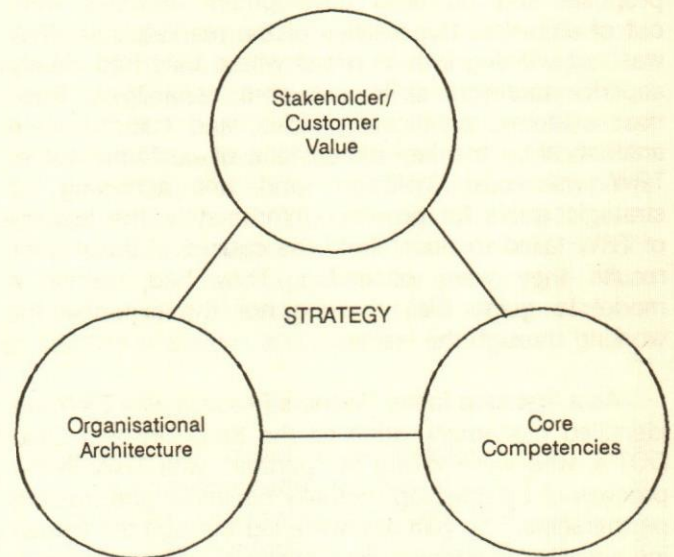


Fig. 1. Strategic Alignment of Value, Architecture, and Competences (Partners International Inc., 1995)

Alignment of these critical elements gives a company strategic advantage. Misalignment of these critical elements results in strategic weakness for the supplier and the delivery of inferior customer value.

Applying the Partners Process

An excellent example of the application of the Partners Process is the case of TRW's Avionics and Surveillance Group. Like many firms involved in defense downsizing in the mid-1990's, TRW has been attempting to apply their technology and know-how to non-defense markets. While attempting to enter the emerging market of Intelligent Vehicle Highway Systems, TRW

services, global positioning services, retail food suppliers, hotel and restaurant management, engineering services, commercial and residential construction, and furniture manufacturing, to name a few.

To be effective in applying core competencies in non-defence markets, defense suppliers will have to craft new strategies and organisational architectures that adapt to the changing values of non-defense customers.

The case of TRW exemplifies the application of the Partners Process where the customer is another organisation in the industrial supply chain. The Process is just as effective when the customer is an individual consumer. A partners process involving AAA Carolina's Motor Club brought these comments from the President. "Partners International skillfully led a business improvement effort that resulted in sustainable improvements that hit the bottom line in the next two financial quarters. The facilitation encouraged creative thinking about some of the fundamental issues and pushed for dramatic changes in the way we viewed customers and aligned our organisational architecture. I have noticed more positive attitudes and involvement among the travel agents since implementing the new customer focused culture. These efforts have proven to be extremely effective."

Strategy, Continuous Learning and Improvement

Developing and executing a successful business strategy is never easy. For a company to succeed as a highly productive, world class organisations that offers superior products and services to its stakeholders, it will have to marry the individual development of every person in the organisation (including its project partners) with superior economic performance. Accomplishing this goal will require a continuous learning experience. Implementing and continuously improving a business strategy requires that you continue to learn about all of the conditions that will contribute to, or threaten, your success. The business environment is constantly changing, so strategic management is an ongoing process of learning and taking action (Bounds, Dobbins, and Fowler, 1995; Bounds, 1996b).

To develop an energized and involved work force, leaders must learn extensively about the internal business environment. This knowledge will provide a basis for properly leading, directing and motivating

employees (Bounds and Woods, 1998). Employees must be encouraged to act in the interest of the organisation (not just of their function or department). Within a dynamic learning environment, employees will better generate new ideas and incorporate them into valued products and services. By creating a learning organisation, a business can lead its stakeholders in ongoing learning and adaptation for improved business results (Bounds, Yorks, Adams and Ranney, 1994). Once the work of the Partners Process is complete, the results will cascade through the organisation and yield outcomes of revenue growth and prosperity for the business. The overall results of completing all of these tasks include the following outcomes:

- an organisation aligned with key stakeholders/customers to achieve common purposes as partners.
- there would exist a clearly articulated strategy which is aligned with stakeholders/customers.
- there would be an implementation plan that is shared among the partners and translated into operational realities.
- there would be a shared vision, mission, goals and objectives that cascade throughout all of the organisation.
- employees would be participants in these activities, and fully educated on the concepts and methods of executing these plans.
- employees would fully understand and commit to these plans and realize that building strategic partnerships is the key to future prosperity.
- the business would be in a strategic position among business partners to act as a leader and facilitator of ongoing business development.
- the business would be a preferred partner in efforts to develop new market opportunities and technology applications.

To develop an energized and involved work force, leaders must learn extensively about the internal business environment.

Strategic alignment is the door to a competitive future in today's global economy. Partnering to build collaborative teamwork among stakeholders is the key to that door. As you experiment with these ideas, refine them, and enhance them, please communicate your

learnings to the authors so that we can learn to together how to be better stewards of our global business heritage.

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Under today's competitive conditions, the rate of product innovation is so swift that almost before one product is launched, the next generation of better ones appears.

— **Alvin Toffler in Powershift**

The basic philosophy of an organisation has far more to do with its achievements than do technological or economic resources, organisational structure innovation and timing.

— **Thomas Watson, Jr.**

Many of the innovative companies got their best product ideas from customers, that comes from listening, intently and regularly.

— **Thomas J. Peters and R.H. Waterman, Jr. in In Search of Excellence**

linking responsibility, performance and reward will result in project success.

In the R&D units, the matrix structure is characterized primarily by horizontal lines of communication and work flow and by the necessity for planning, integrating and controlling various multidisciplinary functional lines. Factors like a clear goal/objective, equitable distribution of workload, effective monitoring, timely supply of resources, facilitate the team process towards the project success. Where as when there is too much supervision of members activities, preference to stick to the position in the hierarchy or when some members are not committed to the goals the project suffer. Lack of trust seems to be an important factor resulting in project failure.

Methodology

The study was conducted at the corporate R&D of a leading Indian manufacturer of equipments for power generation and industrial applications. All research and development activities are done through project teams. Table 1 presents the type of projects undertaken in the R&D unit and the number of projects planned for completion in the present year in each category. For the year 1996-97 a total of 168 projects were undertaken out of which 114 projects were planned for completion in the year 1996-97. There were six types of R&D projects, namely enhancing business potential, cost reduction, quality improvement, new product development, import substitution, and basic research. Around 20-25 per cent of these were high valued multi-disciplinary/ cross-functional projects.

Table 1: Type of projects and the number of projects undertaken at the corporate R&D

S.No.	Types of Projects undertaken	Number of projects taken in 1996-97	Projects planned for completion in 1996-97
1.	Enhancing Business Potential	24	17
2.	Cost Reduction	18	9
3.	New Product Development	34	19
4.	Import Substitution	8	6
5.	Quality Improvement	49	41
6.	Basic Research	35	22
	Total	168	114

Qualitative as well as quantitative data were collected through interview and from structured questionnaires administered on the executives. Qualitative (descriptive)

data was collected from 40 executives. Senior executives from supporting departments like Planning and Management Systems, Human Resource Development and Personnel were also interviewed regarding the criteria used for assessing project success.

From the content analysis of the qualitative data nine criteria for assessing project success were identified. Finally, 83 executives (scientists and professionals) working in different projects were asked to rank the criteria them in order of priority given by their organisation. The mean age of this sample was about 45 years and they belong to E₁ to E₈ levels in the organisation hierarchy. Their educational level ranged from graduation to doctorate level in different disciplines of science and engineering.

Results

The descriptive data were collected from 40 executives on four issues pertaining project assessment.

- What are the criteria of management of Project success/failure?
- Who does the evaluation/appraisal of projects?
- What are the effects of Project success/failure on the team members?
- What is the rate of success of these teams?

These four questions were asked mainly in relation to cross-functional teams where the members have different identities and obligation to another unit of the organisation too and the performance expectation is high since they are (i) high valued projects (ii) top management many a time expects a lot from these kind of teams.

What are the criteria of measures of project success?

Content analysis of the qualitative data culminated in identification of nine measurement criteria namely time, cost, achieving the set objectives, new business development, commercialization, acceptance with end user, patenting the workdone, effort put in and knowledge generated. These nine factors were prioritized using rank order method in the second stage by the 83 professionals.

Who does the project assessment?

Lab managers, Head of the departments and GM (R&D) and usually the Engineering head at the plant level evaluate or appraise the projects. Fulfilment of the pre-defined objectives and acceptance by the end user

(customer and many a time the plant) are important. When a project is successfully completed, the project leader (PL), alongwith the members demonstrate the result in front of the top management of R&D, technical committee, customers/financial authority and sometimes international authorities in that field. Project review by clients is also an integral part of it. Product development projects are evaluated by the senior management of the specific product centre in the manufacturing unit.

How is the individual contribution assessed?

Research and development activities regardless of whether it is product/process development, or cost reduction or quality improvement, are done through different project teams. Scientists are part of many teams where different tasks are assigned to them. The Lab Manager appraises the performance/contribution of his group, where he focuses on the timely completion of assigned tasks, efforts put in by the member, complexity of the problem handled, his/her contribution to the team/project, technical/interpersonal skills involvement/commitment to projects and sense of responsibility to take up his/her part of work. During site testing, the contribution of the individual members are highlighted.

What is the rate of success of R&D projects?

A very interesting response was found when the executives were asked what is the rate of success of such team. Some executives put success rate of R&D projects as high as 80 per cent. Around 50 per cent of the executives interviewed said that the rate of success is high or more than 50 per cent. However, further probing revealed a different picture altogether. Sometimes submitting project completion report is construed as a successful project because it is not terminated half-way. On an average, it was accepted that the rate of success is less than 10 per cent and if commercialization, acceptance by customers are considered as the criteria to evaluate project success, then the rate of success is around 4 to 5 per cent which is close to the international success rate. It is lower particularly in case of multidisciplinary projects where the tasks are complex and in-

Team spirit and the team leader's patience, perseverance and coordination ability combined with the expertise of the members lead to successful projects.

tegration of knowledge is needed. Team spirit and the team leader's patience, perseverance and coordination ability combined with the expertise of the members lead to successful projects.

Prioritising the project success assessment criteria

Table 2 presents the ranking of the nine criteria measures by the 83 executives. The result shows that executives have given first rank to meeting the set objectives as the most important criteria in assessing project success followed by acceptance by end user i.e., customer satisfaction, and the third rank is given to knowledge generated. This confirms that meeting the set objectives is the unanimously accepted criteria for evaluating project success followed by enduser acceptance. However, if we consider the top three ranks, then time emerges as the third important criteria in assessing project effectiveness justifying the point that success depends on the timings. Patenting the work done is considered as the least important criteria as perceived by the respondents.

Table 2: Frequencies and Percentages of the Nine Criterion Measures of Project Success

Criteria	Ranks	Frequency (1st Rank)	Percentage (1st Rank)	Total Percentage upto 3rd Rank
Meeting the set Objectives	1	39	47.0	77.0
Accepting with the enduser	2	19	23.0	49.0
Knowledge generated	3	8	9.6	32.5
Cost	4	4	4.8	31.3
Time	5	3	3.6	34.9
Quick Commercialization	6	3	3.6	26.4
New business opportunity	7	3	3.6	20.4
Effort put in	8	2	2.4	13.2
Patenting the workdone	9	2	2.4	4.8
Total		83	100.0	

To get further clarification, on the basis of grade (position occupied in the organisation hierarchy), the executives were divided in three categories: Lower (n=27), Middle (n=24) and Upper (n=32). Comparison of the ranks in terms of frequencies of the three executive groups and that of the total sample on the project success criteria are given in Table 3. In the lower executive group, out of 27 executives 14 of them have given

first rank to meeting the set objectives followed by acceptance with the enduser (4) and knowledge generated (4). Similarly, in case of middle executives, out of 24 executives, 11 of them have given top rank to meeting with the set objectives followed by acceptance with the enduser (8) and then knowledge generated (2). In case of upper executive group, out of 32 executives 14 have given first rank to meeting the set objectives, followed by 7 executives to acceptance with the enduser and 3 executives to new business opportunity and 2 executives to knowledge generated.

Table 3: Comparison of the Ranks given by executives of different levels on the project success criteria in terms of frequencies

Criteria	Lower	Middle	Upper	Total
1. Meeting the set Objectives	14	11	14	39
2. Accepting with the enduser	4	8	7	19
3. Knowledge generated	4	2	2	8
4. Cost	1	1	2	4
5. Time	1	1	1	2
6. Quick Commercialization	1	0	2	3
7. New business opportunity	0	0	3	3
8. Effort put in	1	1	0	2
9. Patenting the work done	1	0	1	2
Total	27	24	32	83

Even when we compare the ranking given by the lower, middle and upper executives groups, separately it is found that all the three groups have given first priority to meeting the set objectives and the second criteria to acceptance with enduser. While the lower and middle group have given third rank to knowledge generated, the upper management group perceive the importance of new business opportunity as an important assessment criteria of project success in the changing business scenario. The lower and middle level executives do not perceive the importance of this criteria.

The findings of this study have been presented diagrammatically in the Fig. 1. There are 3 concentric circles. The major three criteria, namely, meeting the objectives, acceptance with the user, and knowledge generated occupy the inner circle. Cost, time, new business opportunity and quick commercialization are the second level of criteria measures used for project success. Finally, even though effort put in and patenting the work have been identified as potential criteria for as-

sessing project success, yet the respondents do not seem to consider them as criteria for evaluating project effectiveness. Thus these two measures occupy the third circle of the figure. Effort put in is an input to project success whereas patent comes only when some innovative results are achieved. In the competitive business environment particularly where knowledge and information are considered as resources to any organisation, there is a need for scientists and top management to emphasize on gaining patent rights over their indigenous products/processes.

One factor that emerges from this study is the least importance attached to patenting the work done. It is surprising particularly in the research and development unit where the activities include process/product/technology innovation and the focus is on generation of knowledge. Perhaps this is because of (a) lack of clear understanding regarding what can come under patenting rights (b), the possible perception that the process of patenting is complex and time consuming. Perhaps developing a simpler procedure for the scientists within the unit will highlight the importance of patenting in R&Ds. Personal interview suggests that the top management is giving thoughts to this issue.

Discussion and Conclusions

Traditionally, time, cost and meeting the objective/goal are considered the criteria for assessing project. Perhaps because of the present trend and focus towards customer satisfaction and the realization of the need to meet the demands of customer for any business enterprise, acceptance with end user is considered as the second most important criteria. This is perhaps because (a) not all projects are directly meeting the customer needs. Some of the projects are called futuristic research, like superconductivity research, where the focus is to develop the knowledge base of the organisation and capability development. They do not have immediate impact. Around 20 per cent of the projects are of this kind. (b) In R&D, it is not easy to meet the set goals to meet the customer needs fully. Failure of projects is quite high. It is an acceptable phenomenon. So analyzing the success and failure of different projects, the knowledge base of the organisation gets expanded.

Knowledge generated has emerged as the third important criterion. Quick commercialization, new business opportunity have emerged as important criterion measures, may be because of the recent market trends and the emphasis on growth for business enterprises. Cost and time are accepted as important criteria measures. The executives opined that within a time and cost framework the project success assessment criteria

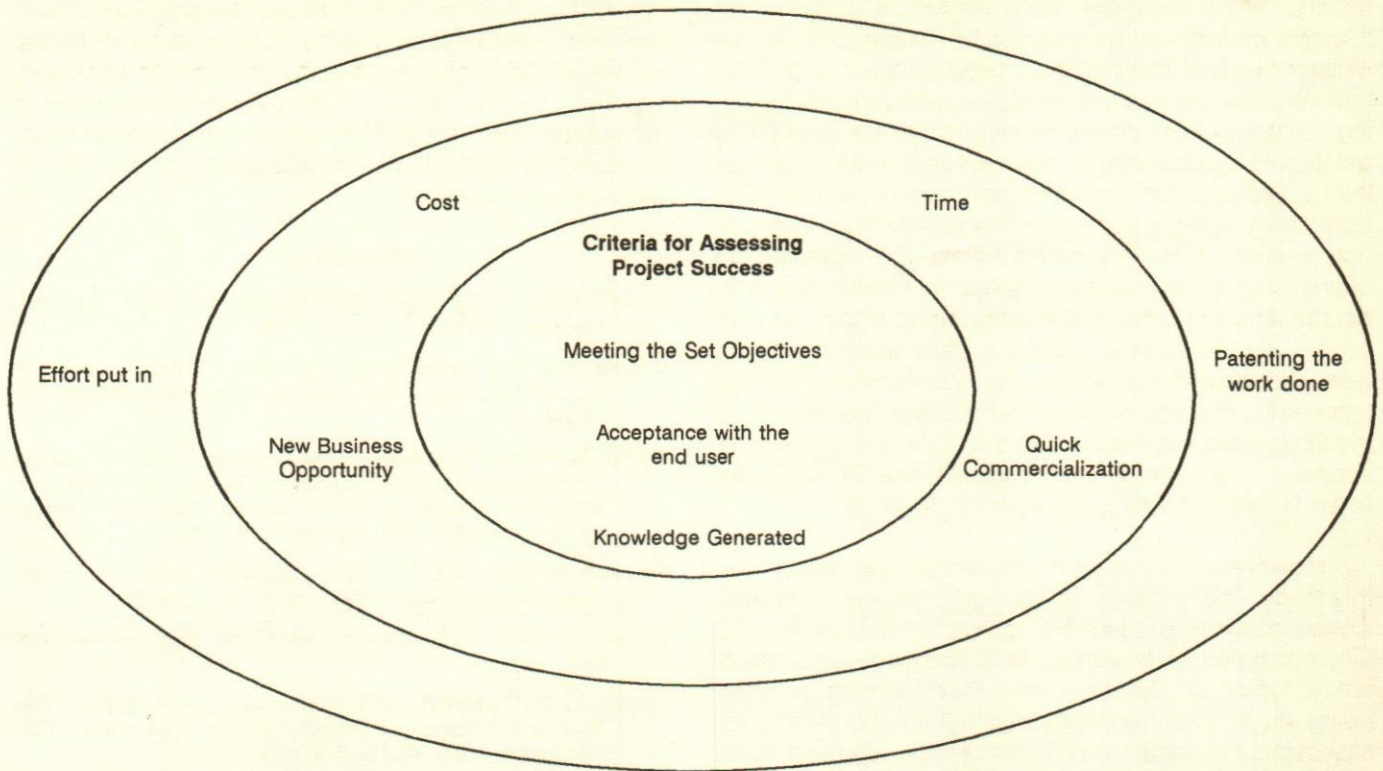


Fig. 1. Diagramatic Presentation of the Nine Criteria Used to assess Project Success

are meeting the objectives, meeting customer needs and the knowledge generation as a resource for the organisation. The projects results will have little meaning unless time and cost are minimum compared to the competitors. Effort as criteria perhaps focuses the fact that sometimes inspite of hardwork, and commitment on the part of scientists the criteria are not met. So while assessing the personal contribution with respect to project result, this factor should be taken into account. However, the top management feel that research for the sake of research will have no meaning unless it facilitates the organisation to achieve its goals since the organisation studied is a business organisation not a research instutition.

The disparity in the ranking/prioritizing the criteria used in assessing project success/failure can be ad-

Within a time and cost framework the project success assessment criteria are meeting the objectives, meeting customer needs and the knowledge generation as a resource for the organisation.

dressed from several angles:

- Conventionally, the assessment criteria for project success are time, cost and objectives. Research result were not assessed whether they directly contribute to organisations' goal like growth, generation of resources and new business development.
- R&D product/process not evaluated in terms of customer needs. Customer focus is a recent phenomena in Indian companies particularly after liberalization.
- The confusion arises also because if we analyze the past functioning of R&D unit, it is found that many a time the corporate planners allocate funds without expecting any direct return from the R&D units in terms of revenue generation.
- Global competition forces companies to look inward in terms of their Human Resource capabilities for process/product/technology innovation that will provide them competitive edge in the market.

A few years back, scientists in the organisation had complete freedom to take up any kind of research project and they were not held accountable for the

results. Most of them were individual projects or projects undertaken by a single functional area or disciplinary unit. Multidisciplinary projects were rare. After liberalization, the focus is on high valued projects involving members from different functional areas in order to get better result within a reduced time span. This has led to confusion among scientists about the expectation from them. A clear understanding of what the organisation expects from the professionals will increase the chances of achieving those goals. In this context, understanding the criteria of measurement of project success is vital. To some extent the present study meets the need in identifying achieving the set objectives, acceptance with the end user and knowledge generated as the three most important criteria while assessing project success. The emergence of importance of customer focus is clearly coming out from the findings.

However, some other issues remain unanswered by this study. The target group studied consisted of professionals from cross-functional project teams working in different types of research. As mentioned earlier there are 6 types of Research and Development activities going on in this organisation. Whether the criteria for assessment is same for all kinds of research need to be addressed. This means the project type may change the ranking of the dimensions. Classifying projects according to their relative complexity, risk factor involved, scope and the nature of the final product expected were not within the scope of this study. However, identifica-

tion of the possible criteria for assessing project success and their relative ranking supported by empirical as well as descriptive data is the strength of this paper. The objective was to make the professionals aware of the criteria that are used in assessing their project success and its implications on their growth as well as organisational growth.

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Leadership for Worldwide Competition: A European Perspective

Hans H. Hinterhuber, Stephan A. Friedrich, Eric Krauthammer and Kurt Matzler

Ahead of us are Darwinian shakeouts in every major market place with no consolation prizes for losing companies and nations.

—Jack Welch, CEO, General Electric Company

The significant problems we face cannot be solved at the same level of thinking we were at when we created them.

—Albert Einstein

In turbulent times, the leadership task of entrepreneurs and senior executives is to inspire and to enable managers and employees to discover new opportunities and to capitalize on them in the interest of all stakeholders of the firm. Leadership is of great importance not only for those at the top of the company or its strategic business units or functional departments. A leader is everyone who exerts a positive influence on the life of others, may he or she be a member of a team or the head of a small department. By using the metaphor of a wheel, the authors show the tasks leaders cannot delegate, if they are to meet their leadership responsibilities. The message of the paper is that in turbulent times, when new markets have to be invented and radical improvements in stakeholder satisfaction are needed, leadership is more important than creative problem solving, i.e. management.

Hans H. Hinterhuber is Professor of Strategic Management and Head of the Department of Management, University of Innsbruck, Austria; Eric Krauthammer is the founder of Krauthammer International SA, Geneva, Switzerland; Stephan A. Friedrich is an independent consultant in Karlsruhe, Germany; and Kurt Matzler is Assistant Professor of International Management, University of Innsbruck.

Introduction

Competition in a borderless world

The globalization of markets, new information technologies, reduced logistics costs and the governments' retreat from the economy have led to an unprecedented level of competition. In numerous industries, even the positions of market-leaders are in constant jeopardy. Leading competitors are attacked by innovative firms from all over the world, established "rules of the game" are constantly violated or evaded up in order to break up existing markets and to bend market equilibria in one's favour.

If we note the price on the vertical axis and the perceived quality on the horizontal axis of a coordinate grid, then we can line up the different competitors in an industry on a diagonal: ranging from competitors who match high quality and excellent service with high price to those who sell cheap products with less service and quality (Fig. 1).

The situation is in equilibrium until a competitor somewhere offers "more value for money" or you "get more than what you pay for" or lowers the price (D'Aveni, 1994). Rivals are then forced to adapt, and the value or equilibrium line shifts to the right. If another player lowers his price or offers more for less, then competitors are forced to move to a new line, even further right of the present equilibrium line. In continuation of this escalating competition, rivals drop out of the market one by one; experience shows that firms offering higher

quality and service at higher prices usually have better chances of survival. The game can be carried on until the remaining competitors reach the final equilibrium (Hinterhuber *et al*, 1998).

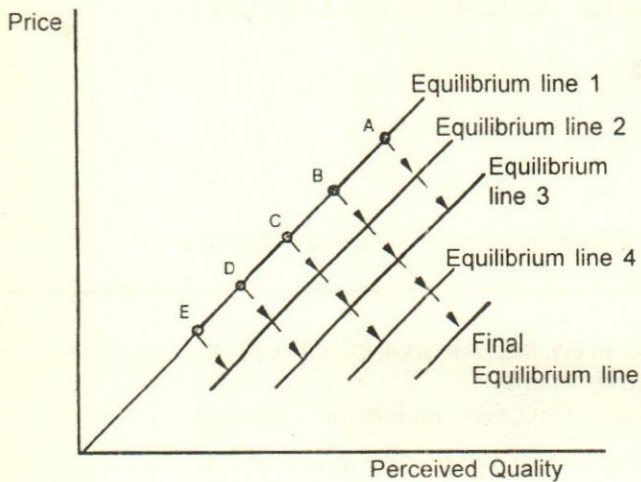


Fig. 1. The implications of hypercompetition (D'Aveni, 1994)

Not in every industry does competition escalate to the final equilibrium line, where rivals offer goods interchangeable in quality and price without a competitive advantage. However, in an increasing number of fields the four factors mentioned in the beginning force firms to such competition for survival. This situation is comparable to positional warfare. The task of entrepreneurs and senior management is to transform this positional warfare into mobile warfare (Hinterhuber *et al* 1998) and is depicted in Fig. 2.

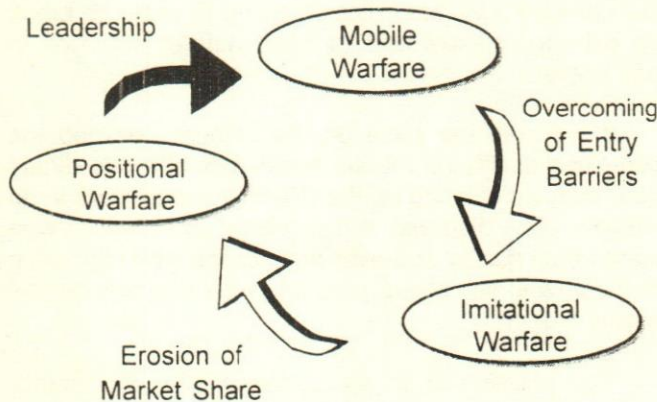


Fig. 2. The Three arenas of Competition (Valdani, 1997)

Leadership and Management

A leader is one who follows his own light. — Rumi

The source of *leadership* is alertness to opportunity (Kirzner, 1980), and the imagination and vision to exploit

Not in every industry does competition escalate to the final equilibrium line, where rivals offer goods interchangeable in quality and price without a competitive advantage.

or capitalize on it, thereby creating values for all stakeholders—i.e. the customers, employees, shareholders, the financial community, society as a whole, suppliers and partners in strategic networks. Leadership creates new paradigms and works on the system (Covey and Merrill, 1994). *Management* is creative problem solving. Management works within the paradigm or within the system. Management uses a great number of instruments, methods and attitudes in order to gain a competitive edge over competitors. Management is easier to learn than leadership; however in a time of uncertainty leadership is more important if radical changes are to be implemented to achieve a dramatic improvement in performance (Taylor, 1995). Figure 3 shows the complementarity of leadership and management. Our definitions however, are not without problems: for example some of the attributes of leadership would not be recognisable in a highly paternalistic firm.

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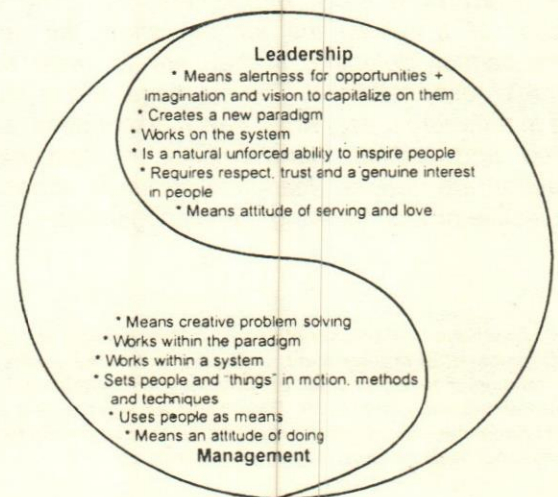


Fig. 3. The complementarity of management and leadership

Leadership is a natural, loose and unforced ability to inspire people giving their best for achieving shared goals. It cannot be effective without the following combined qualities being present: natural drive, a thirst for adventure, courage, sense of reality, ambition, imagination, restive temperament and a fundamental respect as well as a genuine interest in people (De Woot, 1994). Leadership means (1) inventing new markets, (2) or changing the rules of the game in existing markets or (3) changing the structure of industry through mergers, acquisitions or joint ventures in order to create value for all stakeholders.

Leadership has its true roots in ideals and values as well as in unselfish service and commitment that goes beyond personal interests (Greenleaf, 1991; Donithorne, 1994). Leadership is winning the hearts and minds of the followers, or, as Peter Koestenbaum (1991, p. 25) puts it: "Leadership is heart + results. Leadership exists only when power and wisdom coincide in one person".

Creating Values for All Stakeholders

One must see the whole before its parts.

— Scharnhorst

The stakeholder model of the corporation views the firm as an open, socioeconomic system composed of various constituencies: customers, employees, shareholders, the financial community, the public and its government representatives, suppliers, and partners in strategic networks. The stakeholders have obligations as well as rights to the corporation (Fig. 4). Since the success of the corporation depends on gaining the support of all stakeholders, the leadership task of entrepreneurs and senior executives is to integrate the stakeholders into a cohesive community. This leadership task is well defined by William E. Halal in his book *The New Management*: "Corporate managers are dependent on stakeholders because the economic role of the firm is to combine as effectively as possible the unique resources each stakeholder contributes: the risk capital of investors; the talents, training, and efforts of employees; the continued patronage of customers; the capabilities of business partners; and the economic in-

Corporate managers are dependent on stakeholders because the economic role of the firm is to combine as effectively as possible the unique resources each stakeholder contributes.

frastructure provided by government. The need for capital is essential, of course, but the contributions of other stakeholders are no less essential. Because companies are socioeconomic systems, these functions are all as essential as the diverse organs of a body. Thus, managers should act as stewards engaged in a 'social contract' to draw together this mix of resources and transform it into financial and social wealth, which they can then distribute among stakeholders to reward their contributions. The closer the integration into a cohesive community, the greater the wealth" (Halal, 1996, p. 67).

Entrepreneurs, chief executive officers and senior executives need a power-base to be legitimate. In the United States the main source of the legitimacy of a top team is the shareholders' assembly. In Europe, the top team has to be accepted not only by the shareholders, but also by the workers and their unions, by the politicians, by the parties, by the central and/or regional government, by the public opinion, and so on (De Woot, 1998). Entrepreneurs and/or senior executives have to negotiate with all these stakeholders.

The power-base in Europe is larger, more complex and more political than the power-base in the United States. Therefore, priorities in satisfying key stakeholders must be established. Customers are priority number one, employees number two, investors number three—this is the priority order we have found in many European companies. The more transparent the process is and the better an "argumentative discourse" can be established between leaders and key stakeholders, the more effective the company will be able to increase its value.

Leadership, however, is not limited to creating short-term value for the shareholders, but about taking into consideration the logic, the feelings and the expectations of all stakeholders in a long-term perspective; in this way the long-term economic value of the firm for the shareholders can be maximized (Hinterhuber, 1996).

Leaders' Tasks

In life never do as others do. Either do nothing—just go to school—or do something nobody else does; Injunction of a grandmother to her grandson.

—Gurdjieff

There are many metaphors which can be used to characterize leadership: the house (Hinterhuber and Krauthammer, 1997), the ship, the wheel. We have chosen the wheel, because it is dynamic, turns to satisfy all key stakeholders, and is driven by the anticipation of the future and the administrative heritage (Bartlett and Goshal,

quality of a leader's wellbeing determines the quality of his or her life and actions. In our leadership seminars we have found that entrepreneurs and senior executives define wellbeing along six dimensions:

- health
- financial security (the material dimension),
- coping with a fulfilling and satisfying task which fosters personal development and learning (the intellectual dimension),
- love, affection, good family relationships, friends (the emotional dimension),
- contributing to the progress of Society (the social dimension), and
- the meaning of life (the spiritual dimension).

Entrepreneurs and senior executives at leadership seminars recognized the existence of a balance between all six dimensions of wellbeing; in other words, they seemed able to harmonize, each one according to his individuality, the intellectual, emotional, material, social, and spiritual dimension with the care for their health. Each person must find the balance he or she needs (Parikh, 1992).

Inner strength is the key to effective leadership. Only those who possess inner strength and are willing to work on their personal development will be able to cope with changes and conflicts in their environment. Says M.P. Narayanan, retired chairman of Coal India: "If you want to be a good leader, you must first be a good human being" (The Performance Group, 1995, p. 55).

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The Vision

The next task leaders cannot delegate regards the entrepreneurial vision. Leadership must make people understand the importance of what they are doing. The vision is the image of a desirable future, pointing the way like the North Star; it is the answer to the needs of the market and gives a meaning to the endeavour of all employees, explaining "why" the firm exists and for what it stands.

The objective of the vision is to achieve pro-active thinking and acting of all employees in the direction of the vision. A shared vision is the basis for creating and defending competitive advantages. Communicating and explaining the vision is very important because it gives each employee the possibility to define his or her position in the organisation and determine his or her individual role in the satisfaction of internal and external customers. A clear understanding of the vision will enable them to better play their part in the "game". The vision gives them security and self-confidence, and creates an atmosphere of creativity, initiative and pro-active conduct (Calori and De Woot, 1994). The essential question in creating a vision is: "Which society needs does the organisation want to fulfill?"

Communicating and explaining the vision is very important because it gives each employee the possibility to define his or her position in the organisation and determine his or her individual role in the satisfaction of internal and external customers.

The Mission

It is the visualization of the basic rules of behaviour of a firm in accordance with its vision. It is based on the values, orientations and norms as lived in the corporate culture. The objective is to orient, to legitimize and to motivate all employees to deploy their energies for the satisfaction of all key stakeholders of the firm.

The mission statement of BMW contains the following sentence: "Everyone in the company can make mistakes; however, it shouldn't be too many, and they have to be discussed with one's superiors", the formula is aimed at fostering innovation and experimentation, and to make a learning organisation out of BMW. The involvement of executives and employees in defining the mission, i.e. the goals the firm wishes to achieve in relation to each stakeholder, is the third entrepreneurial task which cannot be delegated. The total of these annual goals is the mission statement of the company.

The Strategies

"Strategy is the evolution of the originally guiding idea according to continuously changing circumstances" (Hinterhuber, 1990). This is the famous definition of strategy, given by Helmuth von Moltke (1800-1891), the Prussian general, who added that "its value lays nearly exclusively in its

application". Based on a slight variation of this definition, strategy could be described as the evolvement of an innovative business idea or of one or more core competences according to ever-changing customer demands and competitive situations. The general accepted objective is to be Number One or Number Two in every market segment in which a SBU of the firm operates. In order to achieve this goal, the firm must add value to its customers and the other stakeholders and to satisfy them better and/or quicker than the competitors can do. There are two conflicting requirements which leaders must combine with the strategy: firstly, a great number of decisions taken at different times in different places by different people must be brought into line with adding value to the firm; and secondly the decision making centres must be given as much flexibility as possible in order to consider ever new elements. The latter can be done with directives. In a rapidly changing world formulating directives will help the leaders of an organisation ensure the necessary amount of entrepreneurial flexibility and at the same time bring decisions in line with the stakeholders' demands and thus with the increase in value of the firm as a whole. Strategy means taking actions under great perspectives and at the same time achieving results in the short term. Says Jack Welch, CEO of General Electric Company: "As leaders, we get paid to win in the short term and make sure that we are stronger in the long term" (Lowe, 1998, p. 36).

Shaping the future direction of an organisation is the fourth task which cannot be delegated. There are three types of strategies:

1. *Offensive strategies* aimed (a) at "inventing" new markets where the firm can take advantage of its core competencies and increase its value, or (b) changing the market rules in order to improve its competitive position. By sharing its core competencies with Mercedes-Benz, SWATCH creates a new market in the low price segment of the automobile industry, where the profit perspectives seem to be attractive. Both, Mercedes-Benz und SWATCH, by sharing their core competencies, are trying to achieve a co-evolution which opens more and better options than exist today (Bentivogli *et al*, 1994). On the other hand, Doppelmayr, an Austrian multinational firm, outperforms its competitors in the ski-industries through technological innovations and a customer-friendly service (Hinterhuber and Fink, 1997).
2. *Defensive strategies* are aimed at holding leading competitive positions.

3. *Disinvestment strategies* refer to SBU's or elements of the value chain which do not contribute to the present or future economic value of the firm, have no synergies with other parts of the company and do not benefit from core competencies. The disinvestment can be strategical or tactical in nature; it is strategic, when the available free resources are used to create new markets or to change the rules of the game in existing ones. Philips, for example, sold Grundig in order to strengthen its core businesses. The disinvestment is tactical in nature, if it does not create anything new and is aimed only at gaining time. IRI, the Italian State-owned corporation, employing over 400.000 people, over the last 10 years has been liquidating unprofitable businesses, without using the resources for offensive strategies. If the time gained is not used for discovering opportunities and capitalizing on them, the tactical retreat will eventually lead to the disappearing of the company.

In strategy, the roundabout way often leads to the goal in the shortest time; the indirect strategy—joint venture, outsourcing of non competitive elements of the value chain, sharing of core competencies with other companies for co-evolution—generally is more effective than the direct one.

Generalizations of successful cases of strategies in the form of recipes or prescriptions are not possible. In strategy there are no schemes. What counts, is to keep open as many options as possible, and to pursue the own goal in a clear and determined manner, considering the strategy as a "system of expedients" ad hoc, as Moltke puts it.

The Core Competencies

The fifth entrepreneurial task that cannot be delegated is to identify the core competencies, which keeps the process of creating values for the stakeholders moving, and allow it to further develop in the direction of the vision and mission of the company. Core competence is the integrated total of know-how, organisational capabilities, business processes, technologies, and attitudes co-ordinated through organisational learning processes which

- can be recognised by customers and are important to them;
- add value to all key stakeholders;

- are unique when compared to actual or potential competitors;
- are hard to imitate; and
- have the potential to open a number of new markets.

Leaders must pay undivided attention to core competencies: the full size of value-added activities, outsourcing decisions and strategic withdrawal from markets or operations in which the organisation is not a world player, depends on them. Core competencies enable an organisation to open up new markets if it succeeds in anticipating customers' needs not yet articulated. Good examples of this are products like the minivan or the walkman.

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The Core Products/Services and Strategic Issues

Apart from well-being, entrepreneurial vision and mission, strategy and core competencies the sixth leadership task which cannot be delegated consists of taking care of core products/services and strategic issues. The core products and/or services of a company are:

1. the products and services which in the short or medium term will contribute to an increase in economic value of the organisation, requiring defensive strategies;
2. the products and services which determine the medium or long term increase in economic value of the organisation, thus requiring offensive and/or investment and growth strategies.

The products and services which belong neither to (1) nor to (2), which would not result in synergy effects if combined with either and which make no use of any of the core competencies of the organisation should be dropped or sold.

The leadership task is to establish a portfolio of products and services and implement it in a way that exploits the core competencies of the organisation makes

use of synergies, balances cash-flows and reduces intolerable risks. Selecting senior executives suited for the implementation of offensive, defensive or disinvestment strategies is among the most important entrepreneurial decisions. However, if the firm is seen as a portfolio of strategic business units, resource allocation will concentrate on the related products and/or services.

The strategic logic of core competencies is transversal and makes use of hybrid innovations from which will benefit a variety of strategic business units and which increase the competitive strength of many kinds of products and/or services. Examples of hybrid innovations based on core competencies are laptops, miniature TV sets, medical ultrasound scanners and many products in the field of laser optics. The more complex a product the greater the need for different core competencies.

Thinking in business units as well as in core competences must become part of the corporate culture; creating this shared mindset is an entrepreneurial task that cannot be delegated.

Identifying and developing core competencies is a dynamic process which must be steered by the entrepreneur and senior executives according to vision, strategy and core products and services. The art of leadership consists of choosing one of various possible competence deployments open to the firm for outperforming its competitors in attractive markets. However, the leader also needs to have the modesty and knowledge to immediately exclude company development paths based on core competencies which the organisation would not be able to implement.

A leader is not the one who does everything. He or she considers strategic issue management and a strategic discussion process among all senior executives in the firm equally important than portfolio optimization, particularly in markets where the rules of the game are constantly changing and where new players appear constantly on the markets the firm serves. A leader is personally involved in strategic issues, i.e. succession problems, acquisitions, emergency situations, anticipating the moves of competitors, reacting to them, breaking-up the company, and so on, and he or she

The art of leadership consists of choosing one of various possible competence deployments open to the firm for outperforming its competitors in attractive markets.

and Munroe Faure, 1996, p. 168) The leader must adhere to this rule of independence for managers and employees despite any adverse effects this independence may have created in the past. In our experience, instances of managers and employees taking independent decisions in accordance with the vision and the mission as well as with an understanding of the strategies outnumber those characterised by a lack of understanding or undue stubbornness.

If the firm wants to satisfy customers faster and better than its competitors, barriers between individuals, functional areas, regional units, and hierarchical levels must be removed and the structures reorganised so they become more porous. The business processes have to be co-ordinated according to a flow chart by the process owner. They cut across and optimise the organisation as a whole and concentrate on the satisfaction of internal and external customers and other stakeholders.

The *Leadership tasks* which cannot be delegated are:

- Selecting and developing managers and employees;
- Removing barriers between individuals, teams, functional areas and SBU's;
- Creating an effective system for gathering and disseminating new information;
- Changing existing planning, budgeting and information systems in order to satisfy customers and other stakeholders better and faster than competitors can do;
- Changing decision-making processes by involving those concerned;
- Reorganising human resource management by introducing performance standard as well as financial and other incentives for individuals and teams;
- Promoting personal interconnections between inside and outside know-how contributors.

GE uses corporate culture for management selection. Consider how Jack Welch defines management "types" at GE (General Electric Company, 1995) as depicted in Fig. 6:

"Type I not only delivers on performance commitments, but believes in and furthers GE's values. The trajectory of this group is "onward and upward", and the men and women who comprise it will represent the core of GE's senior leadership into the next century.

Type II does not meet commitments, nor share GE's values – nor last long at GE

Type III believes in GE's but sometimes misses commitments. Type III is typically given another chance.

Type IV delivers short-term results without regard to GE's values. Type IV's often diminish them by grinding people down, squeezing them, stifling them. Type IV's will be removed".

Performance
Commitments

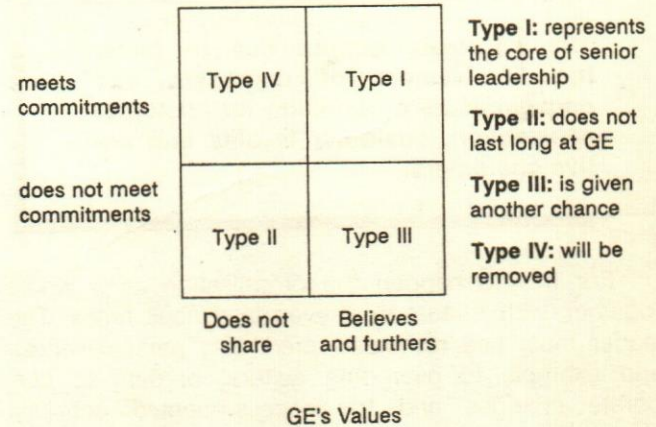


Fig. 6. Management selection at General Electric Company

Source: General Electric Company Annual Report 1995.

The leadership tasks concerns the gradual "reduction of Type IV management and the development of a fresh, open, anti-parochial environment, friendly toward the seeking and sharing of new ideas, regardless of their source" (Jack Welch, in General Electric Company, 1995).

Says Nicoló Machiavelli: "The first method for estimating the intelligence of a ruler is to look at the men he has around him".

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The Corporate Culture

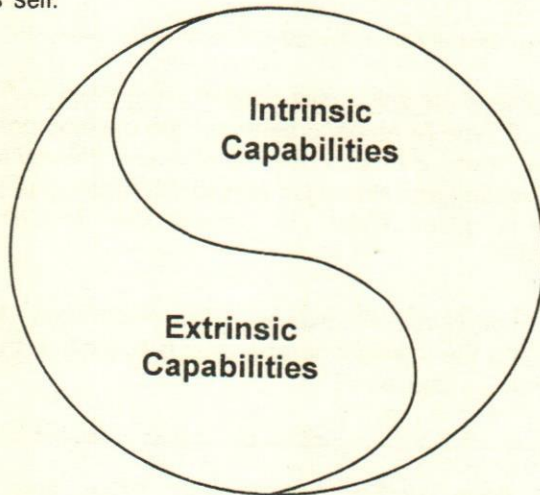
The corporate culture is the integral of all lived and shared values, principles, objectives, and experiences. It determines the behaviour of all employees in their day-

to-day activities. In particular, company values are giving first priority to customers, entrepreneurial behaviour, empowerment, candor, simplicity, speed, team work, intellectual competence, ethics, and so on.

The attitudes and the behaviour of managers and employees have to bring about the image as the firm wishes to be seen and judged by the public. The corporate culture has to foster the involvement of managers and employees as a condition for customer satisfaction, customer loyalty and active customers.

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For this to happen the organisation as a whole together, with mutual trust even in difficult times. The leader must use calmness, credibility, persuasiveness and example to overcome cultural barriers to corporate changes and to process-oriented activities aimed at satisfying internal and external customers. This ninth leadership task requires putting work before one's self.



Extrinsic Capabilities: The core competencies to respond to the changing needs of society

Intrinsic Capabilities: The basic organisational values guiding entrepreneurial thinking, feeling, and action at all organisational levels

Fig. 7. Two key success factors for strategic leadership

A corporate culture which demands that decisions be implemented according to customer needs and ex-

pectations rather than just according to schedule or budget is a prerequisite for increasing the value of the firm. Managers and employees have not just the right but also the duty to change the implementation of decisions to the extent to which the current situation deviates from the one assumed at the time the strategic plan was first conceived. Figure 7 shows the extrinsic and intrinsic capabilities a company needs for adding long-term value to all its stakeholders.

In conclusion corporate culture must get managers and employees used to behave like entrepreneurs, to live the company's values, and to *think through their actions* with regards to the organisation's vision and strategies.

The Corporate Image (CI)

It is the image which other people get of or attribute to the company in a way, as the firm wishes to be seen by the outside world. The more strategic business units interact with an ever more dynamic and complex environment, the more important it becomes for the leaders to make sure that the company doesn't lose its awareness of itself and its identity. An organisation's image is extremely complex: it is the result of a long and difficult personification of values, principles and experiences which:

- reflect the personality and the character of those that founded and/or are currently leading the organisation;
- reflect the attitudes, traditions and standards of the employees which contribute to the success of the organisation or have done so in the past;
- result from the socio-economic and institutional environment in which the organisation works; and
- manifest themselves in the image and credibility the organisation has with its stakeholders.

The more strategic business units interact with an ever more dynamic and complex environment, the more important it becomes for the leaders to make sure that the company doesn't lose its awareness of itself and its identity.

Shaping this image according to the vision and mission, the strategies, the business processes and core competences, the directives required for an optimum

use of resources and the corporate culture is the final leadership task that cannot be delegated.

Conclusions

Always and in everything strive to attain at the same time what is useful for others and what is pleasant for oneself.

— Nasreddin

In this article it is argued that:

- * Hypercompetition can be compared to a positional warfare. In order to break out from a positional warfare, leadership is needed.
- * Leadership stands on three pillars: envisioning, being an example and increasing the economic value of the firm (Fig. 8).
- * Leadership is more important than management. Leadership is a natural unforced ability to inspire people, to discover opportunities and to capitalize on them. Management is creative problem solving. Entrepreneurs and senior executives need both: leadership and management. In our experience, about 80 per cent of the CEO's tasks are leadership tasks, i.e. the tasks illustrated in the leadership-wheel.
- * The leadership tasks entrepreneurs and/or senior executives cannot delegate are illustrated with the help of a wheel. The wheel turns to satisfy all key stakeholders of the firm; it symbolizes (a) the cohesion between all leadership tasks and (b) a concept of time which emphasizes the present as anticipation of the future and as result of past decisions and attitudes.
- * The hub of the leadership-wheel is the wellbeing of the leader. Leadership needs inner strength, visibility, judgement, credibility, dedication to a shared purpose, personification of values and principles, courage, ability to communicate, respect, for people and humility. Helmuth Maucher, CEO of Nestlé, summarizes his leadership credo this way: "In order to lead a company, one needs the ability to remain true to oneself, to stand for what one is".
- * The tasks which leaders cannot delegate refer to:
 - * the wellbeing,
 - * the entrepreneurial vision,
 - * the mission,

- * the strategies,
 - * the core competencies,
 - * the core products/services and strategic issues,
 - * the management selection and development,
 - * the directives and resources for competitive advantage,
 - * the corporate culture,
 - * the corporate image.
- * High performance leadership can be traced back to the golden rule: "Lead others as you would like to led" (Donnithorne, 1994, p. 90). When a person's development as a leader is finished, that leader is finished.

Leaders are not unlike seafarers. They, too, exploit information inside and outside their organisation, they use instruments and methods (cognitive domain); however, they also need to have the energy and courage to break with the past and explore new shores. They need to have good common sense, a feeling for perspectives and proportions as well as commitment to a common objective, power of persuasion and sensitivity, credibility and integrity, in other words attitudes which belong to the affective domain (De Woot, 1998).

The contrast of decentralised leadership and centralised control can only be overcome by letting the managers' and employees' creativity and initiative develop freely within a shared mindset and by assigning them their role in the organisational network according to their ability, commitment, and willingness to take responsibility and to set high objectives. Moltke on this subject: "The advantage which a leader hopes to gain by personal intervention is normally just an imaginary one anyway. In the course of the intervention he takes on functions which have been assigned to other people thus doing without the contribution of others; he increases his own amount of work to an extent where he will no longer be able to cope."

The driving force in any organisation is the managers' and employees' ability to think and act in accordance with the future direction the firm has decided to take. The leader must trust in this driving force. The employees' entrepreneurial independence acts as a multiplier which increases the leaders ability to lead.

There is nothing more dangerous than one-sidedness, and nothing more supportive of leadership than openness for new ideas and the recognition that there are thousands of things apart from one's job which also

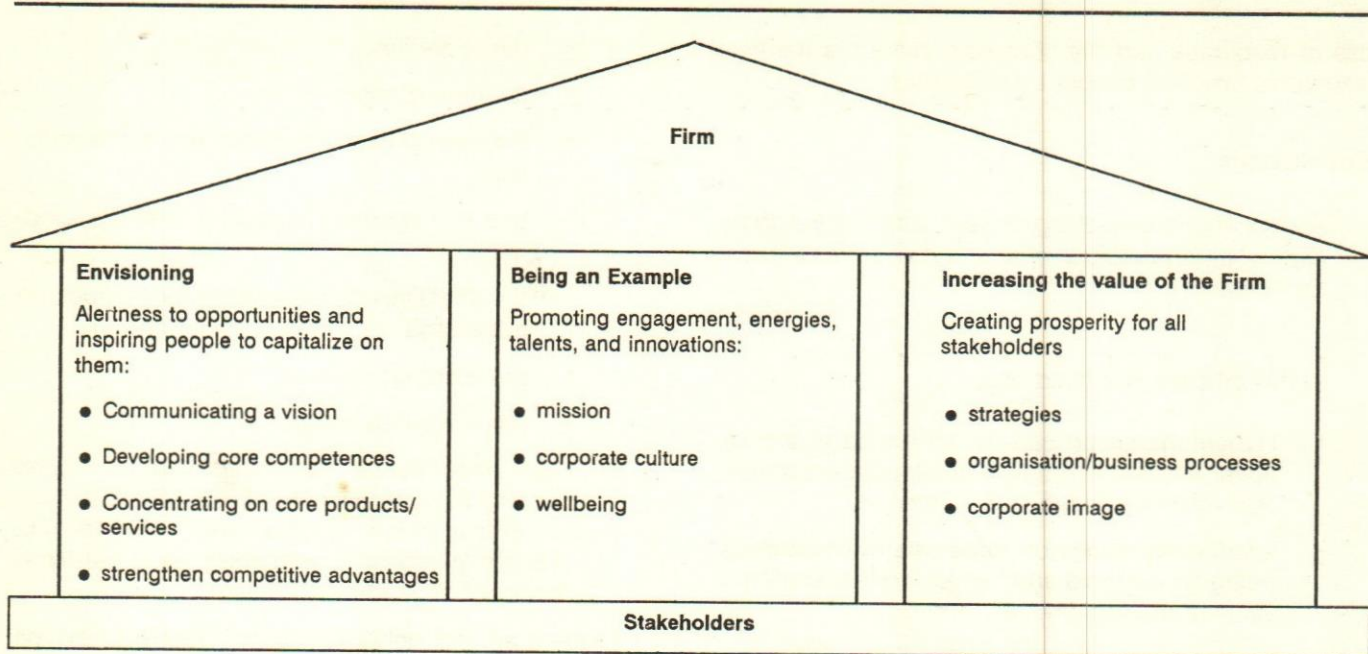


Fig. 8. The three pillars of leadership

The driving force in any organisation is the managers' and employees' ability to think and act in accordance with the future direction the firm has decided to take.

have a right to exist. If the leader possesses inner security and strength and is sure of his/her own value, he/she will have a competitive edge over competitors due to a higher level of being, understanding, and knowledge. Leading means constant work on oneself. Only by constantly working on oneself can an individual learn the art of leadership—an ability to think freely and creatively, to exploit information inside and outside the company, to take the right decisions and set the right actions at the right time; to be, despite all the planning, able to act unconventionally in a variety of situations.

The importance of leadership, the role of good common sense, of character, credibility and judgement, all its inherent qualitative aspects, must make us modest, with respect to our capacity to explain the performance of successful firms or to help educate the executives who will lead them in the future.

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Manufacturing Strategy: Relating Process to Contents

R.R.K. Sharma and S. Upadhyay

In the present paper the relations between manufacturing and corporate strategy making processes have been discussed. Further, it is described how the manufacturing strategy making processes and manufacturing department's objectives are related. Some of the manufacturing decisions (lower level objectives of the manufacturing function) such as manufacturing organisation structure, facility, capacity, vertical integration, scope for introducing new products and vendor relations to processes of manufacturing strategy making are also considered. For a pilot field study, data from manufacturing organisations are taken. Despite small sample size, a substantial support to the hypotheses has been found.

R.R.K. Sharma and S. Upadhyay are at the Industrial Management and Engineering Department, Indian Institute of Technology, Kanpur-208 016.

Introduction

Process model of manufacturing strategy is relatively undeveloped (Ettlie and Penner-Hahn (1990)). Since the seminal work of Skinner (1969) the manufacturing strategy literature has developed on the lines of "contents" of manufacturing strategy. In the present paper an attempt has been made to relate two streams of research works done in manufacturing strategy that is, its "contents" and "processes".

Overview of Manufacturing Strategy

The 'content' of the manufacturing strategy is broadly classified into two categories:

1. Competitive priorities that help in appropriately targeting the manufacturing resources. (Ettlie and Penner-Hahn, 1990).
2. Decision areas of manufacturing function that help anyone to achieve objectives set by the market conditions.

If one combines the competitive priorities of Skinner (1969, 1978, 1985), Wheelwright (1978, 1981, 1984), Buffa (1984), Hayes and Wheelwright (1984), Fine and Hax (1985), Van Dierdonck and Miller (1980), and Hayes *et al*, (1988), one obtains the following six dimensions: (1) Manufacturing cost (2) Delivery performance, dependability and speed (3) Quality (4) Flexibility—product mix and volume (5) Innovativeness and (6) Investment in productive facilities.

Skinner (1974) has suggested five decision areas where management makes trade-off decisions (1) Plant and equipment (2) Production, planning and control (3) Labour and staffing (4) Product engineering and design (5) Organisation and management. Fine and Hax (1985), Hayes *et al*, (1988), Hayes and Wheelwright (1984) and Buffa (1984) have added other decision

areas such as (6) Structural (capital spending) and infrastructural (manufacturing system and people) decisions. (7) Vertical integration (direction, extent, balance, number) (8) Technology (9) Capacity (Amount, utilization, timing) (10) Ability to introduce new products (11) Trying to evolve a fit between product process and life cycles. Wheelwright and Bowen (1996) have listed some more decision areas. These are— (12) Information technology (maintenance, material flows, production planning, cost tracking) (13) Customer (access, relationship, support) (14) Quality management (definition, role, responsibility, yields) (15) New products (integration, start-up, modification) (16) Process technologies (scale, flexibility, interconnectedness).

Since a single production facility cannot meet different priorities of different market segments, Skinner (1978) has suggested plant within a plant concept (PWP for short) that seeks to segment the production facility so that each subplant can set its own priorities to be successful in serving its market segment.

Skinner's (1984) work suggested a hierarchical model in which corporate strategy drives the manufacturing strategy and other functional strategies. But Hayes (1985) has argued that functional capabilities drive the corporate strategy in some cases. Miller and Hayslip (1989) have suggested that capability development and strategy planning activities should be undertaken jointly to achieve competitive advantage. Hill (1985, 1989) has put emphasis on the importance of order winning marketing function in his process model of manufacturing strategy. Chase and Garvin (1989) have depicted measures to emphasize the "fit" of capabilities brought to bear by each function. Swamidass and Newell (1987) have noted in their seminal work that if top management follows an "interactive" process of strategy making, that is when manufacturing managers participate in corporate strategy making, then it yields significantly better results, but they do not give the "contents" of these interactions. Hayes and Wheelwright (1984) have suggested that firm's investment of manufacturing facilities could lead or lag or be on time with the emergence of demand; but they have not discussed the processes used for formulating the manufacturing strategies. Sharma (1997) has tried to extend the process models of corporate strategy making to the manufacturing strategy making process. Processes of manufacturing strategy making have been derived in the present paper from the processes of corporate strategy making.

Miller (1987) has presented a summary of different corporate strategy making process used and documented by researchers. The literature has identified

three multifaceted dimension of strategy making process: rationality, interaction and assertiveness.

The first dimension, rationality, suggests careful analysis of problems and opportunities, scanning of markets, methodical planning, stress on long term objectives, use of analytical tools in strategy formulation and articulating unified strategies (Ansoff 1965, Steiner 1969). It has been referred to as synoptic by Frederickson (1984); planning by Mintzberg (1973) or rational by Miller and Frieson (1984).

The second dimension of the strategy formulation process is "interaction". The name is derived from the fact that men with limited cognitive abilities make decisions while interacting with each other through the process of argumentation (Lindblom and Braybrook, (1959)). Men have limited cognitive abilities and organisation structure place bound on the rationality (March and Simon 1958; Simon 1947) and when faced with complex problems, they only do little analysis and formulate strategies according to disjointed, intuitive, implicit and spontaneous process (Cyert and March (1963); Lindblom (1959), March and Olsen (1976), Quinn (1980). It has been claimed by these authors that such a non-rational approach is necessary due to wide range of complex problems faced by the organisations, and the attendant cognitive limitations and the social and political contexts in which decisions have to be made. Hence politically fragmented firms operate in an adaptive mode (Mintzberg 1973) where goals and means are discovered through a process of argumentation. This process invariably leads to changes in incremental steps.

The third dimension of strategy making process is assertiveness which is concerned with the riskiness of strategy and reactivity and proactiveness of decisions. Entrepreneurial firms act ahead of their environments by taking bold decisions (Miller & Frieson (1984) and Mintzberg (1973); where as more large and complex firms often act conservatively by acting only reactively to the environmental changes. (Cyert and March (1963) and Quinn (1980)).

Strategy making process is applicable in general and hence it was proposed (Sharma 1997) that it will be applicable to the area of manufacturing as well. Hence manufacturing strategy making process can also be categorized into three dimensions, i.e. rational, interactive and assertiveness.

Categorization of manufacturing strategy

A firm pursuing a 'rational' approach to strategy making would use analytical tools such as linear

programming and simulation for major marketing and financial decisions. Such an approach to strategy making would lead to an integrated strategy where firm would benefit from synergy between various decisions, see Ansoff (1965). Carefully planned vertical integration and attention to technology would be the corner stone of an integrated strategy driven towards cost leadership. A firm with a rational approach to manufacturing strategy could aim to limit its investments in manufacturing resources (with a view to maximize its return on investment) by entering into joint ventures with vendors.

A firm may choose an "interactive" approach to strategy making either because it faces an uncertain environment or because it faces resource constraints, or because it faces complex internal environment. A firm pursuing an "interactive" approach to strategy making process is likely to take small steps each time. Thus a

A firm may choose an "interactive" approach to strategy making either because it faces an uncertain environment or because it faces resource constraints, or because it faces complex internal environment.

firm pursuing an "interaction" approach to manufacturing strategy making would invest in little to moderate quantities each time and/or make few departures in policies relating to manufacturing divisions. The firm would then attempt to sell a differentiated product which can command a relatively higher price to make up for a relatively higher costs of production.

An assertive manufacturing strategy would mean to a bold steps with respect to manufacturing resources with investments in manufacturing facilities ahead of competitors. Industries chose an 'incremental' approach to manufacturing strategy making process in the 1980's when costs were rising due to various diseconomies of scale (Leone and Meyer, 1980). This lends support to the framework which categorizes above said manufacturing strategy making processes.

An assertive manufacturing strategy would mean to a bold steps with respect to manufacturing resources with investments in manufacturing facilities ahead of competitors.

Conceptual Framework

Relating corporate and manufacturing strategy making processes

Hypothesis 1: A firm choosing 'rational' process of manufacturing and corporate strategy making is likely to have integrated strategies with large asset bases and have good performance in stable environments.

Hypothesis 2: Firms would pursue an 'interactive' approach to strategy making when facing complex uncertain environments (external or internal) and/or severe resource crunch and would realize 'incremental' changes in strategies. A firm pursuing 'interactive' approach to manufacturing strategy making would realize "incremental" corporate strategies and vice-versa. Also a firm pursuing 'interactive' approach to strategy making in stable environments would lead to poor exploitation of opportunities.

Hypothesis 3: Firm with entrepreneurial leaderships will pursue 'bold' approaches to corporate and manufacturing strategy making in both stable and uncertain environments. These firm may reduce the risks in uncertain environments by emphasizing the marketing function (Hill 1985, 1989).

Relating Manufacturing strategy making process to objectives chosen

If a firm pursues 'interaction' process for framing manufacturing strategies, then they are unlikely to enjoy economies of scale and hence per unit manufacturing cost is likely to be high. Firms choosing interaction process for framing manufacturing strategies are likely to have facilities for producing differentiated products; and hence are likely to have good 'product' flexibility

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but due to low investments in manufacturing facilities are unlikely to have good 'volume' flexibility. With limited facilities the delivery performance is likely to be adequate; but delivery performance will be unlikely to meet large scale changes in scheduling. Quality is likely to be independent of the process used for framing manufacturing strategy. With interaction process of manufactur-

ing strategy making, quality will depend on the level of skills of manpower; if manpower is skilled the quality is likely to be high. Hence we are in a position to frame the following hypothesis.

Hypothesis 4: Firms, pursuing interaction process of manufacturing strategy making, are likely to have following situation: (i) high per unit cost of production, (ii) high product flexibility and low volume flexibility, (iii) medium delivery performance, and (iv) high quality due to skills of labor.

Traditional 'rational' process of strategy making led manufacturing to choose specialized facilities. Here entire manufacturing is geared towards a single objective, usually to have low per unit cost of product. Product flexibility virtually very low. Tool engineering can be emphasized to enable plant to manufacture similar type of products in an attempt to enhance product flexibility. These plants have a very high volume flexibility. Since production rate is very high, the delivery performance is usually very high. High quality machines ensure high quality of products that are produced. Hence we are in a position to state the following hypothesis.

Hypothesis 5: Firms pursuing 'rational' process of manufacturing strategy making are likely to have following situations (i) Low per unit cost of manufacture, (ii) High volume flexibility but low product flexibility, (iii) High delivery performance and (iv) High quality products due to superior capability of machines. Firms pursuing bold process of manufacturing strategy will in general proactively invest high amounts in productive facilities. The per unit cost of product is likely to be high.

Hypothesis 6: Firms pursuing a bold process of manufacturing strategy making are likely to have the following (i) High cost of manufacture, (ii) In general both product and volume flexibilities are likely to be high and (iii) Delivery performance is likely to be high.

Relating manufacturing strategy process manufacturing decisions

Herein six factors of manufacturing decisions, are dealt with which are: (i) organisation structure (ii) Facility (iii) capacity (iv) vertical integration (v) scope and new products introduction (vi) vendor relations.

Organisation

The structure of an organisation and its strategy making are highly interdependent and must be complementary in many ways to ensure good performance.

Integrative liaison devices like task forces and coordination committees can encourage rationality in decision making. They precipitate contact among decision makers that may motivate systematic attempts to develop, scrutinize, and reconcile divergent perspectives. Integrative devices can also induce interaction. Committees increase face-to-face contacts among managers. They promote consultation, useful exchange of information, and worthwhile debate. Integrative devices also increase assertiveness, uniting the perspectives of decision makers and emboldening them to make decisive and proactive decisions.

Formalization leads to the use of formal procedures and job descriptions, cost and quality controls, specialists and professional technocrats increase analytical capabilities and expertise needed for systematic and overtly rational modes of decision making. Specialization and technocratization involve many managers in any given issue and thus can induce highly interactive decision making. Formalization of policies and procedures however reduce assertiveness. People may ignore decision making stimuli that no formal system monitors so their firms respond only to obvious and pressing problems.

Centralization discourages rationality by placing most of the onus of decision making on top executives. It impedes analysis and planning. It also diminishes a felt need for interaction by inducing conformity in methods and goals via power structures rather than through discussion. Centralization can free top managers to be assertive-venturesome and proactive—because they have more power to commit significant resource to a project. It is possible that assertiveness is less hazardous in the context of a decentralized structure, where decision making is a participatory endeavor. Hence we are able to state the following.

Hypothesis 7: Interaction process of manufacturing strategy making will lead to high integration, low formalization, and low centralization; integrated process of manufacturing strategy will lead to high integration, high formalization and high centralization; whereas bold process of manufacturing strategy will lead to low integration, low formalization and high centralization.

Facility

Firm especially with interactive strategy can choose multiple facilities or target to have a large integrated single facility. Size of facilities and their focus can be different. Disadvantages of incrementalism such as lack of integration etc. will be sought to be reduced by having multiplant strategy. Integrated manufacturing strategy process will tend to have single facility plants

which will tend to seek economies of scale of various kinds. Firms with bold manufacturing strategies could have either single or multiple plants. Firms with single facilities shall tend to reduce risks by having cost advantage; whereas firms with multiplants shall reduce risks by competing in multi product markets.

Firm especially with interactive strategy can choose multiple facilities or target to have a large integrated single facility.

Hypothesis 8: Firms following interaction process of manufacturing strategy making are likely to follow multi-plant strategy; firms following integrated process of manufacturing strategy making are likely to have single plant wherein various decisions would be taken in a such a manner to produce synergy. Firms with bold process of manufacturing strategy making may decide to have single plant facility to have cost advantages or have multiple plants to spread out risks.

Capacity

Firms following interaction process of strategy will be facing extremely uncertain environment and hence add capacities in an 'incremental' fashion, and hence may have low capacity utilization. Firms following 'integrated' process of manufacturing strategy will be facing 'stable' environment and hence have a high utilization. Firms following bold process of manufacturing strategy will be encouraged to add large capacities as they have high capacity utilization. Hence the following may be stated:

Hypothesis 9: Firms following respectively interaction, integrated and bold processes of manufacturing strategy will have respectively low, high, and high capacity utilizations.

Vertical Integration

Firms following interaction process of manufacturing strategy making are likely to make much smaller investments in productive facilities and hence are likely to have low vertical integration. Firm with integrated process of manufacturing strategy making make substantial investments in productive facilities and are likely to have high vertical integration. Though they may reduce investments by entering into joint ventures with suppliers. Firms with bold process of manufacturing strategy making with emphasize flexibility and as a result have moderate vertical integration. Hence we state the following hypothesis.

Hypothesis 10: Firm with respectively interaction, integrated and bold process of manufacturing strategy will have low, high and moderate level of vertical integration.

Scope and New Products

Firms with interaction process of strategy making have general capability productive facilities and hence are able to introduce new products into the market. But since a lot of time is spent in consultations before any decision is taken they are expected to have low score on new product introductions. Firms with integrated process of manufacturing strategy making have productive facilities with specific capabilities and hence are able to introduce products with highly similar features. Firms with bold process of manufacturing strategies have the capability to introduce new products frequently. Hence we are able to state the following.

Hypothesis 11: Firms with respectively interaction, integrated and bold processes of manufacturing strategy making have high, low and very high scope of introducing new products.

Vendor Relations

Firms with interaction processes of manufacturing strategy have low vertical integration and hence depend a lot on vendors. Hence vendors have more bargaining power. Hence these firms go in for competitive relationship with vendors. Firms with integrated process of manufacturing strategy have high level of vertical integration and depend on vendors only for low technology items and hence have very high bargaining power. They can go in for very competitive relations with vendors but usually they take a co-operative vendor relations stance to assist vendors to meet quality and delivery demands. Firms with bold manufacturing strategy process go in for competitive vendor relations strategy and the vendors in general have a higher bargaining power.

Firms with interaction processes of manufacturing strategy have low vertical integration and hence depend a lot on vendors.

Hypothesis 12: Firms with respectively interaction, integrated and bold process of manufacturing strategy making go in for competitive, co-operative and competitive vendor relations; and also vendors have respectively high, low and high bargaining powers.

Methodology and Data Analysis

A questionnaire in four parts has been prepared. First part (Miller, 1987) deciphers the corporate strategy making chosen by the firm. This was filled up by the general manager/president of the firm. Second part is the questionnaire prepared by authors themselves which helped to infer manufacturing strategy process used by the firm. This was filled up by vice-president (manufacturing) of the firm. Third part of the questionnaire was geared to decipher the specific objectives pursued by the manufacturing function. Fourth part contained questions which helped us to infer the pattern of manufacturing choices the company has made. The questionnaire is available in Shivanshu (1997).

A pilot study was conducted by the authors by choosing 20 manufacturing organisations around Kanpur city to verify hypotheses as per given conceptual framework depicted earlier. Detailed data can be found in Shivanshu (1997).

Table 1: Corporate and Manufacturing Strategy Process Pursued by firm

Corporate strategy making process	Nos. of firms	Manufacturing strategy Making Process	
Rational	8	Integrated	4
		Integrated and bold	2
		Bold	2
Rational and Interaction	2	Integrated and bold	1
		Interaction	1
Rational and Bold	1	Integrated and Bold	1
Interaction	2	Interaction	2
Interaction and Bold	1	Integrated and Interaction	1
Bold	6	Bold	4
		Integrated and Bold	1
		Integrated and Interaction	1

It can be seen from Table 1 that firms use pure strategy making processes (such as rational, interaction and bold) as well as mixed strategy making processes (such as rational and interaction; rational and bold etc). Out of eleven firms having "rational" process strong component in corporate strategy making process, eight firms had used "Integrated" manufacturing strategy making process. This lends a good support to hypothesis one. It can also be seen that out of five firms having "interaction" process as a significant component of corporate strategy making process only three firms used such a process. This lends support to hypothesis

2. Also out of eight firms with 'bold' corporate strategy making process, five had 'bold' manufacturing strategy making process. This supports hypothesis. Though the sample size is low, it has substantial support to hypotheses 1-3. Two firms with 'rational' corporate strategy process had also 'bold' manufacturing strategy process. Also one firm with 'bold' process of corporate strategy making had 'integrated interaction' manufacturing. This points to gap between corporate and manufacturing managers as pointed out by Skinner (1969). These confirmations are in addition to those obtained by Sharma (1997).

It was further found that firms used 'mixed' process of strategy making for framing both corporate and manufacturing strategies. Further research may take this into account.

Table 2: Self Report Measures on Performance on Objectives given by Manufacturing Dept. Chief for their Firms

Manufacturing strategy making process used	Cost/ Unit Manufactured	Volume Flexibility	Product Flexibility	Quality of Products	Delivery Performance
Integrated	1.4	3.80	3.33	4.40	3.6
Incremental	1.3	3.20	2.50	4.30	3.2
Bold	1.3	3.71	3.50	4.35	3.7

Manager's evaluation of firms cost of manufacture w.r.t. competitors, volume and product flexibility quality of products and delivery performance was recorded on a scale 1 to 5 (Table 2). Incremental manufacturing strategy making process has low cost/unit and low product flexibility manufactured which negates hypothesis 4. But Low volume flexibility and medium delivery performance for interaction manufacturing strategy making process gives support to hypothesis 4. Low cost/unit manufacturing, high volume flexibility, and high delivery performance for integrated manufacturing strategy making process supports hypothesis 5. High product flexibility for integrated manufacturing strategy making process negates hypothesis 5. The firm would have appropriately emphasized tool engineering to increase product flexibility. High volume and product flexibilities, and high delivery performance for bold manufacturing strategy making process supports hypothesis 6. Also low cost of manufacture for bold manufacturing strategy process negates hypothesis 6.

On the basis of a regression model, the result of relation manufacturing strategy making process to dimensions of organisation structure are given in Table 3. High integration and low centralization associated with interaction process of strategy making supports hypothesis seven; whereas high formalization

Making TQM Work—Some Critical Issues

S. Nirmala

By now it is well understood that challenging global competition has forced some business organisations in India to adopt various strategies like BPR, TQM and Bench Marking practices. Realizing that these concepts are yet to have a firm footing in the country, the author of the paper examines the importance of total quality management (TQM), especially to its relation to the well understood concepts of organisational development (OD) and human resources development (HRD). In the background of social and cultural contexts, the author suggests optimal strategies for successful implementation of TQM in Indian industry.

S. Nirmala is Director (HRD) at Ascent Consultants and Trainers (P) Ltd, Hyderabad.

Introduction

Global competition, has forged Indian Companies to experiment with various strategies like Business Process Re-engineering (BPR), managing core competencies, Bench marking practices and Total Quality Management (TQM), with a sudden sense of urgency. Quoting issue of from Business Today, 3rd Anniversary (Jan. 7-21, 1995). "Three years after liberalisation, you may be busy managing your core competencies, restructuring, and diversifying. But you won't win the new global economy unless you manage the only Paradigm of competition tomorrow."

The Quality Revolution

Considering the premise that TQM is strategy based on Organisational Development (OD) and Human resources Development (HRD) philosophies, the following aspects are dealt in the present article:

- Similarities between TQM and OD.
- TQM implementation in different cultural contexts.
- Critical factors of the Change programme.
- Strategies to make TQM work in Indian cultural context.

TQM Philosophy

Although the debate that whether Total Quality Management (TQM) is a part of Organisation Development (OD) Intervention or OD is a part of TQM is still inconclusive, there is enough evidence to agree that the philosophies, values and practices of both these concepts have great similarities at the core.

Bowen and Lawler (1992) and Hackman and Wageman, (1995) have noticed close collaboration, integration and common values between TQM and OD.

Lindsay and Petrick (1997) have established the convergence of TQ and OD concepts and viewed OD as a TQ Approach; thus they found that TQ based OD approach involved employees extensively, within and between levels and functions, as a way of life. Kandula (1997, p. 15-30), concluded that TQM is an OD intervention. Of several convergent factors identified by him, those relating to TQ and HRD are given below:

- Quality means leadership.
- TQM creates a participative environment... involving employees in all the levels in the decision making, which is defined now as employee empowerment.
- TQM is concerned with culture and it emphasises the importance of attitudes.
- Behavioural process is central to TQM.

Thus, like in any OD effort, organisational transformation through TQM, warrants a thorough understanding of principles behind human behaviour and the culture of the organisations society and nation.

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TQM Implementation

Bringing Organisational transformation through TQM is more easily said than done. Thus the firm, Organisational Dynamics Inc. (Business Today, 1995, p. 85) reported that over 70 per cent of TQM initiatives world over failed, due to improper implementation strategies. Bill Creech, on extensive study of TQM Practices in US based companies, concluded that Japan's success in TQM was a result of its cultural advantage. The major cultural factors such as the work ethics, savings ethics and company loyalty are cited for Japan's success. Discussing elaborately on the steps taken by US-based Toyota company at NUMMI (New United Motor Manufacturing Inc.) – a General Motors (GM) – Toyota venture at California, Creech pinpoints that the centralised manager-ship system of GM was a roadblock for change. Eventually, success did not come through until a complete transformation of management style from GM's centralised system to Toyota's decentralised system took place. *Abandoning the traditional the traditional management style was the only way to successful TQM* (Creech, 1994).

Again, Scott Sink (1991) noted that resistance to change was the number one roadblock to performance improvement in America.

All these observations clearly imply that bringing about change through TQM is a formidable challenge. Unless the basic resistance factors are isolated and addressed, it is difficult for TQM to succeed without a supportive culture.

Unless the basic resistance factors are isolated and addressed, it is difficult for TQM to succeed without a supportive culture.

TQM Scenario in India

Although it is a widely acknowledged philosophy and culture for improving the organisational performance, but only a few Indian organisations are ready to implement TQM.

Chakraborti (1997) observes that while 'Culture Change is the soul of success for TQM', implementing TQM in India is tough because of many reasons. He identified several cultural and social problems like:

- Lack of shared vision and common understanding on Quality.
- Poor commitment across the levels.
- Inadequate methods of convincing members.
- Insufficient mechanisms to overcome the hurdles of implementation.
- No understanding on how difficult it is to bring about change in attitudes.

Ajit Singh (1991) found that quality comes mainly from people, as a result of attitudes and values and not by technology alone. As TQM promises change in organisational culture, it is advocated that unless the TQM drive aims at attitudinal change, divorcing stereotype beliefs and promoting conducive leadership styles, it may not be feasible to introduce it.

With the dire need for TQM on one hand, and the formidability of implementing it on the other, the change agents, both external and internal, are zealously trying different strategies for successful implementation. *To bring about changes in the individual mindset and organisational culture, spotting the key factors that influence the change, acquires importance.*

respond to this expectation, the workmen need to identify their potential, empower oneself, shed the dependency syndrome and participate productively with concentrated effort. Keeping the social and familial background of the employees, an attitude-development programme must be planned which should address the issues of individual quality, family quality, work quality, product and service quality and organisational quality. Besides attitudinal change, the workmen must be exposed to the practical functioning of a TQM company and the effect it has on self satisfaction and personal growth. Unless there is a visible change in the actions of the top management, and congruence between their talks and deeds exist, the response of the workman would only be lukewarm. Trust needs to be built at all levels of personnel.

Attuning Structure and Systems

To get optimum mileage out of their TQM efforts, companies must redesign their structure in consonance with the expected accountability at all levels. Certain Indian companies are experimenting with fluid organisational structure that are highly organic in nature, like Amoeba structure.

Suitable changes in the systems of Compensation, reward and appraisal must be adopted. Bringing about policies that reward the participative styles of functioning as group incentives, 360-degree performance appraisal and profit-sharing plans may be helpful in implementing TQM package.

Managing Organisational Dynamics

By putting proper structure and systems in their places, incidence of politics and power struggles can greatly be reduced. However, in politics-ridden organisations, surgical approach of identifying and isolating the trouble creators who trigger conflicts, needs to be done to ensure smooth implementation of change strategy. Conducting Power labs, to locate one's power sources and styles, and help in evoking inner strengths can yield good results. Helping individuals to depersonalise power and to grow towards Social power would have tremendous effect on the dynamics. Insecurity arising out the change efforts, must be carefully noticed and addressed. The intentions must be declared explicitly through continuous communications.

"Being sensitive to the reactions of Change programmes is a pre-requisite to a good TQM programme. The Change-agents must be adept in handling these situations and anticipate the likely effects at every stage".

Being sensitive to the reactions of Change programmes is a pre-requisite to a good TQM programme. The Change-agents must be adept in handling these situations and anticipate the likely effects at every stage.

Transition management

Many of the Change programmes that are initiated by a single individual at the top, will collapse when he/she is separated from the company. Care needs to be taken in initiating change and providing long-lasting impact. Smooth transitions of the key Top personnel is achievable through institutionalising the changes to ensure permanency. By aligning the organisational goals and change efforts, institutionalising is possible.

Same is the case with the Change agents also. Whether external or internal, the timing of withdrawal of the change-agent is very crucial. Too early or too late withdrawals can be suicidal to the change. To counter this, a small group of change agents within the organisation must be identified and trained from the very beginning. This will fill the void arising out of the withdrawal of the facilitator.

Expanding the boundaries

The total quality concept should be extended beyond the organisational boundaries to social institutions like families, Schools, neighbouring communities, will make the changes permanent. In developing a total quality individual, one important aspect is the family quality. Periodical interaction with the families of employees and making them a part of the developmental process will make the changes more permanent. Developing the communities around the organisation will not only have a symbiotic effect on individual and society, but also gives the much needed publicity which helps in internalisation.

Ensuring smooth transitions in management, developing internal change agents, involving the larger segments of the society in the Change process—can go a long way in making TQM a way of life.

Conclusions

In the context of globalisation of Indian economy and the prediction that India will emerge as an economic super power by next decade, Indian industry

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needs to prepare itself to face the formidable challenge with all enthusiasm. In helping the Industry become world class, among other change strategies, TQM seems to be holding the promise.

The experiments with TQM world over, were not as encouraging as they were in Japan. It demanded a sea change in the styles in which the organisations were managed earlier. Paradigm shift in managerial attitudes was a pre-condition to success to TQM. The TQM scene in India is no different. In fact, to make TQM work, the following efforts need to be attempted zealously:

- Transformation of mindset of individual—both at managerial levels and at workmen level, through value-clarification and value-building exercises.
- Aligning structure and systems with TQM culture.
- Managing organisational dynamics to keep the perils of power games and politics at bay, by empowering the employees.
- Managing transition during the withdrawal of internal and external change agents, to ensure smooth shift.
- Expanding TQM arena beyond the boundaries of organisations—to the families, communities and the society, to make it a way of life.

Practicing TQM is more easily said than done. The challenge is alluring, yet formidable. Implementing TQM is a long drawn process. It has no shortcuts. Patience and perseverance are the key words in Change management. Lest, the success eludes.

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Advanced Quality Planning: Accelerating Product Development

Rejenna Chu and Jiju Antony

Rapid development, fierce competition and the intricacy of products and processes have increased the quest for Advanced Quality Planning (AQP) in the early stage of product/process development. Advanced Quality planning is a structured procedure which will assist organisations to ensure all key features and characteristics of the product/process have been considered, evaluated and performed thoroughly. The present paper illustrates an investigation and analysis of AQP in a manufacturing environment. The benefits of AQP in a manufacturing environment are also presented. Some useful guidelines for the application of AQP are also illustrated in the paper. The paper highlights the current AQP procedure in a company and problems for its implementation.

Rejenna Chu and Jiju Antony are at Portsmouth Business School, University of Portsmouth, Portsmouth, UK.

Introduction

As international competition increases, customers are becoming more demanding in terms of the quality, value, appearance and functionality of the products they buy. To be a successful company, fast response to customer demands and requirements are needed. For any manufacturing organisation, customers' expectations are changing and are demanding products that more exactly suit their needs. Successful companies now need to produce products that are right for the customer, are available in advance of the competition; offer more features, more variety and better performance. These requirements indicate that companies have to consider their approach to the new product development. However, a well product development planning programme is a key element for an effective product design and development. In order to design quality into the product at the product development stage (Advanced Quality Planning (AQP) is essential.

Advanced Quality Planning

New products are imperative to the competitive advantage, of which product development and product introduction are strategic processes. AQP process is one of the processes that has the greatest impact on the strategic success of the organisation. AQP can simply be described as:

- Planning for Quality in advance into the product
- Quality planned into the product at the earliest design stage
- Multi-disciplinary teams to implement a new product manufacturing environment
- Planning for the interface between concept design feasibility study to pre-production

AQP is one of the processes that has the greatest impact on the strategic success of the organisation.

- Planning in advance for effective manufacture
- Structured procedure which focus on developing superior product development processes
- Planning to ensure adequate technical interface between functional departments (e.g. Design, Manufacture Engineering, Quality, Production, Sales, Purchasing etc.)
- AQP is a part of the Production Preparation Management System (PPMS) (Nissar Motor Co.,)
- AQP is a proactive approach towards coping with change
- It is an essential constituent for the generation of new products and processes, Dept. of Trade & Industry, 1994
- Plan to ensure all key factors of the product/process development have thoroughly considered, evaluated and performed
- AQP is a cross-functional process involving all the key functions within a company

AQP as a Documented Base Quality System

To achieve this, for ensuring delivery of zero defect products the suppliers have to conclude a quality system which encompasses continuous review and development of management, product design, material specification and manufacturing process. In other words, the suppliers have to establish and maintain a documented quality system as a means of ensuring that product conforms to specified requirements. This is a quality system procedure, which is consistent with the requirements of the standard. This requires AQP to be organised as a world class. A World Class Product Introduction Process or Product Development Process should consist of the following elements:

- Joint project teams, incorporating staff from customers and suppliers
- Cross-functional project teams with team members nominated from various functional departments and also with representative from the suppliers manufacturing. And the project teams are well trained and supported by the organisation.

- A standardised process flow chart for the project introduction process, using a standard terminology and indicating the approval review points.
- An effective engineering and manufacturing change control mechanism, supported by generic platform product concepts embodying standard modules and common hardware and software components to reduce variety and cost and increase quality and availability.
- A standard software-based project support system, using standard project planning and report forms.

AQP and New Product Development

There is a need for rapid and effective new product development because AQP assists (i) increases in aggressive global competition; (ii) companies in the development and application of new technologies; (iii) organisations to reduce product cycle times and (iv) as powerful tool for increasing customer choice and customisation.

Benefits of AQP

The following are some of the most common benefits of AQP in a manufacturing environment.

- Reduce the cost of product development
- Minimise the changes on product/process designs during the product developing stage
- Respond to product/process change quickly and effectively
- Creates added-value performance of the company in the future
- Provides potential impact of early design for manufacturability
- Achieve a higher confidence in the manufacturing process
- Avoid the chance for an excess of last-minute changes prior to launch
- Maintain cost-effective and rapid response to the customer needs.

AQP Procedure Manufacturing

A Company X (identity withheld) has been a supplier of parts for the major motor manufacturers. In the

initial stage, company X was examined and evaluated in terms of its structure and responsibility hierarchy concerning quality.

Company Investigation and Analysis

In the second stage, the aim was to verify the company's existing Advanced Quality Planning procedure. The company quality control procedure for AQP has been reviewed at various levels through a series of internal interviews and informal auditing with different functional departments; those departments are related to the quality planning and involved in the product design and development process. Over 30 individuals from various departments within the company were interviewed, which included Design Engineering, Manufacturing, Quality, Purchasing, Tooling and R&D for assessing their involvements in AQP. The results of the interview have revealed that half of the people did not know the existence of this procedure. A brief flow chart of the Quality Planning procedure was outlined, which showed the interface between the different functions within company X.

A 'Three Level performance' criterion (Rummler and Brache, 1990) was used as an examination tool to examine company X's quality planning system including the 14 key elements of AQP. Non-compliance areas of the current AQP procedure in company X was highlighted and evaluated. Relationship Maps and Process Maps were developed (Rejanna Chu, 1995). Relationship map views the company as a system and highlighted the interface disconnects of the company; Process Map is used as a document based monitoring system. Company X's existing written procedure in AQP was benchmarked against a leading world motor manufacturer's AQP procedure (Ford Motor Co., 1990).

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Results

AQP had not been used properly in company X due to the following factors:

Inadequate structured AQP procedure: For the company X's manual was only brief guidelines and there were

no instructions. A procedure to ensure quality product design and development was not available.

Lack of support of a structured internal product development programme: Some of the company X's customers provided document based Quality Management System Standards to company X, to ensure the required high standard of product design and manufacturing process to be achieved. However, these resources had not been used properly due to the lack of internal support.

Lack of effective quality management system: There was no monitoring system to countercheck whether customers' specified quality management system or internal quality procedure (although limited) were in place.

Incomplete team approach and ineffective internal communication: Communication within project team was inadequate. There was no defined system or individual to co-ordinate the team. Company X had no effective internal communication system such as computer based project management network or engineering data management system. People often interpreted decisions in their own way, created data based on their own assumptions and didn't communicate freely and informally with their project team members. As a result, company X:

- Requires the support of a structured internal product development process as a systematical framework and the current AQP procedure being updated
- Must restructure and redefine the multi-discipline cross function team
- Must develop an effective internal communicating and cooperating system
- Must establish a monitoring system for the project progress
- Redefined and remodeled product development process.

Guidelines for the Application of AQP

For successful AQP implementation, following steps are necessary.

Organising Cross Functional Team: The important part of the planning process are organising Cross Functional Team and establishing Project Timing Plan. According to the world class company practices, effective quality planning and defect prevention should be integrated into the development, maintenance and im-

Design Engineering, Quality Department, Manufacturing Department and Purchasing

- Production of a complete AQP process package; with which the related responded person would be aware of their own concern areas as well as of others

- Constructing a flow chart which shows the entire Advanced Quality Planning process with major functions and prime responsibilities within the scope of Product Design

- Establishment of development process and a process map for the AQP

- Rewriting the procedure with the responsibilities and authority of all the concerned employees clearly redefined and communicated

- Publication of AQP procedure internally for educating everyone

- Enlarging the New Product Development Process flow chart and put it in on display

- Display all the current project progress status for easy noticing of all the employees.

Problems

AQP requires highly individual discipline. If the team members do not take their role properly, the whole project will be loaded to one person; normally to the project team leader or team manager. Due to the incomplete traceability system, and if there was change in job role, the new person may not be able to take up the previous work and follow the project progress. If the executive manager (s) do not put effort to use AQP in place, in terms of providing resources, it would be less successful in applying AQP. AQP procedure often stuck in the medium stage due to various changes and found difficult in doing all the time consuming paper work which required with AQP.

One of the difficult problems that authors found was benchmarking the current company's procedure against another one. The benchmarked items were not quantified.

AQP requires highly individual discipline. If the team members do not take their role properly, the whole project will be loaded to one person; normally to the project team leader or team manager.

improvement efforts of different functional departments within a company. The project teams should assess the feasibility of the proposed design and manufacturing processes to meet all programme objectives. Throughout the feasibility and development phase, the quality planning team should consult with all employees who will be affected by the project.

Establishing Project Timing Plan: Timing key events and actions and this function are to be taken by planning team during Quality Planning process.

Customer's Needs: The early stage of Quality Planning process is designed to assure that the customer's requirements are understood to enable fully consideration during product design and development stage.

Design Review/Development and Feasibility Analysis: This assumes a comprehensive and critical review of the company engineering requirements and other related technical information. A preliminary feasibility analysis has to be made at this stage of the process to assess the potential problems that could occur during manufacturing.

Manufacturing System and Control: This assures the comprehensive development of an effective manufacturing system, which must ensure that the customers requirement (in the form of product design requirement) are understood, deployed and controlled in manufacturing and assembly processes. A control plan will be established to monitor manufacturing capability.

Process Verification: Finally, the adequacy of the manufacturing system and its related controls is verified. The manufacturing system must ensure that the customer's requirement (in the form of engineering requirements) are met and verified from the "voice of the process".

Application of AQP

Responsibility and authority for the Quality Planning procedure in the company X need to be clearly defined and communicated. The suggested measures are:

- Rewriting of company Product development process procedure
- Updating of each department's procedure manual with the area related to the rewritten Product Development Process. This includes

The following issues describe some of the most commonly encountered problem areas:

- Not fully understanding the benefits of the application of AQP
- Lack of management support
- Communication barrier among the people from the multi-disciplinary departments
- Lack of resources and budget for training people in AQP
- Inadequate or insufficient motivation for people involved in AQP process.

Conclusions

Advanced Quality Planning is a powerful tool for product design and development, especially in a manufacturing environment. Organisations should start applying AQP and take this process into account during business planning process. AQP procedure is a simple process which every organisation should make every effort to apply and the result of cost effective product and process development can be easily achieved. In any organisation, more attention should pay to the

process rather than just the product itself, the design and development team should move from firefighting, crisis management to the controlled management. The above AQP procedure has been taken into consideration by the company and the process of implementation will be carried out at a later stage of the research.

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Impact of Information Technology and HRD in the Indian Army

R.D. Pathak and S.K. Tripathi

The world today is in transition from industrial age to information age. The information technology (IT) revolution is making a tremendous impact on the industry and trade and has changed the concept of HRD world wide. The telecom sector has witnessed major technological innovations with the introduction of mobile communication, value added services and digital audio and video broadcasting. The defence forces have not remained isolated from the advancement of IT and Telecom industry. The Indian Army is the third largest in the world with 40,000 officers, more than a million men and Rs. 50,000 crores of inventory. To fulfill its role of security of the country from external or internal threats, there is a need to improve computer literacy and IT awareness in the army. During its training courses for IT in defence, the approach towards design of software syllabus needs to weigh heavily in favour of user friendly commercial and organisational software packages and familiarisation with information exchange in computer networking environment. For the organisational HRD, IT tools can be employed for computer based instructions, weapon control system simulators and wargaming.

R.D. Pathak is Senior Professor and Dean of Faculty of Management Studies, Head of School of Distance Education and Chairman of School of Defence and Management Studies, Devi Ahilya University, Indore and S.K. Tripathi is a research scholar in the Institute of Management Studies, Devi Ahilya University, Indore.

The Army can change its approach towards electronic media based distant education by procurement of multimedia PCs for its sub units and supplying training material on floppies and CDROMs. Automation of libraries to store training material on digital media and creation of an educational network on Intranet technology are recommended. As a long term perspective, creation of a virtual Defence University to control all educational activities deserves serious consideration.

Background

Information Technology (IT) Revolution

The world today is in transition from industrial age to information age. The IT revolution is making a tremendous impact on the industry and trade by relentless technology innovation, massive growth in computer power, worldwide networks and ever-growing electronic factories.

The world today is in transition from industrial age to information age. The IT revolution is making a tremendous impact on the industry and trade by relentless technology innovation.

The telecom sector has witnessed major technological innovations with the introduction of mobile communication, value added services and digital audio and video broadcasting. The convergence of telecom and computers in networks has further advanced the scope of communication equipment by bringing a wide range of improved products. This sector is likely to experience a substantive boost in the coming years due to liberalised policies adopted as a result of national telecom policy, which aims at providing access to basic

The revolution in IT and Telecom sectors have changed the concept of HRD worldwide. Managers at all levels are acquiring skills to handle IT to their advantage for systematic information handling to streamline the decision making process. The business organisations aim to provide an environment of job satisfaction and opportunities of self development to their managers, by offering courses of updation in the areas of telecom and IT advancements, with an ultimate view towards enhancement of their performance for benefit of the organisation. The private sector is acquiring the latest IT equipment and is fast becoming dependent on office automation and computer networking for easy and efficient management of information. Every management training institution is conducting courses for its trainees in IT awareness for overall development of the students. To meet the demand of the market, management schools are on the increase. The tech-

Impact of IT on Human Resource Development (HRD)

The funds to the defence forces are provided by the government annually in the form of a defence budget of which lion's share goes to the Army which is the largest security force. The statistics reveal that average GDP growth of the country has risen from a 3.49 per cent in 1955 to 6.80 per cent in 1996 with the defence expenditure remaining at 2 to 3 per cent of the GDP during this period and actually declining from 23.50 per cent of the central government spending in 1955 to 14.13 per cent in 1996. The budgetary constraints have slowed down the modernisation process of the Indian Army in various fields of growing technology including the area of IT (Mehra, 1997).

The Army and various para military forces. The Indian Army, which is the third largest in the world with 40,000 officers, more than a million men and Rs. 50,000 crores of inventory, is making use of IT in the form of main frame computers, personal computers with their various accessories and the telecommunication network spread all across the country (Singh, 1997). The Army represents diverse culture of the country as its manpower intake comprises of people from every part of the country and all walks of life. It recruits approximately 800 candidates every year to be trained as young officers. To fulfill its role of security of the country from external or internal threats, the Army remains deployed along the vast borders ranging from snow clad mountains and hot deserts to open plains and inhospitable jungles. In addition the Army remains involved in various states in low intensity conflicts to control insurgency and helping the civil administration during famines like floods, earthquakes, accidents and riots.

The defence forces have not remained isolated from the advancement of IT and Telecom industry. Defence forces in the country comprise of the Army, Force, Navy and various para military forces.

The defence forces have not remained isolated from the advancement of IT and Telecom industry. Defence forces in the country comprise of the Army, Force, Navy and various para military forces.

- (a) Proliferation of wireless technology, especially cellular telephones, to provide countrywide mobility to a subscriber (ct 'Miles to Go', Computers Today, April 1997).
- (b) Pagers are spreading widely to all parts of the country as they provide cheap and efficient services.
- (c) Electronic mail (E mail), currently being used by approximately 31,000 subscribers, will grow to a figure of 50,000 users by end of 1997.
- (d) Very Small Aperture Terminals (VSAT) for satellite communication are fulfilling the need of data communication of the corporate sector as they overcome the terrestrial barrier and poor telecom infrastructure.

Planning Commission, in the 9th Plan projection, has predicted a spectacular rise in Internet and E mail users besides the use of mobile phones and pagers. A sharp rise in video conferencing (presently provided only at four metros by VSNL) is also anticipated. Major areas of telecom thrust in the country are:

The business organisations aim to provide an environment of job satisfaction and opportunities of self development to their managers, by offering courses of updation in the areas of telecom and IT advancements,

telecom services of world standards at an affordable and reasonable prices and envisages that India will emerge as a major manufacturing base and exporter of telecom equipment ('Electronics For You, Indian Electronics Industry on the Fast Track' Report, July 1997).

Technology management education should therefore evolve a curriculum that meets the needs of the people above and below the level of top technical managers. The type of education programme needed by the industry would provide management courses

would go greater demand in India (Goel, 1997). education (Negi, 1997). Progressively these new tools media and virtual reality have had profound impact on animation, speech and music on a computer, multi-Adoption of newer concepts like graphics, interfaces, browsing on the world wide web (Prashant, 1997). a reality by way of education through Email and web delivery which makes the concept of classroom at home munication is a very strong medium of education maps etc. with sound and video added. Internet com- amount of material in the form of documents, pictures, networking may not be cost effective. They store large ideal option for education to the remote areas where dents. CD-ROMs run on a multimedia PC and are an specialists can talk directly to a large number of stu- delivery as the best teachers, noted personalities, and which offers an excellent opportunity in the education the broadcast channels TV is a very powerful medium (direct to home) service. Out of these electronic tools, bringing satellite channels directly to homes by DTH via ERNET and INTERNET and a futuristic concept of CD-ROMs for large capacity data storage, networking and TV broadcasts, cable TV, tele-education through satellite and video conferencing, floppy diskettes and projector, overhead projector and LCD projector to dis- tant education tools like audio and video tapes, radio have already progressed from classroom aids like slide nological tools for delivery of education at these schools

- Largeness of the organisation makes HRD a challenging task, both during planning and im- plementation stages.
- Spread of the organisation across the country divides HRD thrust into two streams—firstly training at all Army stations and secondly at various training establishments located in dif- ferent parts of the country.

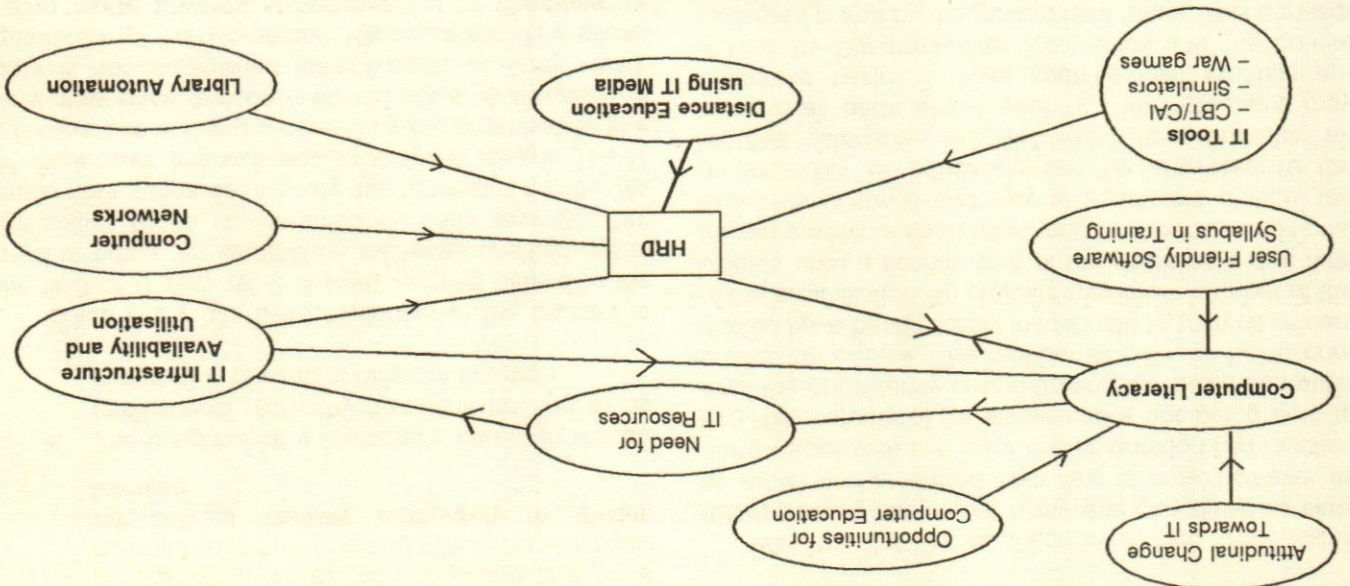
IT and HRD in Indian Army

Indian Army as an organisation is characterised by a few aspects, affecting its HRD plan, thus influencing the thrust areas in the long term:

Large companies should consider building a technology management education programme that bridges the gap between technical education and management training.

focused on challenges of managing technical people, project management, interpersonal skills, technological information, forecasting, business strategies, and tech- nical updating. Large companies should consider build- ing a technology management education programme that bridges the gap between technical education and management training. Universities must develop such alliances with technical schools and engage in research in the field (Welmer, 1991).

Fig. 1. HRD Model in Indian Army



As the Army follows a rigid chain of hierarchy, the attitude of the senior class rubs on the whole organisation down the chain and ultimately causes setback to the slowly evolving computer culture.

Since the inception of EDP policy in early sixties and during its implementation to provide computer hardware for training of men and its subsequent exploitation for automation, there have been inordinate delays in procurement of hardware due to financial constraints and various other factors. As a result, the procurement process has met with either the cost or the technology overrun many a times. The non availability of hardware has resulted into the computer knowledge of the personnel remaining largely unutilised and has hampered the process of self development after acquisition of basic skills and also the orientation of non-qualified men. The organisation needs to take a serious view of this shortcoming and procure hardware on an urgent basis to improve the computer literacy. As the Army follows a rigid chain of hierarchy, the attitude of the senior class rubs on the whole organisation down the chain and ultimately causes setback to the slowly evolving computer culture. An attitudinal change among the senior officers towards acquiring and utilisation of

the organisation. ten years of service to enter middle managerial level in computer literature before they cross the threshold limit of evolves from the premise that all the officers must be expenses borne by the government funds. This concept proved by Department of Electronics and the course undertake basic 'C' level courses with syllabus applied in all parts of the country. The institutions may reputed institutions, like NIIIT, which have branches all responsibility of education can be entrusted to the expenses of travel and stay at a different station, the measure within a short span, and to minimise additional officers upto a service limit of ten years as a one time of the organisation. To educate maximum number of oriented have been grossly inadequate to train all officers orientation course. The number of courses being conducted all the opportunity of undergoing the basic computer into the majority of its officer cadre not being able to narrow approach and poor implementation has resulted as sixties and amended from time to time, however, its (EDP) training plan in the Army was conceived as early

Computer Literacy

- The diverse manpower intake creates the need of training in a common language and on a common platform resulting into more emphasis on contact classes compared to distant learning.
- The progress of a manager's career in the organisational hierarchy demands training to be imparted in phases at different intervals.

Indian Army has been a pioneer in the country in the field of IT and yet it is sadly lagging behind in the present times. Its automation plan was chalked out in the sixties to be implemented by early seventies but could not materialise properly due to various constraints of manpower, finances and processing delays. The IT infrastructure is being procured by the organisation at a very slow pace and on a limited scale. Automation of data is not streamlined except partly at Army Headquarters and five Command Headquarters. The efforts being made towards standardisation of database for streamlining the flow of information are extremely sluggish basically due to largeness of the organisation and its spread across the country. Computer networking still remains a distant dream (Kar, 1997).

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Considering the advances in the field of IT utilisation for training worldwide, and organisational characteristics of HRD in the Indian Army, a framework emerges of HRD and the factors influencing its approach. Computer literacy and HRD are interdependent. The officer cadre needs to have an open attitude towards IT to have an overall improved computer literacy, which can be helped by creating maximum computer education opportunities for all officers and by teaching user friendly software during conduct of such education programmes. Many other factors like availability and utilisation of IT infrastructure, use of computer networks for education and automation of libraries will provide a positive thrust to HRD. Efficient utilisation of IT tools for training of men in the form of Computer Based Training (CBT), Computer Aided Instructions (CAI), Simulators for complex weapon control systems and Wargames will improve results of HRD. Finally, a different concept of distant education programme emerges with the use of IT media for delivery of education. Finally a model depicting impact of these factors on HRD in the Army is shown in the figure 1.

Teleconferencing, apart from increasing access to higher education, is also found to provide an effective and efficient forum for meetings and training sessions.

Teleconferencing, also known as virtual conferencing due to its interactive nature, uses TV, audio speakers, telephone and FAX technologies to provide on line interaction. It can either be two way video and audio or two way audio and one way video. The latter type is currently being used in India by IGNOU for several of its distance higher education programmes and by a few more organisations as well for conducting meetings and training programmes. Teleconferencing, apart from increasing access to higher education, is also found to provide an effective and efficient forum for meetings and training sessions. It uses satellite uplinks from the receiving ends to connect audio and video signals. Teleconferencing creates an analogue of communication forms that typically occur in a face to face

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A large number of universities across the world are already providing on-line education on Internet to students at faraway locations logging in whenever required to download training material available with the host computer at the university. The defence training establishment of USA (known as TRADOC) through the on development of doctrine, organisation and training for emerging systems towards concept of information dominance in war (Khurana, 1997).

From the learning theory perspective, it can be argued that distance learning supports the socio-cultural model of learning by allowing students to remain embedded in their cultural environment rather than forcing them to adapt to a new culture. Distant learning facilities can be equipped with tools and PCs to enable students to communicate with each other and hence to promote collaborative learning across distances (Leider, 1995; Alavi, 1995).

- The material can be supplied to the student over the computer network or by mailing of floppies, audio or video tapes and CDROMs.
- It overcomes the limit of educating only a fixed number of students in the campus.
- The student can seek immediate queries over the computer network and appear in the examination as and when fully prepared.

instructions, simulators and virtual reality tools are becoming inexpensive day by day. Computer based teaching has become an increasingly used training resource over the past few years. This is successor to the simple audio visual instructional system and thus has proved to be an essential element of the truly integrated training system. The IT resources available with the organisation need to be suitably utilised for such training aids.

The preparedness of any army is dependent amongst other factors, on the standards and quality of training of its personnel and is a decisive factor in war.

With the proliferation of hitech sophistication in the arena of the weapon control systems, the modern weapon systems present a highly complex plethora of equipment with devastating power. Weapon control systems are heavily relying on the advancement of communication and computer technology based on dedicated and intelligent computers for path assessment of the target and guidance of the weapon after launch. Use of computers as simulators of weapon control systems for training of men in peacetime in an expensive and effective utilisation of IT.

To train the army for endless eventualities of war is a costly proposition. To economise the cost and yet be able to enhance decision making skills of the officers and men, as also to try out new tactical doctrines that continually emerge as a consequence of launching new weapon systems and technologies, development of simulation software for wargaming at various hierarchical levels of the army offers a fruitful area of IT utilisation.

IT Revolution on Distant Education

The concept of IT based distant education is taking a different shape for army. Other characteristics of distant education, using electronic media can be summarised as:

- Teacher and student both remain at their place of work and hence the effort in terms of time and money spent to travel for contact is saved.
- It extends the physical boundaries of the campus beyond all limits.
- Concept of electronic library saves on the infrastructure requirements for maintenance of the manual library.

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Presently defence establishments have affiliation to various universities for grant of degree for the studies and courses being conducted at its training establishments. For example, JNU, Delhi is awarding graduate degrees to cadets at NDA and engineering degrees to officer trainees at technical institutions and DAV, Indore is awarding M.Phil., M.D. and M.S., M.B.A., Senior and Junior Diplomas in Defence Management and Certificate for courses in Defence Management to the officers undertaking studies at Mhow. With the concept of distant education catching up on the evolving electronic media, the organisation can plan in terms of its own defence university, under due recognition from the government, for conducting graduate and post graduate courses in various fields at its numerous institutions. The defence university will have a permanent faculty both from the academic world and the defence forces. Other than controlling the educational programmes in the defence forces, it will interact with other universities and educational institutions within the country and abroad to take up futuristic defence related studies and research work.

Epilogue: Concept of a Virtual Defence University

ment its distant education programme.

Army may consider use of internet to supplement its distant education programme.

With the private Internet Service Providers (ISP) likely to come up in the country to offer Internet connectivity in all corners of the country, the Army may consider use of internet to supplement its distant education programme.

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- All training courses, where face to face instruction is not a mandatory requirement, may be considered to be conducted through distant education programme. Even some of the other courses may be divided into two parts with the first part disseminated on electronic media before the conduct of the second part requiring contact classes. In addition, pre course training material to a candidate before a course may be provided on this media.
- Syllabus content of selected courses to be made available on video cassettes and CDROMs at the libraries of training institutions to be supplied on demand by the regiments.
- Create a backbone network across the country down to headquarters level covering all Army stations based on satellite terminals (VSAT) to cover large and inaccessible areas, supplemented by leased lines of DOT (Department of Telecom) to be used as educational as well as communication network. This network can be connected to all institutions of military training across the country with the latest training material placed on-line. The network may be developed on Intranet model for reasons of security.
- The procurement of multimedia PCs for provision down to each sub unit of the Army, even if deployed along the border, to be utilized for training of officers and men by the material supplied on floppies and CDROMs.
- Automate libraries of training institutions, with the material being made available on electronic media.

With this background, the impact of IT revolution can be considered to influence the concept of distant education in the Army in the following manner:

Number of experiments have been conducted in India on educational teleconferencing, such as ISRO-UGC Talkback experiment (1991), INDO-US Subcommission Project Classroom 2000+ (1993), ISRO-IGNOU Teleconference (1993), New Information Communication Technologies—a course through teleconferencing (1994), ISNET through video technology: An innovative Indian experience (1996), NOS-DECU-ISRO Talkback experiment (1996). Through all these experiments, attempts have been made to realise two way communication for distance education (Goel, 1997).

conference, including paper presentation, discussion, moderation, questioning and answering etc. (Ushadevi, 1997).

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Future of Traditional Performance Measures

Dinesh K. Gupta

Introduction

In the field of cost and management accounting, many developments have taken place; one of them is the advent of activity-based costing (ABC). The philosophy of ABC has strongly impacted the way costs should be perceived, monitored and controlled. The superiority of ABC over the traditional process of product costing has been established especially under multi-product and multi-process settings. It has been highlighted through field studies that a number of organisations were forced to take wrong decisions, regarding pricing and promotion of their products, based on faulty cost data reported by the traditional cost systems (Kaplan, 1986).

The cost is charged to different products on the basis of actual use of a specific activity (or a set of activities), under an ABC system, because it is argued that an activity gives birth to a cost. So the root cause is not the cost rather an activity. This has resulted into a shift in the focus of control process. The focus has shifted from the cost level (which happens to be a financial variable) to the activity level (which happens to be physical variable). This change in the focus has perpetuated a philosophy called activity-based management (ABM).

The present paper attempts to analyse the impact of shift in the focus of control process, from the cost level to the activity level, on performance evaluation. The rest of the paper has been divided into four parts.

Accounting numbers based performance measures have dominated the area of performance evaluation. The list of such measures includes sales, profits, return on sales, return on investment and residual income. Profit used to be the basis of monitoring performance during the nineteenth century (Johnson and Kaplan, 1987). This was so because the focus was on the performance of a single activity in an efficient manner. To carry out time-series and cross-sectional analyses, profits were related to variables like sales and cost of production. It was only in early twentieth century that a relation-

The area of cost and management accounting has been significantly influenced with the philosophy of activity based costing. The impact has not only been on cost management but also on performance evaluation. This impact is reflected by the shift in the focus of performance evaluation from financial variables to non-financial variables. The paper briefly traces his history of the heavy use of financial performance measures and foresees a bleak future of these measures which happen to be the lagging measures.

Dinesh K. Gupta is Reader at University Business School, Punjab University, Chandigarh-160 014.

It has been realised by the management accountants that mere tracking of the variables like innovation, productivity, quality and cycle time will not serve any purpose. These variables should become an integral part of a performance evaluation system. As a result, a number of

The impact of ABM philosophy, which is an offshoot of refined process of cost measurement under ABC, is clearly exhibited by this change in perspective. As discussed earlier, the focus of cost measurement, and hence cost control, has shifted to the activity which happens to be a physical variable. So, in order to make the employees responsive to the activity, it is necessary that the performance measures do not happen to be too aggregated and necessarily financial in nature. Rather the measures are too focussed to the root cause of the costs, i.e., the activities.

The organisations are supposed to be continuously responsive to the needs of their customers. This is the order of the day because of heavy competitive pressures. In the light of this, it becomes necessary that the performance measures used by an entity should bring it closer to the customer and must reinforce continuous improvement. The philosophy of continuous improvement dictates that the value added activities be distinguished from non-value added activities. Further, even the value added activities should be made more efficient through the process of benchmarking and benchtrending.

Using financial performance measurements to improve performance is like concentrating on the scoreboard in a football game. Although the scoreboard tells the coach whether they are winning or losing, it does not provide them with much guidance as to which plays should be called. What the coach needs is information that ultimately affects the score, such as which running plays are more successful, how well the defense is stopping the opponent's attack and so on. In business terms, managers need performance measurements of the activities and prior outcomes that lead to superior financial results (Eccles, 1992).

Such observations regarding the financial measures are not a new phenomenon. Dissatisfaction with the use of financial measures was expressed as far back as in 1951 when Ralph Cordiner, the CEO of General Electric, constituted a task force to identify key Corporate performance measures. The task force traced, apart from profitability, market share, employee attitude, productivity, public responsibility and the balance between short and long-run goals (Eccles, 1991).

were dissatisfied with their performance measurement systems that are based on obsolete traditional measures.

ship was established between profit and investment when the founders of DuPont asserted that there 'be no expenditures for additions to the earning equipment if the same amount of money could be applied to some better purpose in another branch of company's business' (Johnson, 1975).

Accounting numbers based performance measures have dominated the area of performance evaluation. The list of such measures includes sales, profits, return on sales, return on investment and residual income.

A measure called return on investment (ROI), which is a ratio of operating income of investment, was designed by DuPont. It studied the measure in two components: a return measure that assessed efficiency and a turnover measure that assessed productivity. The measure was used for investment decision making initially. The use of ROI as a measure of performance evaluation gained momentum when DuPont started functioning on decentralised lines in 1920's (Kaplan and Atkinson, 1992). The measure is being heavily used for performance evaluation, the world over, since then. Economic Value Added (EVA) equals income less the economic cost of the investment used to generate that income is better than ROI, (Horngrén, 1994).

The choice of a performance measure is important both for the management and for the employees. It is reflective of the fact that to which aspect of performance the employees, performance measure acts as a basis to tailor their operating behaviour.

The existing set of financial measures of performance is found wanting in several respects. As per the joint-survey of National Association of Accountants and Computer Aided Manufacturing-International (Howell, et al/ 1987), it was found that 60 per cent of the 260 financial officers and 64 operating executives stated that they

The choice of a performance measure is important both for the management and for the employees. It is reflective of the fact that to which aspect of performance highest importance is attached by the management.

measures have been experimented to measure and evaluate the performance in different areas like vendor, time, productivity and customer service.

The performance of the vendor should focus on

quality, price and delivery time. These measures include vendor quality, vendor on-time delivery and vendor simplicity. The time-based performance measures attempt to monitor lead time, set up time and machine up time. The productivity related performance measures focus on work force productivity, activity productivity and direct material yield. The customer satisfaction can be monitored through measures like on-time delivery, complete order filling and customer complaints (Burch, 1995).

The above discussion makes it clear that apart from

financial measures, there are a number of measures that need to be captured and monitored. Kaplan and Norton (1992) advocate the use of "Balanced Scorecard" for performance evaluation. Balanced Scorecard is a multi-dimensional system comprising four distinct perspectives, viz., financial, customer, internal and innovation and learning. The scoreboard balances between financial and non-financial measures, between short and long-term objectives, between lagging and leading indicators and between external and internal performance measures. It provides a direction to the action of the employees to generate goal congruence. Scorecard approach has been experimented by a number of organisations including Motorola, Analog, Shell and Bank of Montreal (Kurtzman, 1997). The approach has been found to be superior to the traditional financial numbers based performance evaluation approaches.

The performance evaluation systems are likely to be comparatively less dominated by financial measures in future. Financial measures, which are lagging measures, will be replaced by leading measures. Further, the per-

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Productivity Measurement of Public Sector Enterprises: A Perspective

G.D. Sardana

The public sector enterprises (PE) having registered a phenomenal growth, have a pivotal position in the economy. The private sector too over the years have made some progress in few areas. Privatisation, partial or complete in some areas have been suggested in order to transform PEs into profitable ventures. However, the paper points out that there are several pitfalls especially on the societal roles of private sector. The present paper compares and contrasts the PE against private sector in terms of performance, commercial accountability and social objectives. In view of this there is need to develop and use appropriate models for better evaluation of the performance of both sectors. The paper also demonstrates the application of Pefor-mance Objectives—Productivity (PO-P) model with the help of some case studies.

The public sector has come to occupy a significant and a pivotal position in the economy of India. It has grown steadily in size over the years and encompasses a wide spectrum of the industrial economy covering segments such as heavy engineering, electricals, automobiles, ferrous and non-ferrous metals, minerals, petroleum, machine tools, ship building, and construction. In many areas its presence is monopolistic. Starting with a comparatively small investment at the beginning of the first five year plan, the investment in the public sector has grown significantly. In terms of assets it owns assets worth over 50 billion US\$. It produces 100 percent of petrol, 60 per cent each of steel, zinc and aluminium in the country.

Pure commercial and investment considerations together with the compulsions arising from the 'liberalisation of economy' resultant of changed international political scenario, have brought a sharp focus on the evaluation of the public sector enterprises (PE). Serious questions have been raised and doubts expressed about the performance and the productivity of this sector. Privatisation, partial or complete is a strategy suggested presumably on grounds that private sector has demonstrated a better performance or has better skills to transform a PE into a profitable venture.

Pure commercial and investment considerations arising from the liberalisation of economy have brought a sharp focus on the evaluation of the public sector enterprises (PE).

No attempt has been made herein to justify the performance, good or bad of a PE as evaluated on principles of commercial accountability; nor PE is

G.D. Sardana is a Director with Ujala Pumps Pvt. Ltd., New Delhi-110 092

Again, technology development has seldom been considered as one of the major objectives of a private sector enterprise. Borrowed technology has remained the main stay. Many companies continued to sparkle as long as these enjoyed the advantages of the new technology acquired. However, as the technology got replaced with latest developments, the company also suffered as it had made no arrangements towards development of indigenous technology or towards self-reliance. R&D, as such, is missing from the agenda. This is again on account of pure commercial con-

By and large, a private sector corporation is characterised where the promoters family have a controlling equity interest and it is run by desire for private gain and commercial viability. An enlightened company would prescribe objectives of economic performance such as rate of growth, market share, generation of capital assets, net worth and similar other parameters. No private enterprise as such is promoted to accelerate the growth of national economy, generate employment or to provide impetus to social transformation in the country.

Objectives of the Private Sector

Model employer—PE has been created to work as a model employer. The work conditions, welfare provisions, amenities to the employees and extending these benefits to their families in areas such as housing, schooling, medical aid are a part of the package. No one over has heard of exploitation of workers in a PE. This is because these enterprises have no motive for private gains. They have opened up all disciplines to qualified and experienced professionals. It has created some of the best professional managers and administrators in areas of finance, HRD, technology and general management. Some of them have made a name at the national and international levels. Thus at higher levels of CEO, CMO, directors etc., PEs have attracted a large number of competent professionals, even though package of perks, etc. offered to them is peanuts in comparison to a private sector.

PEs have created employment both directly and indirectly. A large number of the small sector units and ancillary units owe existence only because of PEs.

ment is one of the performance objectives, it has led to over staffing in many cases leading to increased costs and lowered labour productivities.

Generation of employment—PEs have created employment both directly and indirectly. A large number of the small sector units and ancillary units owe existence only because of PEs. Even when some of the PEs went sick retrenchment and closures were not resorted to. On the other hand sick private companies were nationalised and converted as PEs solely for the objective of avoiding unemployment. As generation of employ-

Balanced regional development—A large number of PEs have been established in areas taking into account the needs of balanced regional growth and development of backward regions of the country. In many instances the manufacturing units have been set up in such places which are economically and commercially justifiable. At these places, the private sector would hardly venture.

Uplift of the underprivileged—PEs provide job reservations and other opportunities of industrial training and enhancement of skills to the socially and economically backward communities. And to a great extent this policy has helped millions of backward and deprived citizens to improve their standards for a dignified living. It has to be appreciated that such reservations do entail some privileged, such as the scheduled castes, backward classes etc. has been at the sacrifice of certain merit.

Redistribution of income—Through judicious controls PEs have ensured comparatively lesser disparity of income as contrasted to a private sector company where there is a wide gulf between the incomes of an executive and a worker at the shop floor.

However it is in the areas of social objectives that a PE differentiates itself so strongly from a private sector corporation. Committed to a socialistic pattern of society strives to achieve social objectives especially for weaker sections of the society. The following emerge as the main social objectives:

Social Objectives

India has meagre financial resources or development as well as to meet the social objectives. These many instances is conditional impinging on national pride. A long term plan calls for developing economy for self-reliance. To earn an appropriate return on investment and to generate funds is, therefore, an important objective. Generation of commercial surplus to finance economic development is one of the objectives of a PE.

Financial Returns

Keeping these factors in view, a more appropriate model to measure the overall productivity has been proposed (Sardana and Prem Vrat, 1987; Sardana, 1985 and 1989) have presented a model termed as PO-P (Performance Objectives-Productivity). Based on

fully accounted (Laxmi Narain, 1980). as a result of inputs which for a PE especially has to be social amenities etc. Achievement of these objectives is of wealth, generation of employment, provision of exclusion of a large number of outputs viz., redistribution of outputs. The biggest drawback in these models lies in represented in the conventional approaches of input types, or are at conflict to each other. These do not get as outputs which are of intangible nature, qualitative sum. Besides, there are a large number of inputs as well as outputs which are of intangible nature, qualitative sum. However, in case of some inputs the resultant of addition of two or more inputs need not be pure arithmetic. However, in case of some inputs the laws of addition, that the input and the output follow the laws of addition, other factorial indices. These approaches also consider indices can be increased or decreased at the cost of carry a causal relationship. Some factorial output-input productivity. The output and the inputs do not always inconsistencies in this type of approach to measure There are many flaws, inadequacies, fallacies and

employed or expenses incurred. 'returns on expenses incurred' where the 'output' has been equated with the returns and 'input' with capital age old indices of 'returns on capital employed' or measures of productivity so advocated are virtually the inflation/deflation and reference time period. The of inputs and the outputs and reduction of the same to a common base by taking into account the rates of aggregation of diverse inputs and outputs, quantification of inputs and outputs, measurement problems as aggregate solution to such measurement problems as labour, materials, capital, technology etc. or only provide to define input in its factorial forms such as labour, approach have been advocated which either attempt to the outputs. A large number of variations on this basic resources, capital employed or value paid out to obtain diverted to monetary terms) of costs incurred on all generally considered are in monetary terms (or converted to monetary terms) of costs incurred on all inputs or monetary benefits obtained. Similarly, inputs income realized or returns obtained, value added to in- considered is the sale value of commodities produced/sold, the inputs are pure economic parameters. Output con- productivity measurement models both the outputs and the inputs to the enterprise. In a large number of This has been defined as the ratio of outputs and

Measurement of Productivity

progressive of the private sector corporations are at micro level valid for the current period.

On the other hand, financial returns constitute the most dominant performance objective of a private sector enterprise. Objectives other than profits and returns on investments are of secondary nature and carry a low priority. Social objectives, as adopted by the most

Thus it is clear that there is a marked difference of performance objectives as followed by the two types of corporations. A PE has predominance of social objectives to achieve and has comparatively less emphasis on commercial returns. Lack of profit motive is obvious. It is only recently that financial returns from a PE has been regarded as one of the important objectives.

Performance Objectives

This is not to state that a private sector enterprise has not taken any step towards social objectives. One set of social objectives concerns compliance of statutory provisions. These include checks and controls on pollution, safety at work places, creation of training centers etc. Some organizations have also chosen to support or sponsor sports events or other similar activities in entertainment area. Yet others have chosen social areas which can be termed more as philanthropic acts. But a predominant scenario suggests that social obligations, if carried out, are largely at the cost of sacrificing personal gains or commercial consideration.

In the area of social objectives, a private sector enterprise is distinct from a PE. In particular, it is not called upon to carry out redistribution of wealth through reduction in disparity of income between the executives at the top and employees at lower level. As a matter of fact the disparity has increased tremendously over the years. The private sector enterprise is not obliged to work towards creation of balanced regional development by setting up manufacturing units in the backward areas nor it is called upon to generate employment. On the other hand, if there is a commercial justification, it has not hesitated to install automated equipment and machinery to save upon work force employed.

Technology development has seldom been considered as one of the major objectives of a private sector enterprise.

considerations. Returns on R&D expense, on short term basis are invariably poor and there is a large uncertainty of returns on longterm basis. With few exceptions, the private sector enterprises today is without any worthwhile infrastructure for technology development.

Table 1: Performance* and weightage factors

Sub-systems	W _n KPA's	W _{vu} PO's	W _{vu}	PE Pvt. Co.
Production	0.20		7	9
Marketing	0.20		7	9
HRD	0.05		7	9
Materials	0.05		7	9
Technology	0.05		7	9
Financial Accts	0.05		7	9
Goals and Values	0.40		10	10
Societal Goals: Statutory	0.20		10	10
Pollution control	0.20		10	10
Safety and work conditions	0.20		10	10
Consumer protection	0.20		10	10
Statutory rules	0.20		10	10
Welfare	0.20		10	10
Societal Goals: Current Impact	0.20		8	5
Salary & Wages	0.25		8	5
Family Welfare	0.25		8	5
Community Involvement	0.25		8	5
Consumer Service	0.25		8	5
Development of backward areas	0.25	0.60	8	5
Technology growth	0.25		8	5
Employment generation	0.25		8	5
Infrastructure development	0.25		8	5
	1.00		1.00	

* Performance is converted on a scale of 0-10 with 10 showing the best performance i.e., 100% level

Performance objectives play a very important role in evaluation of performance or system productivity of an organisation.

prices is asking them to do the impossible task". In case the checks on prices are removed and social goals eliminated and PE's permitted to operate on equal terms with a private sector company, a large number of PE's which are specially involved in the production or distribution of essential goods/products such as bread, milk and dairy products, food grains, fertilizers, ferrous and non-ferrous metals etc. will become highly profitable undertakings overnight. The Marketing sub-system will show a high productivity thereby improving the system productivity. There is every reason to believe that productivity of a PE in the changed environment will be matching the private sector company or even surpass in most cases.

Thus, it is obvious that performance objectives play a very important role in evaluation of performance or system productivity of an organisation. Social objectives constitute important targets of a PE and these call for spending of resources. Therefore, these have to be incorporated in any model of productivity measurement. A PE and a private sector company can be compared only if these have a common yardstick of evaluation.

Conclusions

Productivity in its true perspective is a holistic concept. For an enterprise considered as a system,

It may be argued that the model as described suffers from high subjectivity as the exercise involves setting of several parameters which can vary depending upon the perception of individuals responsible for setting of the same. These issues can be resolved by involving key persons in participative discussions for reaching a consensus. A number of techniques such as Nominal Group Technique, methods of direct scaling, method of paired comparisons, hierarchy ranking are also useful techniques employed to minimise subjectivity.

This is not to suggest that with change in measurement mechanism all PE's will be found performing better than any private sector company. PE's have also several causes of non-performance which are exclusive and not common with the private sector company. Some of these include absence of proper accountability; security of jobs, overstating leading to inefficiency; lack of competitive culture, absence of motivation to the performers, interference from the bureaucrats and political

equal footing with a private sector company. This is not to suggest that with change in measurement mechanism all PE's will be found performing better than any private sector company. PE's have also several causes of non-performance which are exclusive and not common with the private sector company. Some of these include absence of proper accountability; security of jobs, overstating leading to inefficiency; lack of competitive culture, absence of motivation to the performers, interference from the bureaucrats and political

productivity of a system carries more appropriate meaning and high significance as compared to factorial input factor is often on account of and sacrifice of productivity of another input factor. Further productivity of a system is not the sum of productivity of each input factor, nor can all inputs be added as these do not follow the law of additions. Productivity in its broader concept is representative of actual achievement of objectives against the targeted objectives.

It is seen herein that there is a wide difference of performance objectives of a PE as compared to a private sector company. This will establish a case based on rationality and logic for any solutions to improve the performance.

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Total Factor Productivity in Indian Manufacturing: 1973-93

R.S. Dhananjayan and N. Sasikala Devi

Introduction

Estimation of Total Factor Productivity Growth (TFPG) indices for the Indian two-digit manufacturing industries and analysis of the emerging behavioural characteristics are the twin purposes of the present study. The question as to why productivity differences manifest, when output growth of the manufacturing industries tend to meet the growing demand from the national and international markets has evoked much debate in economic theory and empirical research. During the early phase of the growth in the manufacturing output, historically a rapid growth in the use of factor inputs, essentially that of capital formation has been universal. The neo-classical theory of production function, provided the conceptual framework of partial factor productivity to trace the sources of output growth. It also gave the apparatus to visualise how changes in factor price ratios will lead to changes in factor proportions and alter the factor augmentation characteristics. Empirical studies in this area have shown, the factor augmentation in general, to be capital rather than labour deepening.

During the early phase of the growth in the Manufacturing output, historically a rapid growth in the use of factor inputs, essentially that of capital formation has been universal.

Total Factor Productivity Growth

Inefficacy of partial factor productivity measures, for identifying sources of growth led economists to look for alternative measures. The concept of total factor productivity (TFP) was introduced as an alternative by Tinbergen (1942). He defined the TFP as the ratio be-

Estimates of Total Factor Productivity (TFP) growth of output provide the theoretical framework to assess the efficient use of the given technology or harnessing technical efficiency in the use of given set of resource inputs. Behavioural characteristics of TFP across industries is a useful empirical exercise to understand how efficient use of technology accounts for the rapid rate of growth in certain categories vis-à-vis others. Kendrick, Solow and Divisia indices of TFP are estimated in the present study for the 18 two-digit Indian manufacturing industries for the period ranging 1973-74 to 1993-94. The TFP contribution in many industries has been quite varied but generally low in magnitude. Specifically, the Divisia index points out that finer variations in output growth are attributable to technical efficiency. On the whole, trends in TFP growth rate during the study period has both favourably and adversely affected the output expansion with time lag of one to two years depending on the nature of policies adopted.

R.S. Dhananjayan is a Professor at the Department of Economics, Bharathiar University, Coimbatore-641 046 and N. Sasikala Devi is a Lecturer in Economics at the Guruswamyurappan Institute of Management, Coimbatore-641 006.

Under the assumption of perfect competition, constant returns to scale and factor rewards being paid strictly on the basis of marginal products, the total income paid to factor inputs viz. labour and capital during the base year will exactly be equal to the base year value added. Hence, by definition the TFP in the base year will assume a value equal to one.

Where, Y_t = Value added (in Rs.), L_t = Labour measured in physical units, K_t = Capital measured as fixed capital (in Rs.), w_0 = Base year real wage rate (in Rs.), r_0 = Base year real rate of return on capital (in Rs.) and subscript t stands for year.

$$A_t^k = \frac{w_0 L_t + r_0 K_t}{Y_t} \quad (1)$$

The Kendrick index of total factor productivity growth (A_t^k) is defined by the following expression:

Kendrick or Solow indices are the most often used ones. In some recent studies, it is observed that use of an approximation to measure total factor productivity growth using the Divisia index is being made.

Measurement of TFP

TFP estimates are useful to infer how resource transfers from a less to more productive industrial manufactures can help to accelerate the pace of economic growth.

much needed structural change in a developing economy. On the other hand, if the rate of increase in the real returns to the factors falls short of their TFP growth rates, then the industries with below average rates can be predicted to experience a relative contraction. Further, a comparison of the TFP growth rate of the individual industries with the economy's average TFP rate, and interfaced with the relative prices can provide useful information on the future course of change that can alter the competitive position of the individual industries. The inter-industry differentiation of the individual industries, thus assumes significance, in developing a knowledge on the structural characteristics of output expansion in the manufacturing sector of a nation (Krueger and Tuncer, 1980). Further, higher rates of total factor productivity will be technically consistent to foresee the trends in the growth of real income to the factors of production i.e., national income at factor cost.

As an important source, the TFP estimates are useful to infer how resource transfers from a less to more productive industrial manufactures can help to accelerate the pace of economic growth. If, in some industries, the TFP rates increase more rapidly than others, then it is possible to infer that these industries will register faster expansion and can bring about the

The TFP can be associated with improvements in human capital, economies of scale, capacity use, better practices, allocative efficiency in the use of resources and so on, to capture the role of abstract technology in explaining the residual growth rate in output.

Logically, TFP can be associated with improvements in human capital, economies of scale, capacity use, better organisational and managerial practices, allocative efficiency in the use of resources and so on, all bundled up in one measure so as to capture the role of abstract technology in explaining the residual growth rate in output. A system of weighting the residual growth rate in estimating the total factor productivity growth in equilibrium in a competitive market is parallel to the concept of total factor productivity growth. Various methods of estimating the total factor productivity growth rates differ due to the underlying production function concepts employed for the estimation purposes. The Kendrick index of TFP is based on a production function which assumes linear relationship between factors and the commodity output. The Solow index uses the homogeneous Cobb-Douglas production function of degree one. The Translog approximation of the Divisia index. The Tinbergen measure of TFP attempts to disentangle the effect of scale economies on output growth.

between the real product or the output and the real factor input (a weighted sum of the different inputs) while he made an attempt to compare the trends in international productivity growth. Kendrick (1961), developed the concept of total factor productivity as a ratio of growth in real output to the growth in the weighted combination of real factor inputs by taking into account the base year real factor costs. Solow (1957), decomposed the output growth into that which can be directly attributed to the productive contributions of the factor inputs and that which can be associated with the weighted contribution of the total factor inputs."

Under perfect competition, constant returns to scale and factor rewards being paid strictly on the basis of marginal products, the total income paid to factor inputs during the base year will exactly be equal to the base year value added.

The Solow index of total factor productivity growth (A_t^T) is computed on the basis of the growth rates in Y , L , and K . It employs a typical Cobb-Douglas production function with the assumption that technical change is Hicks neutral and elasticity of factor substitution is equal to one. Thus, given the production function,

$$Y = A \cdot L^\alpha \cdot K^\beta \quad (2)$$

and the marginal productivity of labour and capital being equal to:

$$\frac{\partial Y}{\partial L} \cdot \frac{Y}{L}, \text{ and } \beta = \frac{\partial Y}{\partial K} \cdot \frac{Y}{K} \text{ respectively. Treating } \alpha \text{ and } \beta \text{ to measure the factor rewards equaling to } w_0 \text{ for labour and } r_0 \text{ for capital, the function can be expressed in its time derivative form to account for the rates of growth:}$$

$$\frac{\dot{Y}}{Y} = \frac{\dot{A}}{A} \cdot \frac{\dot{L}}{L} + r_0 \frac{\dot{K}}{K} \quad (3)$$

This equation in its discrete approximation can be expressed as:

$$\frac{\Delta Y_t}{Y_t} = \frac{\Delta A_t}{A_t} w_0 \frac{L_t}{K_t} + r_0 \frac{\Delta K_t}{K_t} \quad (4)$$

where the symbol ' Δ ' is used to measure the growth rates of Y , L and K . Solow, further simplified the expression in equation (4), by dividing it by $\frac{\Delta(Y/L)_t}{(Y/L)_t}$, such that functionally, growth of labour productivity, i.e. output per physical unit of labour is determined by the ratio of growth in capital per physical unit of labour.

$$\frac{\Delta(Y/L)_t}{(Y/L)_t} = \frac{\Delta A_t}{A_t} + \beta \frac{\Delta(K/L)_t}{(K/L)_t} \quad (5)$$

He also introduced a further assumption that there would exist a fixed share of capital (β) in the total output per unit of physical labour and defined it to be equal to:

$$\frac{Y}{L} = \alpha + \beta \frac{L}{K} \quad (6)$$

By substituting the ' β ' coefficient in the growth rate equation, and rearranging the terms, Solow index of TFP growth is arrived as under:

$$\frac{\Delta A_t}{A_t} = \frac{\Delta(Y/L)_t}{(Y/L)_t} - \beta \left[\frac{\Delta(K/L)_t}{(K/L)_t} \right] \quad (7)$$

From the estimated values of $\Delta A_t/A_t$ series, for arriving at the time-series of TFPG rates the following procedure is applied:

$$A_{t+1} = A_t \left[1 + \frac{\Delta A_t}{A_t} \right] \quad (7a)$$

A strong case to use Divisia index of total factor productivity growth has been put forward by Jorgenson and Griliches (1967). They pointed out, the rates of growth of Divisia indexes of prices and quantities would add up to the rate of growth of value (factor reversal test) and such indexes are symmetric in different directions of time (time reversal test). Further, they have reproducible property and as well allow for variable elasticity of factor substitution. The method does not involve the assumption of technical change to be Hicks neutral. In order to apply to data at discrete points of time, an approximation to the continuous Divisia index is required. The translog index provides for the discrete approximation for the continuous Divisia index. The translog index is conveniently derived by using the translog production function that satisfies constant returns to scale. The translog production function takes the following form:

$$\text{Log } Y = \alpha_K \text{Log}(K) + \alpha_L \text{Log}(L) + \alpha_T \text{Log}(T) + 1/2 \beta_{KK} \text{Log}(K)^2 + \beta_{KL} \text{Log}(L) \text{Log}(K) + \beta_{KT} \text{Log}(K) \text{Log}(T) + \beta_{LL} \text{Log}(L)^2 + \beta_{LT} \text{Log}(L) \text{Log}(T) + \beta_{TT} \text{Log}(T)^2 \quad (8)$$

The translog production function not only captures the relation between Y , K , L and T but also the relationship between the aggregates and the components.

The assumption of constant returns to scale implies that:

$$\alpha_K + \alpha_L = 1; \beta_{KK} + \beta_{KL} = 0, \beta_{LL} + \beta_{LT} = 0 \quad (8a)$$

Imposing this assumption on equation (8) and differentiating totally with respect to time and rearranging the terms, we obtain (Goldar, 1983).

The estimates of Kendrick TFP indices for the 18 two-digit Indian manufacturing industries are presented in Table 1. An analysis of the TFP magnitudes reveals that the average contributions to output growth for the 70's as a decade being relatively higher than in the 80's and early 90's in the industries engaged in the manufacture of the Beverages, tobacco and tobacco products (22), the Cotton textiles (23), the Wool, silk and synthetic textiles (24), the Wood and wood products (27), the Paper and paper products (28), the Chemicals and chemical products (31), the Non-metallic mineral products (32), the Basic metals and alloy products (33), the Metal Products and parts (34), the Machinery,

Results and Discussion

Index numbers of Wholesale Price for the various commodity categories to the base 1970-71 were used. The data on net fixed capital was normalised using the Wholesale Price Indices of Machinery and Transport Equipments. In doing so, Perpetual Inventory Method (PIM) was employed taking the net fixed capital of the year 1973-74 to be the bench mark year. The time series data on net value added has been normalised using the appropriate wholesale price indices for the 18 two-digit industrial manufactures. The total emoluments paid to the employees was normalised by taking into account the wholesale price indices of all commodities to estimate the real wage bill and the real wage rate per employee in the different industries.

The present study is based on the ASI data for the 18 Indian two-digit factory sector manufacturing industries and covers the time period from 1973-74 to 1993-94. The ASI, since 1989-90 started reporting data as per the new NIC of 1987 instead of the NIC, 1970. In this reporting procedure, the industry groups 30 and 31 are interchanged. In the present study to ensure, time-series uniformity in the data pertaining to the 18 two-digit industry categories, we have treated the data of 31 since 1989-90, to be the data for 30 and that of the 31 for 30. Total Factor Productivity (TFP) growth trends are estimated by employing three standard measures viz. the Kendrick, Solow and the Divisia Indices. The data on the relevant variables viz. Net fixed Capital, Net Value Added, the Number of Employees and the Total Emoluments in the current year prices reported in the ASI were compiled for the time period. Since, the time period involved in the study is fairly long, the need to normalise the data has been recognised and the following procedure has been used for obtaining data corrected for the inflationary trends in the economy.

Materials and Methods

The results at the aggregate as well as at the industry level manufactures, have shown the contribution of TFP to output growth in the developing nations yielding low magnitudes as compared to the developed nations.

Using the concept of total factor productivity growth as an analogous measure, number of studies in the developing and developed nations have estimated the contribution of technical efficiency to output growth. The results at the aggregate as well as at the industry level manufactures, have shown the contribution of TFP to output growth in the developing nations yielding low magnitudes as compared to similar studies in the developed nations (Sasikala Devi, 1996). Further from the studies it also became evident that the yearly trends in the TFP growth rates have tended to be quite sensitive to changes in macroeconomic policies, aggregate and sectoral demand conditions. Goldar (1983), Ahluwalia (1985), Krishna (1987), Singh Bagel and Neelkanth (1996-97) and Metha (1980) have found the TFP estimates to be quite low and also exhibiting with pronounced degree of inter-industry variations. Again Rajalakshmi (1981), Arya (1981), Acharya and Nair (1978), Gupta (1985), Dhilian (1983) and Bawa and Kaur (1992), while examining the total factor productivity as a source of output growth have reported low magnitudes of growth in the industrial manufactures of the States as well as in select industry categories in India.

Select Studies

where $\text{Log}(Y_t/Y_{t-1}), \text{Log}(K_t/K_{t-1}), \text{Log}(L_t/L_{t-1})$ are the approximations corresponding to $dY/dT, dK/dT$ and dL/dT , the time differentials. Thus, the expressions in equation (9) are the logs of successive years approximating the differentiation with respect to time. In empirical estimations, such growth ratios will tend to be quite sensitive to variations in the time series data. However, in Solow index of TFPG, the time differentials are approximated to rates of change in the variables and so are relatively more stable to variations in the time-series data. Consequently, the Divisia index of TFPG though may yield quite similar results as that of the Solow Index, it will reflect sensitivity to variations in the absolute values in the time-series data.

$$g^d \cdot \text{Log}(A_t/A_{t-1}) = \text{Log}(Y_t/Y_{t-1}) - [\alpha_K \text{Log}(K_t/K_{t-1}) + \alpha_L \text{Log}(L_t/L_{t-1})] \quad (9)$$

Note: X 70's = Arithmetic mean for the period 1973-74 to 1979-80
 X 80's = Arithmetic mean for the period 1980-81 to 1989-90
 X 90's = Arithmetic mean for the period 1990-91 to 1993-94

Years	20-21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
1973-74	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1974-75	1.083	1.307	0.863	1.001	1.151	0.933	0.963	1.181	0.995	1.017	0.863	0.982	1.210	1.001	1.037	0.846	0.955	1.136
1975-76	1.068	0.759	0.731	1.073	1.236	1.041	0.930	1.074	1.133	0.933	0.691	1.064	0.993	0.910	0.985	0.863	0.893	1.050
1976-77	1.101	0.966	0.744	1.007	1.029	0.984	0.973	0.963	0.884	0.914	0.769	1.120	1.059	0.975	1.147	0.873	0.981	1.235
1977-78	1.168	0.492	0.768	0.978	0.990	0.920	1.053	0.973	0.775	0.917	0.773	1.283	0.853	0.988	1.094	0.906	0.976	1.128
1978-79	1.190	0.601	0.885	1.048	0.994	0.926	1.098	0.988	0.741	0.693	0.869	1.010	0.950	0.985	1.122	0.900	0.785	1.104
1979-80	0.879	0.388	0.860	0.938	1.343	0.664	0.971	0.946	0.761	0.716	0.639	0.948	0.801	1.020	0.996	0.851	0.789	1.027
1980-81	0.370	0.310	0.827	0.898	1.218	0.704	0.812	0.785	0.587	0.837	0.314	0.961	0.841	1.005	1.087	0.875	0.776	0.994
1981-82	0.453	0.297	0.723	0.953	0.822	0.763	0.871	0.835	0.567	0.702	0.392	0.899	0.957	0.945	1.112	0.839	0.861	0.863
1982-83	0.567	0.308	0.862	0.748	0.746	0.886	0.682	0.596	0.855	0.438	1.047	0.826	0.837	1.137	0.917	0.917	1.049	1.063
1983-84	0.612	0.408	0.694	0.844	0.725	0.662	0.964	0.669	0.680	0.242	0.463	0.990	0.836	0.919	1.188	0.885	0.904	1.063
1984-85	0.543	0.366	0.568	0.810	0.836	0.783	0.966	0.766	0.725	0.320	0.440	1.070	0.573	0.863	1.323	1.010	0.874	1.115
1985-86	0.534	0.278	0.628	0.930	0.714	0.570	0.838	0.664	0.562	0.418	0.422	0.949	0.670	0.841	1.314	0.708	0.805	1.422
1986-87	0.501	0.314	0.699	0.951	0.912	0.636	0.866	0.733	0.561	0.384	0.399	0.816	0.565	0.888	1.276	0.725	0.892	0.795
1987-88	0.482	0.296	0.619	0.702	0.745	0.504	0.871	0.706	0.654	0.381	0.430	0.806	0.631	0.952	1.261	0.784	0.818	0.720
1988-89	0.559	0.318	0.640	0.710	0.755	0.619	0.884	0.714	0.586	0.348	0.443	0.752	0.790	1.016	1.225	0.778	0.859	0.609
1989-90	0.578	0.320	0.762	0.873	0.745	0.669	0.735	0.887	0.663	0.384	0.448	0.794	0.731	0.854	1.431	0.841	0.937	0.656
1990-91	0.445	0.347	0.823	0.924	0.798	0.716	0.938	0.919	0.746	0.387	0.452	0.974	0.787	0.812	1.497	0.813	1.099	0.553
1991-92	0.442	0.371	0.698	0.698	0.787	0.746	0.874	0.946	0.813	0.271	0.450	1.179	0.450	0.928	1.506	0.674	0.901	0.660
1992-93	0.394	0.327	0.669	0.701	0.784	0.726	0.791	0.921	0.740	0.319	0.516	0.734	0.551	0.789	1.454	0.791	0.864	0.600
1993-94	0.447	0.349	0.705	0.944	0.859	0.858	0.872	1.076	0.958	0.309	0.553	0.790	0.656	0.959	1.588	0.722	0.927	0.815
X 70's	1.070	0.788	0.836	1.006	1.106	0.924	0.998	1.018	0.899	0.884	0.800	1.058	0.981	0.983	1.055	0.891	0.911	1.097
X 80's	0.520	0.322	0.677	0.853	0.822	0.666	0.869	0.744	0.618	0.487	0.491	0.909	0.745	0.912	1.235	0.836	0.864	0.929
X 90's	0.432	0.348	0.724	0.817	0.807	0.762	0.869	0.966	0.814	0.321	0.493	0.919	0.611	0.872	1.511	0.750	0.948	0.657
X All	0.686	0.482	0.739	0.897	0.914	0.770	0.912	0.878	0.749	0.588	0.560	0.960	0.798	0.928	1.228	0.838	0.896	0.933

Table 2: Estimates of Total Factor Productivity Growth: Slow Indices for the Indian Manufacturing Sector: 1973-74 to 1993-94

(29). An analysis of the non-traditional manufacturing industries implied a higher output growth due the Solow's TFP in respect of all, except those of the Machinery, Machine Tools and Parts (35) and the Transport Equipment and Parts industries (37). With the exclusion of the above industries, output expansion in the other industry categories on an average due to TFP growth was relatively higher during the early 90's than that of the 70's and the 80's. Among the 18 two-digit industrial categories, the TFP estimates obtained from Solow's index on an average has been systematically greater than the base year unitary magnitude during the 70's, the 80's as well as in the early 90's only in one industry viz. the Machinery, machine tools and parts category.

The estimated Divisia Index of total factor productivity growth is presented in Table 3, for the 18 two-digit manufacturing industries in India for the period 1973-74 to 1993-94. The average contribution of Divisia index of TFP to output growth during the 70's was observed to be relatively higher in magnitude than the 80's and early 90's in the Food and food products (20-21), the Beverages, tobacco and tobacco products (22), the Wool, silk and synthetic textiles (24), the Wood and wood products (27), the Paper and paper products (28), and the Leather and leather products (29) industry categories belonging to the traditional sector and the Metal products and parts (34) manufacturing industry in the non-traditional sector. The Divisia Index of the 80's has not emerged with better contributions to output

Note: X 70's = Arithmetic mean for the period 1973-74 to 1979-80
 X 80's = Arithmetic mean for the period 1980-81 to 1989-90
 X 90's = Arithmetic mean for the period 1990-91 to 1993-94

Years	20-21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
1974-75	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1975-76	0.996	0.996	0.888	1.081	1.042	1.165	0.950	0.894	1.103	0.928	0.868	1.132	0.913	0.880	0.951	1.029	0.996	1.087
1976-77	1.019	0.779	0.946	1.017	0.893	1.094	0.970	0.797	0.889	1.160	0.949	1.234	1.008	0.905	1.123	1.064	1.186	1.365
1977-78	1.033	0.485	1.019	0.972	0.859	1.036	1.040	0.802	0.748	1.150	0.960	1.420	0.837	0.934	1.072	1.131	1.185	1.255
1978-79	0.957	0.606	1.221	1.033	0.911	1.095	1.081	0.812	0.720	1.005	1.137	1.147	0.932	0.910	1.101	1.132	1.166	1.283
1979-80	0.711	0.417	1.239	0.934	1.268	0.823	0.960	0.768	0.710	0.903	0.903	1.135	0.831	0.918	0.983	1.076	1.094	1.227
1980-81	0.414	0.336	1.314	0.853	1.259	0.892	0.760	0.616	0.548	0.934	0.555	1.249	0.889	0.823	1.079	1.163	1.084	1.311
1981-82	0.514	0.323	1.245	0.898	0.992	0.986	0.810	0.651	0.528	0.904	0.743	1.258	1.055	0.763	1.105	1.176	1.228	1.232
1982-83	0.647	0.335	1.139	0.783	0.916	0.987	0.811	0.529	0.545	1.178	0.823	1.551	0.943	0.657	1.131	1.360	1.347	1.520
1983-84	0.589	0.491	1.412	0.743	0.972	0.886	0.810	0.505	0.625	0.634	0.934	1.640	0.977	0.655	1.184	1.395	1.359	1.685
1984-85	0.506	0.434	1.286	0.717	1.107	1.092	0.840	0.578	0.671	0.917	0.892	1.875	0.714	0.633	1.329	1.659	1.366	1.938
1985-86	0.475	0.319	1.540	0.828	1.114	0.832	0.732	0.517	0.520	1.369	0.892	1.910	0.880	0.588	1.318	1.288	1.338	2.602
1986-87	0.416	0.361	1.742	0.839	1.426	0.967	0.738	0.563	0.518	1.268	0.898	1.860	0.787	0.590	1.281	1.414	1.527	1.736
1987-88	0.401	0.340	1.614	0.639	1.346	0.795	0.720	0.545	0.611	1.281	0.966	1.942	0.861	0.630	1.266	1.611	1.453	1.689
1988-89	0.458	0.368	1.787	0.639	1.600	0.983	0.713	0.538	0.551	1.300	1.034	1.968	1.133	0.632	1.229	1.783	1.545	1.488
1989-90	0.445	0.369	2.141	0.804	1.530	1.054	0.590	0.686	0.629	1.379	1.168	2.139	1.086	0.551	1.461	2.001	1.770	1.757
1990-91	0.323	0.402	2.484	0.840	1.798	1.154	0.778	0.703	0.690	1.499	1.296	2.767	1.264	0.466	1.532	2.029	2.135	1.529
1991-92	0.305	0.432	2.282	0.622	1.834	1.236	0.723	0.722	0.753	1.139	1.281	3.568	0.859	0.527	1.542	1.784	1.825	1.942
1992-93	0.266	0.377	2.342	0.616	1.711	1.201	0.653	0.699	0.669	1.415	1.525	2.556	1.092	0.421	1.487	2.211	1.822	1.945
1993-94	0.291	0.404	2.663	0.886	2.089	1.481	0.678	0.824	0.904	1.514	1.755	3.045	1.375	0.482	1.630	2.216	2.018	2.938
X 70's	0.953	0.651	1.052	1.006	0.996	1.035	1.000	0.846	0.862	1.024	0.969	1.178	0.920	0.924	1.038	1.072	1.105	1.203
X 80's	0.487	0.368	1.522	0.774	1.226	0.947	0.752	0.573	0.754	1.117	0.891	1.739	0.932	0.652	1.238	1.485	1.402	1.696
X 90's	0.296	0.404	2.443	0.741	1.858	1.268	0.708	0.737	0.754	1.392	1.464	2.984	1.148	0.474	1.548	2.060	1.950	2.089
X All	0.588	0.460	1.565	0.837	1.283	1.038	0.818	0.688	0.697	1.144	1.029	1.820	0.972	0.698	1.240	1.476	1.422	1.626

Table 3: Estimates of Total Factor Productivity Growth: Divisia Indices for the Indian Manufacturing Sector: 1973-74 to 1993-94

growth in any of the two-digit industries in reference. The average values of the Divisia index during the early 90's has recorded relatively higher rates of output growth than the 70's and the 80's in the industries engaged in the manufacture of the Cotton textiles (23), the jute, hemp and mesta textiles (25), the Textile products (26) in the Traditional sector and the Rubber, plastics, petroleum and coal products (30), the Chemical and chemical products (31), the Non-metallic mineral products (32), the Basic metals and alloy products (33), the Machinery, machine tools and parts (35), the Electrical machinery and products (36), the Transport equipments and parts (37) and the 'Other' manufactures in the case of the Non-traditional industrial category in India. For the reference period as a whole the average output growth on account of the

Divisia index of TFP has been markedly higher in the Non-metallic mineral products (32) with the 'Other' manufactures (38), the Cotton textiles (23), the Electrical machinery and products (36), the Transport equipments and parts, the jute, hemp and mesta textiles (25), the Machinery, machine tools and parts (35), the Rubber, plastics, petroleum and coal products (30) and in the case of the Chemical and Chemical and chemical products (31). As a source of output growth, the TFP of the Divisia index on the average has tended to be uniformly high in the 70's, the 80's and the early 90's in a more number of non-traditional industrial category than the traditional ones.

In general, the yearly rates of TFP in all indices have tended to register a declining phase during the second

FIGURE 1

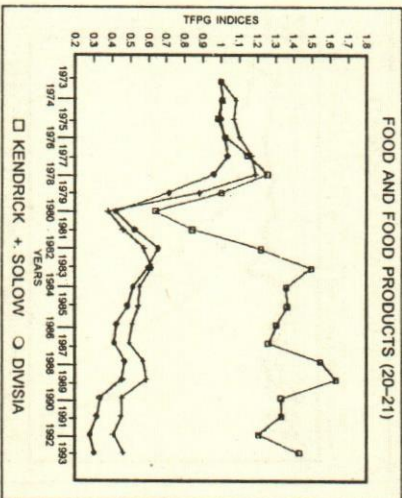


FIGURE 2

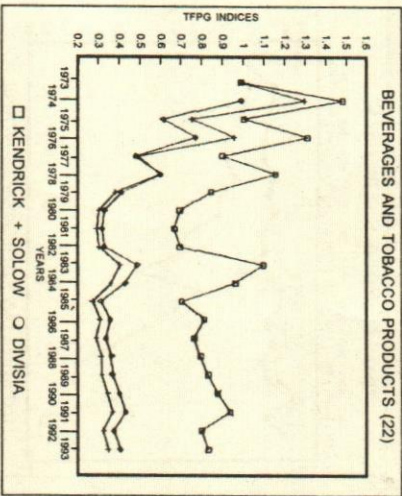


FIGURE 3

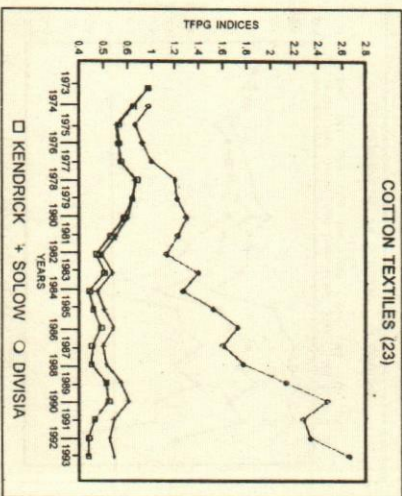


FIGURE 4

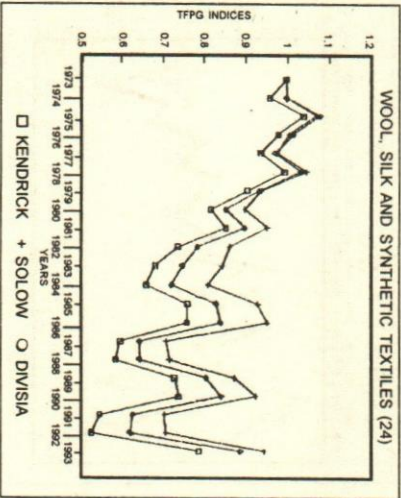


FIGURE 5

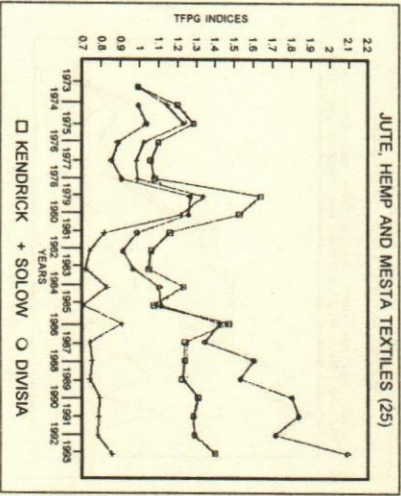


FIGURE 6

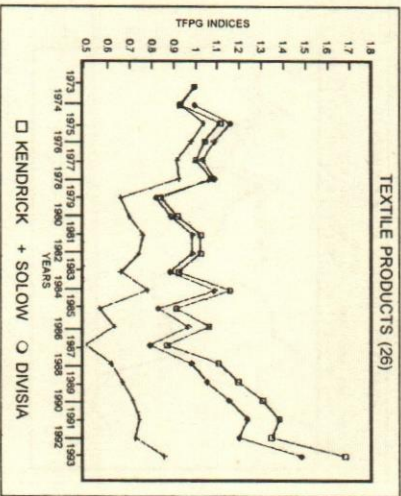


FIGURE 7

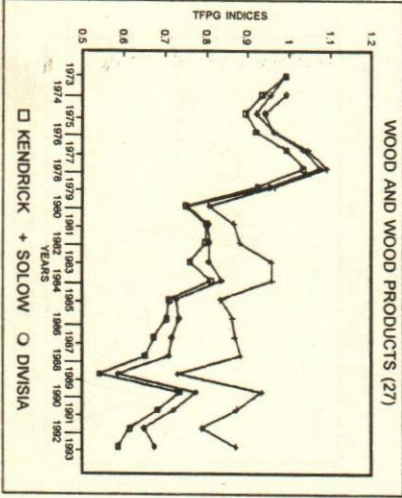


FIGURE 8

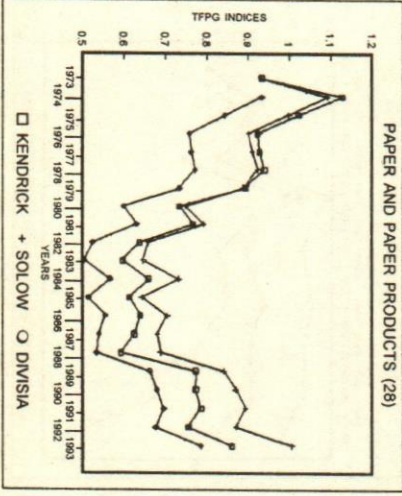
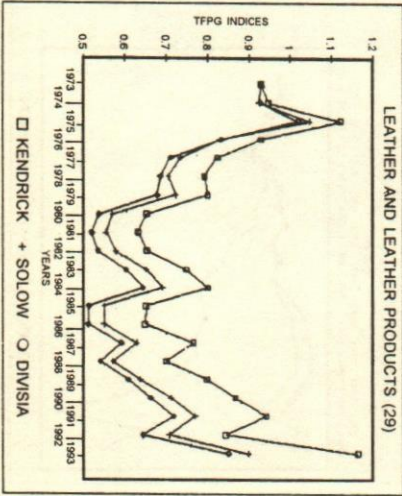
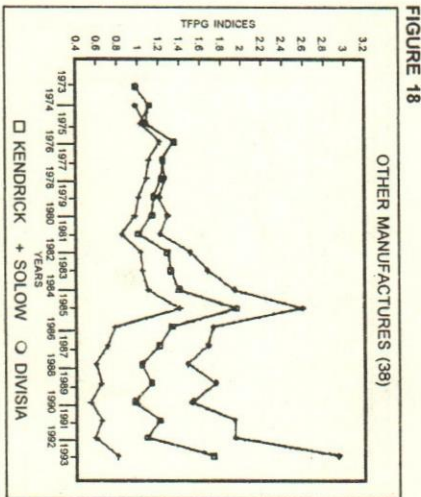
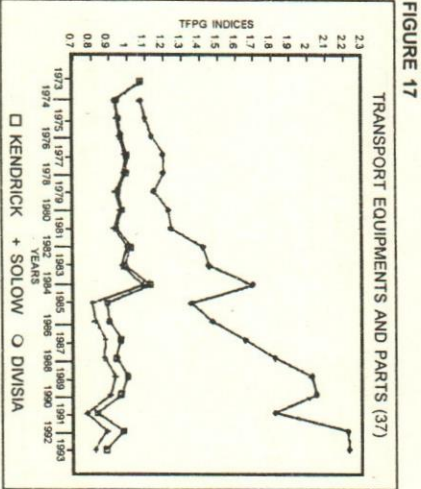
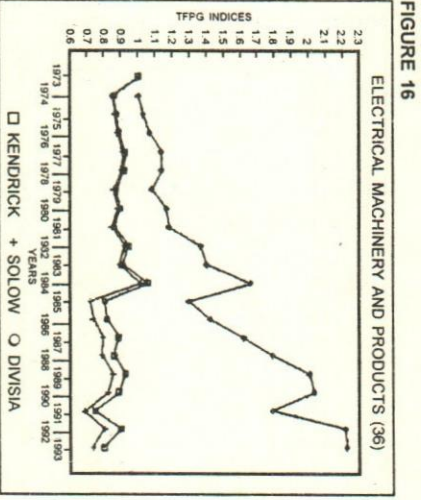
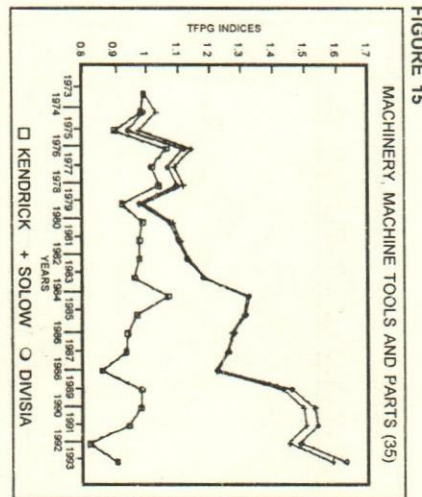
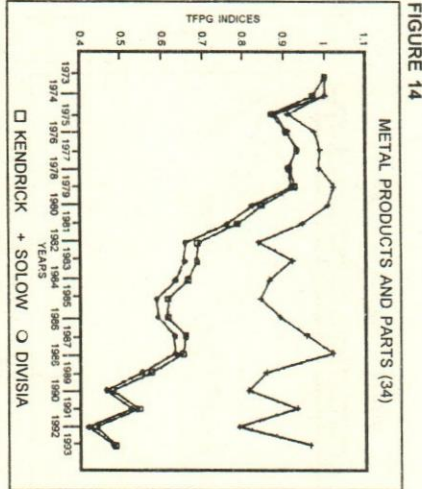
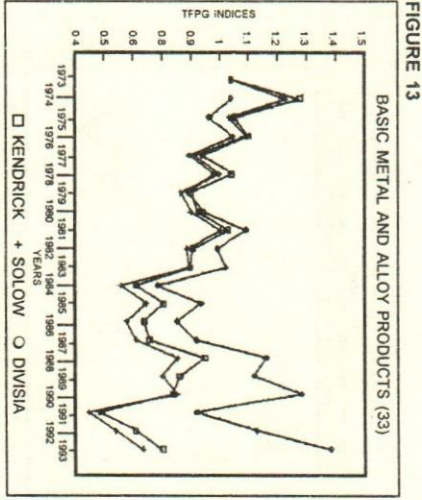
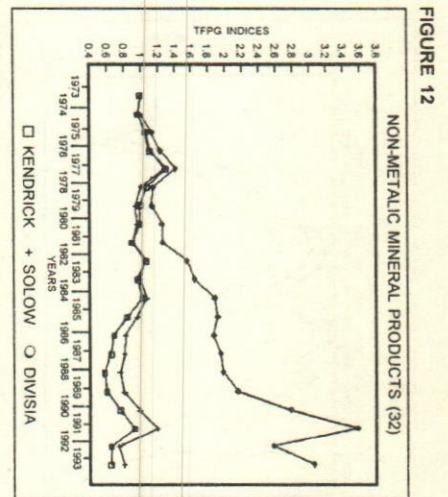
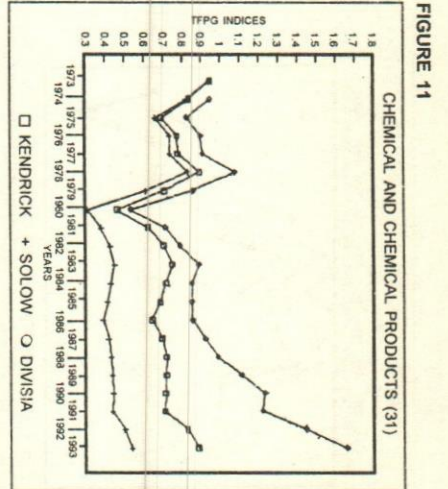
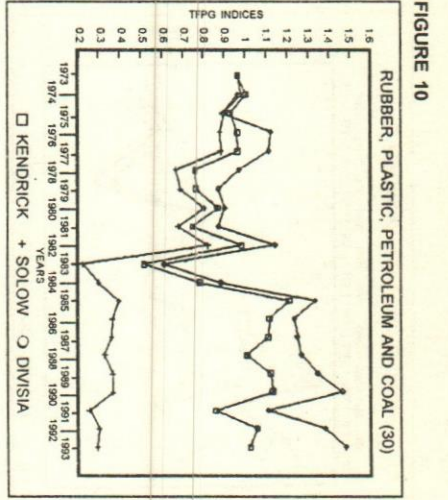


FIGURE 9





Figs. 1-18. Total Factor Productivity Growth in Indian Manufacturing Sector During 1973-74 to 1993-94

half of the 70's and the early 80's, in the industries like the Beverages, tobacco and tobacco products (22), the jute, hemp and mesta textiles (25), the Cotton textiles (23), the Paper and paper products (28), the Leather and leather products (29) and the Basic metals and alloy products (33), the decline in the TFP rates are found extending upto the end of the 80's, even though intercepted by some spurt in the intermittent years. In the Wool, silk and synthetic textiles (24) and the Metal products and parts (34) categories the declining phase of the TFP rates has extended upto 1992-93. An interesting 'U' shaped time pattern of behaviour was apparent in the Paper and paper products (28) and Leather and leather products (29), in that a steep fall in the TFP rate was seen characterising the 70's and the early 80's, while in the remaining years of the study are found witnessing an upward trend in the TFP rates. In general, among the three estimates, in all the non-traditional industrial category, the Divisia index has recorded values greater than one in most of the years in the study. In the case of the traditional industries, such magnitudes were found alternating between the Kendrick and the Solow index. However, in the Cotton textiles (23) of this group, the Divisia index was systematically higher with values greater than one.

Even though, among the three TFP estimates, the magnitudes tended to vary, the behavioural characteristics in general has been more uniform and symmetric in nature in most industrial categories, despite being dotted occasionally by mild differences. It also became evident that in almost all the industries in reference, a decline in the TFP values characterising the year 1992-93, while increase in the year 1993-94 was uniformly observed.

Conclusions

As in most of the previous studies, the TFP contributions to output growth in the present study also has yielded, in general, low magnitudes. This is particularly true during years when the economy was reeling under the strains imposed by recession. Further, during periods of inflation in the economy viz. the mid 70's late 80's and the beginning years the 90's, a certain amount of spurt became evidently characterising the TFP growth rates across the 18 manufacturing industries. The impact of the fiscal reforms initiated in the later half of the 80's and the beginning of the 90's seem to have had favourable contributions from the total factor productivity estimates to output expansion in India, but with a time lag of one to two years.

On the whole, the magnitude and the behavioural characteristics of the three TFP estimates have tended to confirm marked degree of differences across the two-digit industry categories in reference during the study

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vis-à-vis the industrially advanced nations.

period 1973-74 to 1993-94. This finding is in line with the findings of the previous studies on Indian industries. The implication is that the extent of efficiency accomplished by the different industrial manufactures towards harnessing the maximum attainable growth rates in output has been industry specific in the Indian conditions. If, one, however, looks at the issue from the point of view of the underlying production functions of the three methodologies, the Divisia index marks a sharp difference upwards vis-à-vis the Kendrick and Solow mostly in the non-traditional industrial sector than the traditional sector. This means, the use of log values of successive time differential ratios for the variables in the translog production function to estimate the Divisia index of TFP has yielded better rates of technical efficiency and hence, higher rates of output growth. These higher TFP growth rates observed in the non-traditional industries when interfaced with the beginning of an era of liberal policy regime in the economy provides a convincing reason as to why these industries were able to consolidate their share in the national income (Dhanrajayan *et al.*, 1996) consequent upon the gains from improved levels of technical efficiency and better quality of the products due to the free play of the market forces. This also enables us to understand why output growth rates across the industries vary when the economy moves from a lower to a higher stage in the development process. Higher rates of output growth, if are to be achieved in the Indian manufacturing sector by scaling better levels of technical efficiency and accelerate the rate to output expansion, the findings of the present study, point out that the ad-hocism in policy programmes concerning the industrial sector, have to be toned down and discernible long-term policy directions have to be devised and adhered to strictly. Lack of such directions could distort the general economic scenario in which the manufacturing sector has to effectively handle matters which are not directly connected with the actual decisions in terms of using the factor inputs and maximising their marginal products, but also other organisational, managerial and R&D decisions. Such long-term policy directions will provide conducive economic climate for the Indian industrial manufacturers to achieve higher and efficient scale economies which in turn can enhance their competitive edge in both the internal and international markets. This could be the possible reason, why the extent of TFP contributions to output expansion in India compares at a low magnitude

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Buyer Behaviour in Rural Markets: A Study of Soap Market

V. Sanal Kumar

Rural and urban markets are distinctly different in terms of buying behaviour which is dependent upon a host of socio-economic traits. The present paper examines activities, influences and characteristics of buyers and compares them in both rural and urban markets. Personal interviews are used to understand buyer behaviour of soaps. The data indicates variation of the behaviour of rural buyer compared to the urban buyer in many aspects. Such an understanding of the rural buyer behaviour has implications for marketing decisions.

V. Sanal Kumar is with the Centre for Management Development, Thiruvananthapuram.

Introduction

Rural Market is growing faster than urban markets, offering opportunities to the marketer. Increasing competition and maturing urban markets force many suppliers to look at the potential in rural markets. Rural markets present challenges to the marketer as it differs from urban markets in literacy levels, incomes, social system and habits. These factors affect consumer behaviour and the marketer tuned to the urban markets is handicapped in dealing with the less than familiar rural consumer. This suggests the need to understand buying behaviour of rural consumers. The issues examined include:

- Activities during buying process that affect consumer knowledge
- Influences on buying activities of the rural consumer
- Characteristics of buyers grouped by activities and influences.

Rural markets present challenges to the marketer as it differs from urban markets in literacy levels, incomes, social system and habits.

Consumer Information Source

The use of personal source of information by consumers in rural areas is greater compared to those in urban areas (Balakrishna, 1978; Sinha, 1980; Mishra, 1992; and Pratula Chandra, 1992). Television has limited reach in rural markets (Chatterjee, 1992) but use of multiple channels and relative effectiveness of television has also been indicated (Bose, 1992; Pratula Chandra, 1992; and Dhawan, 1996).

Place of Purchase

In rural markets consumers used to purchase most of their requirements from nearby towns (ICICI, 1979) but this does not appear to be true any longer (Ghosh, 1997). Most of the shops in rural areas are general merchants-cum-grocery stores (ICICI, 1979). The purchase from rural shops indicate the growing importance of the place of purchase by these consumers.

Hypothesis 1: In rural markets awareness of products or brands is from multiple sources with personal sources of information and television as important sources of information.

Hypothesis 2: Consumers in rural areas make most of their purchase from grocery stores.

Furthermore, in rural markets the male members are more dominant in purchase decision (Suri, 1995).

Hypothesis 3: Male member in the rural market is the person who decides on the brand to be purchased.

Rural Market Influences

Consumer loyalty is perceived to be greater in rural markets and this is expected to reduce trial of new brands. Again the influence of retailer is indicated to be high in rural markets (Goyal, 1986) and more so far durables (Sanal Kumar and Suri, 1996). This suggests that the loyalty to retailer is high and retailer suggested brands may be tried.

Hypothesis 4: In rural markets trial is not induced by advertisements unlike urban markets where advertisements induce trial.

Hypothesis 5: In rural markets loyalty to shops is greater than loyalty to brands.

Hypothesis 6: In rural markets the brand purchased when regular brand is out-of-stock is the one suggested by the retailer, while it need not be so in urban markets.

Cohesive social grouping in rural areas suggest purchase of similar brands by members within the group. This affects the number of brands used in the village and within a family. In rural markets there are fewer brands and one brand tends to dominate (Ghose, 1997). The benefits sought by rural consumer is mostly economy and overall quality than specific features or determinants of quality (Sinha, 1980; Sanal Kumar and Suri, 1996; and Ghosh, 1997).

Cohesive social grouping in rural areas suggest purchase of similar brands by members within the group. This affects the number of brands used in the village and within a family.

Hypothesis 7: In the case of those non-durable products used by many members in a family, only a single brand is purchased for the entire family in rural areas unlike in urban areas.

Brand Awareness

The rural consumer has low awareness of the different brands (Sinha, 1980). This is possibly true as television is not considered an effective media to reach consumers in rural markets (Chatterjee et al, 1992).

Hypothesis 8: Awareness of available brands is much less in rural areas compared to urban areas. The limited number of brands in rural markets suggest that the consumers are more likely to buy the same brand than try new brands.

Hypothesis 9: Rural buyers are more of habitual buyers than variety seekers.

Hypothesis 10: Rural buyers seek less number of benefits compared to urban buyers.

Hypothesis 11: The benefits of economy is more important to rural consumers than to urban consumers.

Methodology

For a comparing of rural markets with behaviour in urban markets, the buying behaviour of washing soaps and of toilet soaps is examined. Survey using structured questions is administered through personal interviews (Sanal Kumar, 1995).

The sample covers three regions; urban, semi-urban and rural markets. Urban, semi-urban and rural locations are identified by the type of local self-government, i.e., Corporation, Municipality and Panchayat respectively. Interviewers are selected from the locations and trained for conducting personal interviews. The sample size is 496, with 249 for toilet soaps and 247 for washing soaps. The sample of 249 for toilet soaps include 91 urban, 117 semi-urban and 41 rural consumers. The sample of 247 for washing soaps include 90 urban, 117 semi-urban and 40 rural consumers. The personal interviews for 'toilet

The type of outlet from which the consumer makes his or her purchase is examined by location. The outlets examined are 'Grocery store', 'Pan-shop', 'Large centrally located shop', 'Nearby shop', 'Civil Supplies Outlet', and 'Central Sales Depot of Armed Forces'. Proportion of these outlets is examined for variation by

Place of Purchase

The hypothesis 1 that, in rural market consumers use 'multiple sources of information' with television as an important source is true. In urban markets, Television is the major source of information.

The information source used by consumer is examined by location. The information sources are 'magazine', 'newspaper', 'point of purchase', 'television', 'wall posters' and 'others'. The locations are categorized into 'urban', 'semi-urban' and 'rural'. Proportion of each information source is examined for variation by the three locations. A Chi-square test is performed (Table 1). It indicates a significant difference in the information source used by consumers by location.

Consumer Information Source

Analysis and Inference

"soaps" and for "washing soaps" are administered separately to avoid respondent fatigue.

For toilet soaps, the decider is either the housewife or the head of the household both in urban and rural

In rural areas, the decider for washing soaps is the housewife but the buyer is mostly the head of the household, the male member. In urban areas, for washing soaps, in addition to the housewife, others too have some influence on the decision. Purchase in urban areas is either by the housewife or the male member.

In the case of washing products, the role of 'buyer' and of 'decider' is examined by location for the two categories viz., washing products and toilet soaps. The 'buyer' and 'decider' categories are 'housewife', 'Head of household', 'Children', 'Servants', and 'any other'. There is significant variation across locations. For toilet soaps the variation on 'decider' is not significant, but is significant with regard to 'buyer' (Tables 3 and 4).

Buyer Role

Though the hypothesis 2 is true that most rural buyers buy from Grocery store, there is no significant variation in the outlet from which the urban and rural buyers make their purchase. The outlets frequently used by urban consumers are Grocery shops, Super-markets and General Stores. In rural areas it is mostly Grocery stores and to some extent 'nearby-shops'.

location (Table 2). There is no significant difference in the place of purchase or location.

Note: Sample Chi-square is 17.887 and Chi-square statistic at .05 significance level is 26.296

Place of Purchase	Grocery Store	General Store	Super Market	Pan Shop	Large Central Shop	Nearby Shop	Civil Supplies	C.S.D.	More than one	Total
Rural	20	3	2	0	0	5	1	0	9	40
Semi-Urban	43	9	19	0	4	18	2	3	19	117
Urban	29	13	16	1	2	7	4	3	12	87
Total	92	25	37	1	6	30	7	6	40	244

Table 2: Place of Purchase by Location (Washing Soaps)

Note: Sample Chi-square is 22.638 and Chi-square statistic at .05 significance level is 21.026.

Information Source	More than one source	Magazine	Newspaper	P.O.P.	T.V.	Wall posters	Others	Total
Rural	22	0	0	1	15	0	1	39
Semi-Urban	71	1	1	7	34	0	2	116
Urban	26	0	2	4	53	1	1	87
Total	119	1	3	12	102	1	4	241

Table 1: Consumer Information Source by Location (Washing Soaps)

(Frequency of Responses)

(Frequency of Responses)

The hypothesis on the role of the male member is only partly true. The buyer in rural market is the male member unlike in urban markets where it is either the male member of the housewife.

In the case of brand choice the 'decision maker' role depends on the product. The decision maker for washing soaps in rural markets is the housewife and this is to a great extent true for urban areas too. The decision maker for toilet soaps is either the housewife or the male member both in urban and rural markets. Consumers can try new brands for quite a few reasons. It

The hypothesis on the role of the male member is only partly true. The buyer in rural market is the male member unlike in urban markets where it is either the male member of the housewife.

markets while the purchase is by the male member in the rural household.

Note: Sample Chi-square is 19.645, Chi-square statistic is 21.026 at .05 significance level and 18.549 at .1 significance level.

Location	Rural	Semi-Urban	Urban	Total
Factors influencing Trial	22	55	43	120
Regular brand not available	4	10	18	32
Advertisement	1	1	2	4
Retailer opinion	0	0	2	2
Display	0	0	2	2
P.O.P.	0	0	2	2
Discounts/gifts	9	44	16	69
More than one reason	0	0	1	1
Total	36	110	84	230

Table 5: Factors influencing Trial by Location (Washing Soaps) (Frequency of Responses)

could be because of advertisements, display P.O.P., retailer opinion or discounts (Table 5). And in Table 6 effects of brand loyalty and retailer loyalty are examined for rural and urban markets.

Note: Sample Chi-square is 36.03 for Washing Products and 30.31 for Toilet Soaps. Chi-square statistics at .05 significance level is 18.307.

Location	Washing Products			Toilet Soaps				
	Rural	Semi-Urban	Urban	Total	Rural	Semi-Urban	Urban	Total
Head of Household	16	63	34	113	18	61	38	117
Children	5	9	11	25	7	18	12	37
Servants	0	15	1	16	2	13	3	18
Any other	0	1	3	4	0	0	2	2
More than one person	9	8	7	24	8	5	5	18
Total	40	117	89	246	40	114	90	244

Table 4: Buyer for Washing Products and Toilet Soaps (Frequency of Responses)

Note: Sample Chi-square is 15.576 for Washing Products and 7.94 for Toilet Soaps. Chi-square statistic at .05 significance level is 15.507.

Location	Washing Products			Toilet Soaps				
	Rural	Semi-Urban	Urban	Total	Rural	Semi-Urban	Urban	Total
Housewife	34	100	62	196	10	35	29	74
Head of Household	3	13	15	31	10	38	28	76
Children	0	1	5	6	11	31	21	63
Servants	0	1	3	4	0	1	0	1
More than one person	3	2	4	9	9	9	11	29
Total	40	117	89	246	40	114	89	243

Table 3: Decider for Washing Products and Toilet Soaps (Frequency of Responses)

Note: Sample Chi-square is 2.183, Chi-square statistic is 5.991 at .05 significance level and 3.219 at .1 significance level.

Location Influence on Brand Choice	Bar Soap			Detergent Cake			Detergent Powder			
	Rural	Semi-Urban	Urban	Rural	Semi-Urban	Urban	Rural	Semi-Urban	Urban	
Known Brand	28	75	54	15	40	44	99	20	64	54
Retailer suggestion	5	8	3	7	23	4	34	7	15	3
Total	33	83	57	22	63	48	133	27	79	57

Table 7: Brand Choice When Regular Brand is Out-of-Stock of Bar Soap, Detergent Cake and Detergent Powder (Frequency of Responses)

The results show that when regular brand is not available the consumer buys a brand known/used before and not the one suggested by the retailer. This is

Brand Awareness: This is identified as 'know 3 or more brands' or 'do not know 3 brands'. This is examined

Brand Awareness and Habitual Buying

The influence on brand purchased when regular brand is out-of-stock is examined. The influence categories include 'known brand' and 'retailer suggestion'. The influence is examined by location and product category; bar-soap, detergent cake (Table 7).

The analysis indicates that family members in rural markets prefer a single brand of toilet soap while in urban markets different brands of toilet soap are purchased for different members. Hypothesis 7 is therefore, accepted.

In urban area, equal number of consumers are loyal to brand and to the shop but in rural areas, loyalty to shop is higher.

Brand preference of members within a family is examined by location (Table 8). The brand preference within a family is categorized as number of brands purchased within the family. These include categories of 'one brand', 'two brands', and 'different brands for different members'.

Social Influence

In rural markets trial is made when 'regular brand is not available' and to some extent because of 'discounts/gifts'. In urban areas trial is made because 'regular brand is not available' and to some extent 'advertisements' and also 'discounts/gifts'. The hypothesis 4 is accepted to an extent with variation by location true at .01 significance level. In urban area, equal number of consumers are loyal to brand and to the shop but in rural areas, loyalty to shop is higher. This difference however is not significant and hypothesis 5 is therefore, not accepted.

Note: Sample Chi-square is 2.183, Chi-square statistic is 5.991 at .05 significance level and 3.219 at .1 significance level.

Location Loyalty	Rural		Semi-Urban		Urban	
	Total	Urban	Total	Urban	Total	Urban
Brand loyal	14	49	41	104	114	104
Retailer loyal	23	54	37	114	114	114
Total	37	103	78	218	218	218

Table 6: Retail Loyalty and Brand Loyalty by Location (Frequency of Responses)

The hypothesis that in rural markets the brand purchased when regular brand is out-of-stock is the one suggested by the retailer, while it need not be so in urban markets, is only partially accepted. This is because while retailer influence is greater in rural than urban markets, more than retailer influence, it is the knowledge on the brand that influences choice.

not for bar soaps. The hypothesis that in rural markets the brand purchased when regular brand is out-of-stock is the one suggested by the retailer, while it need not be so in urban markets, is slightly more in rural than urban markets for detergent cake and detergent powder but true both in the rural and urban markets, though influence of the retailer is slightly more in rural than urban markets, though in-

The hypothesis that in rural markets the brand purchased when regular brand is out-of-stock is the one suggested by the retailer, while it need not be so in urban markets, is only partially accepted.

Note: Sample Chi-square is 3.061 for Bar Soap, 17.083 for Detergent Cake and 10.502 for Detergent Powder. Chi-Square statistic is 5.991 at .05 significance level 3.219 at .2 significance level.

Location	Bar Soap			Detergent Cake			Detergent Powder		
	Rural	Semi-Urban	Urban	Rural	Semi-Urban	Urban	Rural	Semi-Urban	Urban
Awareness	28	96	73	18	59	64	28	95	82
Know 3 brands or more	8	13	9	17	46	13	12	18	7
Do not know 3 brands	36	109	82	227	35	105	77	217	40
Total	72	218	173	245	99	182	117	307	127

Table 9: Brand Awareness by Location of Bar Soap, Detergent Cake and Detergent Powder (Frequency of Responses)

The picture of the rural consumer is a buyer who uses multiple sources of information with television as one of the important sources. The actual purchase in rural markets is by the male member of the household, though the decision maker depends on the type of product. He makes the purchase mostly from grocery store. Trial of a brand is done when regular brand is 'out-of-stock'. He does not switch the shop when the regular brand is not available, but the brand purchased is one known or used before rather than the one suggested by the retailer. The brand choice is influenced by the social group as indicated by the same brand of toilet soap purchased for the

Rural Consumer Behaviour and its Implications

Benefits Sought: The most important benefit sought for toilet soaps by the rural buyer is cleaning ability, as pointed by 17 out of 41 respondents. Low price is sought by 4 out of 41 respondents. None of the 91 urban buyers indicated 'price' to be the most important benefit. The number of rural buyers who consider 'price' and 'long lasting' to be most important is not very different from those in urban markets. The hypothesis that rural buyers consider the benefit of economy to be important is not supported. The possible explanation for this is the competitive nature of toilet soap market and the availability of number of brands in various price range.

The number of benefits sought is different according to location only at .2 significance level. Many rural buyers seek a brand which provides one most important benefit whereas in urban areas the buyers prefer brands that provide multiple benefits. There is therefore weak support for hypothesis 10 that rural buyers seek less number of benefits compared to urban buyers.

Number of Benefits Sought: Influence of the number of benefits on brand choice is examined for rural,

Benefits Sought by the Rural Consumer

Trial of washing products in rural markets is very rare but in urban markets a significant number try new brands frequently. The hypothesis 9 that rural buyers are more habitual buyers than variety seekers is accepted.

Habitual Buying: Habitual buying is identified by trial frequency, the categories of trial frequency are 'every month', 'once in 6 months', 'once a year' and 'very rarely'. These categories are examined by location (Table 10).

The analysis indicates that for bar soaps, both rural and urban markets are aware of brands but in the case of detergent cake and detergent powder, the rural markets are less aware of brands than urban markets. The hypothesis 8 that awareness is much less in rural areas compared to urban areas is only partly true as the influence of location is moderated by product category.

by location for Bar Soap, Detergent Cake and Detergent Powder (Table 9).

Note: Sample Chi-square is 53.985 and Chi-square statistic at .05 significance level is 9.488.

Location	Number of Brands Purchased			Total
	Rural	Semi-Urban	Urban	
One brand	33	77	5	115
Two brands	3	26	12	41
Different brands for members	5	21	28	54
Total	41	124	45	210

Table 8: Brand Purchase in a Family (Toilet Soaps) (Frequency of Responses)

In promoting the product, the influence of the group is indicated. The message and illustration indicating preference by the community helps trial and acceptance. Promotion requires, in addition to television, effort to push the brand at the retail level. Retail effort is to include displays and retailer suggestion to the consumer, which is useful when the regular brand is out-of-stock.

The understanding of the rural consumer has rich implications for the marketer. The study suggests a positioning effort that focuses on delivering the basic rural retail shelf. This is because the rural consumer seeks few if not single basic benefit. The product is to be positioned, wherever relevant, as a family brand for use by all the members than exclusive use by a member of the family.

Note: Sample Chi-square is 4.506, Chi-Square statistic is 5.991 at .05 significance level and 3.219 statistic at .2 significance level.

Location	Rural	Semi-Urban	Urban	Total
Number of Benefits	23	46	29	98
Brands with one most important benefit	17	66	58	141
Brands with 3 or 4 benefits	40	112	87	239

(Frequency of Responses)

Table 11: Influence of Number of Benefits on Brand Choice (Toilet Soaps)

Note: Sample Chi-square is 22.271 and Chi-square statistic at .05 significance level is 12.592.

Location	Rural	Semi-Urban	Urban	Total
Frequency of trial	3	7	21	31
Every month	6	16	18	40
Once in 6 months	0	0	1	1
Once a year	31	93	47	171
Very rarely	40	116	87	243

(Frequency of Responses)

Table 10: Frequency of Trial by Location (Washing Soaps)

entire family unlike the urban markets where family members buy different brands. The rural buyer is less aware of brands of new products compared to the urban consumer. He is more of a habitual buyer than a variety seeker and seeks few if not a single basic benefit from the brand purchased.

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Retailer incentives need to include display incentives. Display is suggested as rural buyers use multiple sources of information. They are also habitual buyers loyal to the retail shop than brand, but exhibit a tendency to purchase a brand they are familiar with. Display is important as it helps the brand to gain familiarity when the consumer visits the retail shop. Most consumer non-durables are purchased from a single shop and therefore the grocery shops are the type of shop relevant in rural markets for serving and targeting retail promotion.

A segment of rural buyers are willing to switch when discounts or gifts are made available. This suggests the need to offer gifts/discounts to get this group of habitual buyers to switch. This is to be after two/three months after the launch. Sales promotion after a time lag is to allow the consumer to gain familiarity with the brand, as this is important for inducing trial.

The objective of promotion is to create awareness and familiarity. The buyers are mostly habitual buyers who switch to another brand when regular brand is out-of-stock. This suggests that awareness followed by familiarity is important.

The understanding of the rural consumer has rich implications for the marketer. The study suggests a positioning effort that focuses on delivering the basic benefit effectively, and better than existing brands in the rural retail shelf.

— *Phillip Crosby* in
Let's Talk Quality

If a company does not have a policy of doing things right, then the innovator is always going to be disappointed.

— *Schumpeter* in
Capitalism, Socialism
and Democracy (1950)

Technological Progress is increasingly becoming the business of teams of trained specialists who turn out what is required and make it work in predictable ways.

— *Peter F. Drucker* in
The Frontiers of Management

Schumpeter's "innovator" with his "creative destruction" is the only theory so far to explain why there is something we call "profit".

□
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Instability in Agricultural Growth in Tamil Nadu: A Probe

K.N. Selvaraj, B.L. Bindhu, K. Chandran and N. Ravendaran

Introduction

Agricultural in India has shown distinct growth over the period with the advent of green revolution technologies. In their studies Barker, *et al*, 1981; Mehra, 1981; Hazell, 1982; Ray, 1983; Anderson *et al*, 1986 argued that such new technologies had destabilising effect on production and as a result the production instability increased in India. This put into question, whether the new technology has helped to accelerate crop production or has made the crop production more stable or unstable (Ray, 1991). The much of increased instability in agricultural was found during the post green revolution period compared to pre-green revolution period (Hazell, 1982; Ray, 1983; Kumar and Kaul, 1987; Pal and Sirohi, 1991; Tripathy and Gowda, 1995) due to widespread adoption of improved seed/fertilizer intensive technologies. Similarly, Mehra (1981) found that the standard deviation and coefficient of variation of production for all the crops aggregate increased during the period between 1968 and 1978 in India. The increase in variability of crop output must also be attributed to other sources, such as, increased price variability, more erratic rainfall patterns and fluctuating supplies of modern farm inputs terms and fluctuating supplies of modern farm inputs (Hazell, 1982; 1984; Kuch, 1986; Paland and Bisaria, 1990; Kumar and Kaul, 1991; Dev, 1991). Also, studies by Cummings and Ray, 1967; Ray, 1971; 1977 showed the impact of rainfall variation on trend and fluctuation in output.

The increase in variability of crop output must also be attributed to other sources, such as, increased price variability, more erratic rainfall patterns and fluctuating supplies of modern farm inputs.

Though green revolution in India led to tremendous agricultural growth, in the post revolution phase the growth has plummeted. This is because the induction of new seeding technologies coupled with large scale use of pesticides and chemical fertilizers have had destabilising effect on production causing a production instability. The present study addresses the nature and extent of instability in Tamil Nadu in agriculture pertaining to early and later phases of post green revolution periods. Based on statistical inferences, the authors have pointed out the causes of instability, especially of cereal production.

K.N. Selvaraj and K. Chandran are Assistant Professors, N. Raveendaran is a Professor and B.L. Bindhu is a Post Graduate Student, all at Department of Agricultural Economics, Tamil Nadu Agricultural University, Coimbatore-641 003.

1. Tamil Nadu was divided into seven agro-climatic regions. Region I comprises of Salem, Namakkal and Dharmapuri districts, region II covers Erode, Coimbatore, Karur, Perambalur, Tiruchirappalli, Pudukkottai, Dindigul, Madurai and Theni districts, region III represents Kancheepuram, Tiruvallur, Vellore, Cuddalore, Villupuram and Thiruvannamalai districts, region IV covers Thanjavur, Thiruvannamalai districts, region V represents Ramnathapuram, Virudhunagar, Sivagangal, Tirunelveli and Tuticorin districts, region VI covers Kanyakumari district and region VII comprises of Nilgiris district.
2. $Y = a + bt$, where Y is the index number of agricultural output, production of rice/cereals/pulses/foodgrains/sugarcane/groundnut/cotton, t represents time variable.
3. $Y_1 = a_1 + b_1t$, where Y_1 is the lower points of agricultural output index or production of rice/cereals/pulses/foodgrains/sugarcane/groundnut/cotton, around the estimated line and t is the time variable.
4. $Y_2 = a_2 + b_2t$, where Y_2 is the upper points of output index (or production of rice/cereals/pulses/foodgrains/sugarcane/groundnut/cotton around the estimated line and t is the time variable.
5. Conditions

a. $b_2 > b > b_1$	Favourable
b. $b_2 < b < b_1$	Unfavourable
c. $b_2 > b = b_1$	
d. $b_2 = b > b_1$	
e. $b_2 < b < b_1$	
f. $b_2 > b < b_1$	
g. $b_2 = b = b_1$	
h. $b_2 = b > b_1$	
6. $d_1 = e_1$ s where e_1 is the residual term and S^2 is the residual mean square.
7. $R_1 = a + bt$ where, R_1 is the actual rainfall measured in mm and t is the time variable.
8. $Z = e/\sigma_e$ where e_1 is the residual term falling below trend line σ_e is the standard deviation of e_1 .

Test of Variability between Two Periods

The probability of shortfall in rainfall was estimated to exhibit the relationship between rainfall and instability. A linear trend equation was fitted for the actual rainfall data for both the periods. From the estimated trend line, the residuals representing the lower points of the estimated line were used to calculate the z values. The probability of shortfall in rainfall was determined following the cumulative normal distribution table and the average probability of shortfall in rainfall was estimated.

Causes of Instability

The extent of instability was examined by locating the abnormal year in the entire period under study. By 'abnormality' is meant those observations which do not fall in the general pattern of the growth, as explained by the fitted regression model (Kumar and Kaul, 1991). To find out the abnormal years 'd' statistic⁶ was estimated (Snedecor and Cochran, 1967; Johnston, 1983).

Extent of Instability

Linear growth curves were fitted for lower points³ and upper points⁴. These upper and lower points show the upper and lower fluctuations in agricultural output over the period. The distance between these two lines indicated the nature of instability in the growth of agricultural output over the period. By comparing the slope coefficients of these estimated lines, the nature of instability⁵, such as, favourable or unfavourable can be studied (Kumar and Kaul, 1991).

Nature of Instability

Methodology

The analysis herein is restricted to aggregate agricultural production and production of rice, cereals, pulses, foodgrains, sugarcane, cotton an groundnut. The data used have been obtained from the various statistical issues, such as, Season and Crop Report for Tamil Nadu and Tamil Nadu—An Economic Appraisal. The time series data on production of major crops, agricultural production index and rainfall have been gathered for the period 1965-66 to 1994-95. Region-wise¹ production of rice, sugarcane, cotton and groundnut were collected for the same period. The analyses were carried out separately for the two periods viz., 1965-66 to 1979-80 (Period I) and 1980-81 to 1994-95 (Period II).

Sources of Data

The present study addresses the nature and extent of instability in Tamil Nadu's Agricultural pertaining to early and later phases of post green revolution periods, viz., 1965-66 to 1979-80 and 1980-81 to 1994-95, respectively. Specifically, the paper discusses (i) the nature and extent of instability in the growth phases of agriculture, (ii) causes of instability particularly, the effect of rainfall on agricultural production and (iii) whether there exists significant difference in instability between the two periods. The paper is organised under five sections, namely, setting, nature and source of data, analytical framework, empirical results and conclusion.

To examine the nature of instability (desirable or undesirable) in the growth of production of various crops, the linear growth curve² was estimated for the two periods for aggregate agricultural output (agricultural production index), production of rice, cereals, pulses, foodgrains, sugarcane, groundnut and cotton. Using the estimated trend line, lower and upper points of data around the trend line were obtained. Two separate

Coefficient	Aggregate Production		Cereals		Pulses		Foodgrains	
	I	II	I	II	I	II	I	II
a ₁	88.76	95.38	47.80	45.65	0.80	1.30	46.96	44.71
b ₁	5.14***	2.91***	1.42	4.77***	0.10***	0.26***	2.24	6.23***
a	99.00	61.64	49.11	54.85	0.96	1.81	50.07	56.66
b	3.23***	2.62***	1.67***	1.94***	0.07***	0.12***	1.75***	2.06***
a ₂	126.68	116.26	58.42	64.15	1.34	2.47	59.74	65.94
b ₂	3.91***	6.69***	2.11**	2.49***	0.15*	0.15***	2.20***	2.33***
	(27.43)	(14.38)	(22.29)	(26.93)	(5.26)	(15.91)	(21.71)	(28.76)
	(4.71)	(2.79)	(3.90)	(5.70)	(3.78)	(5.78)	(3.94)	(5.99)
	(15.90)	(2.80)	(12.59)	(17.68)	(5.58)	(9.60)	(12.46)	(18.10)
	(3.29)	(3.22)	(4.53)	(5.27)	(2.34)	(4.77)	(4.49)	(5.71)

(Figures in parentheses denote 't' ratios)
 *** P ≤ 0.01 (two tailed test) ** P ≤ 0.05 (two tailed test) * P ≤ 0.10 (two tailed test)
 I Period I (1965-66 to 1979-80) II Period II (1980-81 to 1994-95)

Table 1: Estimates of intercept and slope coefficients-linear growth curves

Tables 1 and 2 show the estimates of intercept and slope coefficients of major crops for both the periods. For total output, pulses, foodgrains, sugarcane, and groundnut the condition $b_2 > b < b_1$ was satisfied, which was favourable during the period I. Thus, it may be inferred that the instability in the growth of output of these crops decreased during Period I. The upper and lower lines seem to be parallel in these crops, but the rate of gap between lower and middle lines was decreasing, which showed that the upper fluctuations have contributed to growth of output during the period I, which was favourable in the period I, which was satisfied, which was favourable in period I. This indicates that the upper and lower lines seem to be parallel. The rate of gap between lower and middle line was increasing and the rate of gap between upper and middle line was decreasing, which showed that the lower fluctuations, have contributed to growth of output of cotton positively during the period I which was favourable.

Nature of Instability

Empirical Results

levels were obtained from the statistical table. To be significant at a given α level, the obtained U must be equal to or less than the table value or the obtained U' must be equal to or greater than its corresponding critical value. If the estimated value of U and U' falls in the critical region, the null hypothesis i.e. $CV(P1) = CV(P11)$ is accepted.

The greater value is designated as U'. Critical values of U and U' which are significant at various α

R_1 = Sum of ranks assigned to regions in Period I
 R_2 = Sum of ranks assigned to regions in Period II

where

$$U' = n_1 n_2 + \frac{n_1(n_1+1)}{2} \cdot R_1$$

$$U' = n_1 n_2 + \frac{n_2(n_1+1)}{2} \cdot R_2$$

The values of CV for the two periods for production of a particular crops were combined for seven regions and arranged in ascending order and ranked from 1 to 14. The sum of ranks in Period II were obtained. The value of U and U' are obtained as follows.

$H_0 : CV(P1) = CV(P11)$ against $H_A : CV(P1) \neq CV(P11)$.

For testing the null hypothesis,

The significance of difference in coefficient of variation (CV) values of two periods in the seven agro-climatic regions was tested by Mann-Whitney Test (Haber and Runyon, 1971; Rai and Sarup, 1991). The test was applied to four major crops namely, rice, sugarcane, groundnut and cotton. The coefficient of variation (cv) around the trend line was computed for the seven regions for the periods I and II.

The extent of instability was examined by estimating the 'd' statistics (Tables 3 and 4), which indicate the abnormal years for the period under investigation. The large absolute values of 'd' statistics indicate abnormality in production. Positive and large values of 'd' statistics may favourable to growth of agricultural outputs and identified as bumper crop years. However, these values have also been taken into account to locate the abnormality. From the table was found that values of 'd' statistics it were found higher for the years 1971-72 to 1974-75 and 1976-77 in the case of total production in period I. In period II, the abnormal years for aggregate production were 1981-82, 1983-84 and 1994-95. In the case of cereals, the years 1974-77 for period I and 1981-82 and 1982-83 for period II were found to be abnormal years. The period between 1971-72 and 1975-76 was found to be abnormal as estimated 'd' statistics were found to be more than one for pulse

Extent of Instability

In cereals, the condition $b_2 < b < b_1$ was satisfied and found unfavourable. It shows that the instability in growth of output of cereals has increased during this period due to increase in gap between lower line and upper lines. The rate of increase in gap between lower and middle was greater than the rate of gap between upper and middle line. Hence, it could be concluded that the contribution of depressant years is higher towards instability in cereals production.

In period II, the condition $b_2 < b < b_1$ was satisfied for total output, pulses, foodgrains, rice, sugarcane and groundnut, which was favourable. Mehra (1981) argues that irrigation played crucial role in stabilising the production of crops and observes that the absolute increase in yield variability is small in rice. Similarly, Ray (1991) indicates that among the non-foodgrains, particularly, sugarcane, absolute and relative yield variability is lower due to contribution of irrigation towards stability. The results indicate that the upper and lower lines seem to be parallel and the rate of gap between upper and middle lines was increasing and the gap between lower and middle lines was decreasing, which implies that the upper fluctuation contributed to growth of output of these crops negatively during the period II. In Cotton, the condition $b_2 < b < b_1$ was satisfied, which was favourable. This indicates that rate of gap between lower and middle lines was increasing,

For cereals and rice, the condition $b_2 < b < b_1$ was satisfied, which was unfavourable. Hence, it could be inferred that the instability in growth of output of cereals and rice has increased during the period I. It was observed that the gap between upper line and lower line has increased with the time and the middle line in the case of rice. In the case of cereals, the rate of increasing gap between upper line and middle line was higher than the rate of gap between lower line and middle line. The results indicate that in the case of rice, the contribution of depressant years is higher towards instability, while in cereals the contribution of bumper years is higher towards instability.

Table 2: Estimates of intercept and slope coefficients-linear growth curves

Coefficient	Rice		Sugarcane		Groundnut		Cotton	
	I	II	I	II	I	II	I	II
a ₁	34.30	38.45	64.60	143.00	8.04	7.33	2.76	2.06
b ₁	(15.02)	(12.49)	(17.63)	(15.60)	(9.68)	(12.86)	(9.37)	(8.37)
	0.97	3.55***	10.45	11.97***	0.16	0.74***	0.06	0.24***
a	(1.55)	(5.82)	(16.04)	(8.12)	(0.85)	(5.82)	(1.19)	(6.59)
	35.33	40.77	80.84	146.61	8.73	6.51	3.84	2.90
	(9.68)	(15.01)	(6.89)	(8.41)	(11.22)	(7.64)	(4.36)	(5.74)
b	1.43***	2.00***	5.61***	9.19***	0.15***	0.72***	0.01	0.13**
	(3.56)	(6.70)	(4.35)	(4.79)	(7.69)	(7.69)	(0.01)	(2.28)
a ₂	44.33	40.48	88.93	126.57	10.12	7.01	6.88	5.74
	(14.29)	(11.02)	(3.62)	(2.94)	(12.89)	(8.51)	(3.80)	(7.61)
	1.69***	4.76***	14.34*	38.65**	0.19	1.55***	-0.42	-0.28
b ₂	(3.06)	(5.79)	(2.27)	(2.98)	(1.20)	(9.52)	(-0.77)	(-1.02)

(Figures in parentheses denote 't' ratios)

I Period I (1965-66 to 1979-80)
 II Period II (1980-81 to 1994-95)
 *** P ≤ 0.01 (two tailed test)
 ** P ≤ 0.05 (two tailed test)
 * P ≤ 0.10 (two tailed test)

I Period I (1965-66 to 1979-80)
II Period II (1980-81 to 1994-95)

Year	Rice		Sugar cane		Groundnut		Cotton	
	I	II	I	II	I	II	I	II
15.	0.19	0.96	-0.51	2.49	-0.19	0.19	-0.08	-0.42
14.	0.04	-0.26	-0.24	-0.48	0.37	1.31	1.05	-0.44
13.	0.47	0.25	0.75	-1.10	0.62	1.14	0.87	-0.02
12.	-1.54	0.23	-0.27	-0.25	-1.83	1.01	-0.30	-0.34
11.	0.15	-0.99	-1.07	-0.40	0.15	-1.68	-0.88	-0.22
10.	-2.06	-0.03	0.41	-0.39	-1.42	-1.02	-0.83	0.98
9.	1.10	-0.35	2.34	0.25	1.37	-1.31	0.34	-0.02
8.	1.33	-0.13	-0.21	-0.39	0.32	0.52	-0.40	0.49
7.	1.15	-0.29	-0.77	0.16	1.94	-0.40	0.20	-1.07
6.	0.92	0.18	-0.95	-0.05	0.20	0.59	-0.41	1.28
5.	-0.35	-0.57	0.01	-0.52	-0.99	0.16	-0.40	2.49
4.	-0.82	-0.49	-1.71	-1.25	-0.19	-0.07	-0.85	-0.56
3.	-0.32	-2.07	-0.50	-0.37	-0.13	-0.99	-0.54	-1.15
2.	0.04	2.41	-0.74	1.36	-0.13	1.57	2.77	-0.58
1.	-0.22	0.002	0.05	0.93	-0.45	0.29	-0.52	-0.45

Table 4: Extent of instability—estimated 'd' statistics

I Period I (1965-66 to 1979-80)
II Period II (1980-81 to 1994-95)

Year	Aggregate Production		Cereals		Pulses		Foodgrains	
	I	II	I	II	I	II	I	II
15.	-0.32	1.45	0.04	0.06	0.28	-0.57	0.02	0.56
14.	0.31	0.37	0.18	-0.39	0.69	-2.05	0.20	-0.51
13.	0.14	0.22	0.65	0.01	0.21	0.18	0.64	0.02
12.	-1.27	0.004	-1.05	0.17	-0.19	0.77	-1.03	0.22
11.	-0.44	-0.72	0.43	-0.85	-1.50	1.36	0.35	-0.76
10.	-1.60	-0.19	-2.65	0.27	-1.66	0.95	-2.64	0.33
9.	1.93	-0.67	0.95	-0.27	1.37	-1.16	0.98	-0.33
8.	1.25	-0.51	0.96	0.28	1.36	0.19	0.99	0.28
7.	1.23	-0.71	0.84	0.04	1.56	1.35	0.89	0.13
6.	0.73	-0.29	0.92	0.60	-0.19	0.65	0.88	0.64
5.	-0.07	-0.63	-0.18	0.32	-0.72	0.23	-0.20	0.33
4.	-0.82	-1.53	-0.87	-0.39	-0.59	-0.20	-0.87	-0.40
3.	-0.43	-0.07	-0.15	-2.34	-0.11	-0.77	-0.15	-2.28
2.	-0.27	2.30	0.14	2.30	0.22	-0.47	0.14	2.25
1.	-0.38	0.91	-0.206	-0.36	-0.04	-0.47	-0.20	-0.38

Table 3: Extent of instability—estimated 'd' statistics

For rice production in period I, the abnormal years were 1971-72 to 1974-75 and 1976-77. In period II, 1981-82 and 1982-83 were found to be abnormal years for rice production. In the case of sugarcane, the abnormal years were 1968-69 and 1974-75 during the period I, whereas 1981-82, 1983-84, 1992-93 and 1994-95 were found abnormal years during period II. For groundnut, 1971-72, 1973-74, 1974-75 and 1976-77 were found abnormal years for period I. On the other hand, 1981-82, 1988-89 to 1990-91 and 1992-93 to 1993-94 were found

The probability of shortfall in rainfall was considered to examine the relationship between instability in aggregate agricultural production and rainfall. The probabilities of - shortfall in rainfall was presented in Table 5. From the table it could be observed that the average probability in shortfall of rainfall in period I is 0.30 and that in period II is 0.27. These low probability values can be attributed to the reasons for favourable instability in total agricultural output in both the periods.

Causes of Instability

abnormal years during period II. With regard to cotton, the abnormal years were 1966-67 and 1978-79 during period I, while in period II, 1982-83 to 1984-85 and 1986-87 were found abnormal years.

production in period I. In period II 1986-87, 1988-89, 1990-91 and 1993-94 were found to be abnormal years for pulse production. In the case of food grains, 1974-75 and 1976-77 were found to be abnormal years during period I, while 1981-82 and 1982-83 were found to be abnormal years during period II.

Region	Period I (1965-66 to 1979-80)		Period II (1980-81 to 1994-95)	
	I	II	I	II
Rice	5.38	26.30	31.47	15.45
Sugarcane	16.83	18.00	15.89	4.45
Groundnut	16.53	15.07	24.63	26.69
Cotton	12.70	24.40	16.95	38.10
	0.89	17.99	57.93	17.29
	19.62	4.24	101.16	87.09
	5.51	8.08	7.98	63.03
	12.52	95.94	7.73	15.70
	30.92	1.10	19.40	7.18
	27.26	46.08	34.30	16.80
	10.27	72.12	49.95	83.56
	18.07	40.98	25.73	9.43
	7.62	14.49	24.19	0.22
	32.29	58.32	28.85	12.40
	12.52	95.94	7.73	15.70
	30.92	1.10	19.40	7.18
	27.26	46.08	34.30	16.80
	10.27	72.12	49.95	83.56

Table 6: Coefficient of variation as a measure of variability in production of major crops for the seven agroclimatic regions of Tamil Nadu (Per cent)

Year	Period I (1965-66 to 1979-80)		Period II (1980-81 to 1994-95)	
	e_t	Z	Probability	Year
1965-66	-42.31	-0.28	0.39	1980-81
1968-69	-240.58	-1.61	0.05	1982-83
1970-71	-11.56	-0.08	0.47	1984-85
1973-74	-97.33	-0.65	0.26	1986-87
1974-75	-295.42	-1.98	0.02	1988-89
1975-76	-88.91	-0.60	0.27	1990-91
1976-77	-8.00	-0.05	0.48	1991-92
1978-79	-6.18	-0.04	0.48	1992-93
				1994-95
				Mean = 0.30
				Mean = 0.27
				0.19
				0.15
				0.37
				0.15
				0.13
				0.12
				0.47
				0.35
				0.48

Table 5: Probability of shortfall in Rainfall

crops considered for the analysis. However, the degree of instability in the case of rice and groundnut was higher during period II compared to period I. In the case of cotton the degree of instability was greater during period I compared to period II.

The instability in cereal production was found unfavourable in both the periods implying that the instability in growth of cereal production increased. The instability in growth of rice production was found unfavourable in period I and turned to favourable in period II.

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Test of Variability in Crop Output Between Two Periods

The significance of the difference in CV values of two periods based on seven agro-climatic regions for each crop was tested by Mann-Whitney Test. The coefficient of variation and estimated Mann-Whitney test statistics are furnished in Tables 6 and 7. The comparison of U and U' with that of critical table values indicates that there was no significant difference in variability in production of rice, sugarcane, groundnut, cotton between two periods. However, it was observed that the sum of ranks for period II was more the period I in the case of rice and groundnut implying that instability in rice and groundnut production was higher during period II as compared to period I at probability level 0.01. In the case of cotton, the sum of ranks for period I was higher than the period II indicating that greater instability in cotton production in period I compared to period II at probability level 0.01. In the case of sugarcane, the sum of ranks for period I and period II were found equal.

Table 7: Estimated Mann-Whitney test statistics

Crop	U	U'	R ₁	R ₂
Rice	15.00	34.00	43.00	62.00
Sugarcane	24.00	25.00	52.00	53.00
Groundnut	11.00	38.00	39.00	66.00
Cotton	11.00	38.00	66.00	39.00

The critical table at = 0.01 are 4 and 45.
 R₁ = Sum of ranks during the period I
 R₂ = Sum of ranks during the period II

Conclusions

For total output, pulses, foodgrains, sugarcane, groundnut and cotton the instability was found favourable indicating that the instability in the growth of output of these crops decreased during both the periods. The instability in cereal production was found unfavourable in both the periods implying that the instability in growth of cereal production increased. The instability in growth of rice production was found unfavourable in period I and turned to favourable in period II. Thus, the instability in rice production increased during period I, while it decreased during period II. The estimates of probability in shortfall in rainfall was found low, which could be attributed for the favourable instability in the growth of aggregate output in both the periods. The estimates of Mann-Whitney statistics indicated that there was no significant difference in instability between two periods for the major

— Sheridan M. Tatsuno in
Created in Japan

The ultimate level of creativity, if it can be achieved, is spiritual enlightenment in which the creator and idea become one.

— James B. Quinn

It is essential that technological managers and policy makers learn from the past successes and failures, those patterns that lead to important innovations.

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Methodologies for Optimal Agroforestry Systems

K.R. Shanmugam

Agroforestry is a new discipline that integrates forestry and agriculture. In India, the agroforestry practices are very location specific and information on them is mostly anecdotal. Lack of appropriate methodologies also poses serious impediment to assess the viability of these practices. Therefore, their benefits have remained vastly under exploited to other potential sites. This paper outlines the recently developed methodologies for evaluating optimal agroforestry practices using hypothetical example. The methodology consists of two computational techniques, namely the cost-benefit analysis and linear programming. They provide a guideline for developing economic strategies for optimal agroforestry systems.

K.R. Shanmugam is an Assistant Professor, Madras School of Economics, Chennai-600 025.

Introduction

Agroforestry (AF) refers to all land use systems and practices where woody perennials are deliberately grown on the same land management unit as agricultural crops and/or animals in either spatial arrangement or a temporal sequence, there being both ecological and economic interactions between different components. India has a long tradition of AF practices. Wherein the cultivators integrate a variety of woody perennials in their crop and live stock production fields depending upon the agro-climatic conditions and local needs. Based on the nature of components, these practices are classified in to agro-silviculture (crops + trees), silvi-pastoral (trees + pasture/ + animals), agro-horticultural (crops + fruit trees), agro-silvi-pastoral (fruit trees + pasture + animals), agro-hort-silviculture (crop + fruit trees + multi purpose tree species) and homestead agroforestry. Most of these AF practices are, however very location specific and information on these systems is mostly anecdotal. Therefore, their benefits have remained vastly under exploited and unexploited to other potential sites. With the current interests in AF in worldwide, attempts are being made in India to introduce improved AF techniques using indigenous and exotic multi purpose and/or nitrogen fixing trees and shrubs. However, lack of appropriate methodologies for evaluating various types of AF systems has been a serious impediment to realistically assessing their merits and benefits (Nair and Daggar, 1991).

Most of these AF practices are, however very location specific and information on these systems is mostly anecdotal. Therefore, their benefits have remained vastly under exploited and unexploited to other potential sites.

The second step is to express productivity of different outputs in measurable, quantitative and meaningful terms. In a vast country like India with distinctly different agro-ecological regions, such a valuation of productivity outputs based on the local market value of the products is a good method of comparing systems from different areas. But the main drawback is that many of the products of AF systems are of non-monetary nature. Moreover, many of the products are consumed at the point of production and they do not enter even the local markets (Nair and Dagar, 1991). The best example is the existence of subsistence farming. In this context, one can use the proxies (or opportunity costs) for item values. For example, to value the fuel wood, the labour time for collecting it or prices of alternative fuels such as kerosene or dungcake may be useful (Hoekstra, 1985). For valuing fodder, one can use the increased amount of cattle production (Nadkarni, Ninan and Pasha, 1992) or cost of substitute fertilizers as a proxy. Regarding environ-

In general, there are both social and private costs and benefits associated with any project. The private benefits and costs are internalized into a production unit while the public costs and returns accrue to the society as a whole.

costs and benefits streams. In general, there are both social and private costs and benefits associated with any project. The private benefits and costs are internalized into a production unit while the public costs and returns accrue to the society as a whole. In the private profit making units, the society's welfare is not given primary consideration. Hence, the concept of social cost-benefit is not relevant in the context of AF. The cost stream involves establishment (fixed) cost and recurring/maintenance cost. The former consists of all the expenses on goods and services (excluding land value) required for the establishment of trees. It includes land preparation, ploughing, bunding, filling of pits, seedling costs, gap filling etc. The later exists in almost all the years. It covers the expenditures on manure, fertilizer and water, pruning or lopping, felling cost (only in harvest year), expenses on all hired labours and interest on establishment. Besides, it adds all the costs incurred on seasonal crops if inter cropped with trees. The benefit stream includes all the direct benefits from trees and seasonal crops and indirect benefits such as increased land value and credit worthiness. It also includes the environment benefits such as soil conservation, salinity control, wind shelter and live fencing.

In this analysis (CBA), the first step is to identify the

Cost-Benefit Analysis

The basic attributes of all AF systems are productivity, sustainability and adaptability. A productivity criterion is concerned with the calculation of the economic values of different products/systems and evaluates their performance. Sustainability refers to the maintenance of production over time, without degradation of natural base on which production is dependent. Adaptability requires a land classification system that takes in to account biophysical as well as legal and social consideration. The productivity criteria, deals with how economic analysis helps to evaluate AF practices, assuming that other two criteria are fulfilled. Since farmers have limited resources, it is essential to determine optimal AF technologies. To optimize the system, one has to answer the following two questions: (i) what is the optimal or best joint production possibility for a specific AF management option? and (ii) what is the optimal mix of AF management options to apply for a given area? To answer such questions, two methodologies, namely cost-benefit analysis and linear programming method might be useful. The first one helps to determine the best practice to use while the second helps to find out the optimum solution.

Economic Criteria for AF Systems

The design of AF systems based on economic tools, requires a land management planning process that clearly specifies needs, requirements and objectives along with land suitability for potential AF practices.

The design of AF systems based on economic tools, requires a land management planning process that clearly specifies needs, requirements and objectives along with land suitability for potential AF practices. Specifically, production economics, capital theory, valuation techniques, cost-benefit analysis and linear programming are useful to find out the best or optimal mix of AF management options to apply (Better, 1988). In the Indian context, a few studies have emerged to evaluate selected tree crops using cost-benefit analysis (Singh, 1988 and Sudha and Reddy, 1990). However, no attempt has been made to provide estimates of the best production combinations and to provide optimal AF practices to use. This paper outlines the methodologies that are recently developed for determining optimal AF systems using a hypothetical example:

$$BCR = \sum_t B_t (1+r)^{-t} / \sum_t C_t (1+r)^{-t} \quad (3)$$

BCR is a ratio of discounted benefits to discounted cost, given by

$$AV = NPV / \sum_t [1 / (1+r)^t] \quad (2)$$

for measuring AV is: worthy. AV gives a constant annual amount. The formula on the capital. If it is negative, the investment is not of the capital invested plus the specified rate of return, r in year $t=0, 1, n$. If NPV is positive, the return is excess where B_t and C_t are the benefits and costs respectively

$$NPV = \sum_t (B_t - C_t) (1+r)^{-t} \quad (1)$$

The formula for computing NPV is The surplus generated by the system in today's term. (IRR) may be useful to judge a system. NPV is simply (AV), Benefit cost ratio (BCR) and internal rate of return (IRR) may be useful to judge a system. NPV is simply appraisal measure, net present value (NPV), annuity value of time to wait for consumption. Regarding project ap- the risk of AF practices being successful and the length take into account the status of the farmer, his outlook, rate. To determine the time preference rate, one has to rate. Another school favours the use of time preference some mix of debt to equity to determine the discount farmers best alternative investment (equity) and the rate depends on factors such as the rate of return for the various methods to select the discount rate. Usually it differences in the loss of interest. The literature suggests denominator, namely present value (PV). It eliminates bring back costs and returns to a common times on a comparable basis. Discounting is useful to computing costs and benefits that occur at different and the choice of project evaluation method. AF prac- The next step involves the choice of discount rate

In a vast country like India with distinct-ly different agro-ecological regions, such a valuation of productivity outputs based on the local market value of the products is a good method of comparing systems from different areas.

mental benefits, various procedures are available in the literature to value them, particularly, the contin- gent valuation methods might be useful. Inputs are also valued at commercial prices.

AF systems represent simultaneous mixing of perennial and seasonal crops and/or animal production. The basic idea is that total net benefit is greater where joint rather than monocropping exists. In economic term, this is a joint production enterprise.

AF systems represent simultaneous mixing of perennial and seasonal crops and/or animal production. The basic idea is that total net benefit is greater where joint rather than monocropping exists. In economic term, this is a joint production enterprise. Hence it is essential to recognize various possibilities of AF joint production. There are three distinct relationships among tary and competitive. If an increase in the production of tree crop has no influence on seasonable crop yield, it is called a supplementary/independent relationship. A complementary relationship exists if an increase in tree output increases another product. A competitive relation is one in which a rise in tree production causes a decline in crop yield. In each of these categories, there may be a several combinations of trees and food crops. Based on land type, soil, topographic and other condi- tions the farmer has to choose a particular tree/crop combination and then determine the best production combination to produce. For example, for a given cost stream, a farmer can produce a several combination of tree (say, Casuarina) and food crop (tomato—a vegetable). Given the value of casuarina and tomato, one particular combination may maximize NPV. For another combination, (say casuarina and maize) the same cost outlay may yield a different optimal combina- tion and net return. Thus, proper AF planning would

Each measure has its own merits and demerits. Evaluate different species and rank them accordingly. or graphic method). One can use these measures to still break even. One can calculate IRR by interactive procedures (i.e., solving polynomial equation method, interest that a farmer could pay for the resources if he is it measures the maximum rate of return. That is, it is the

$$\sum_t (B_t - C_t) (1+r^*)^{-t} = 0. \quad (4)$$

the equation: If $BCR > 1$, it is worthy to invest on the system. If it is less than one, the system is not economically viable. IRR determines the rate of discount at which NPV is zero. Mathematically, it is the value of r^* that satisfies

consider this type of analysis for all the possible AF practices. The next step is to determine the best over all option in terms of maximizing net returns while increasing cost outlays (for example, increasing fertilizer use). Numerous optimal combinations may exist as costs increase. But only one combination may be the best over all.

Application of CBA

For instance, assume that a farmer in a village of South Arcot district in coastal Tamil Nadu is not well fed and his land is suitable for either intercropping casuarina with maize or vegetables. Casuarina is a hardy erect growing tree with a rotation of 5 years. Intercropping is possible for first 2 years. The side branches can be lopped in the 3rd and 4th years. Let the market prices for vegetables, maize and fuel wood is Rs. 5/kg, Rs. 4/kg and Rs. 1000/tonne respectively. Assume further that other intangible benefits are negligible. Using market prices of material inputs and wages for labour, one can estimate the cost stream. Since the cultivator is not fairly well fed, we can use a higher time preference rate of 12 per cent to calculate NPV, BCR and AV.

The selected options may have a varying density of casuarina and different yield of food crop/vegetables and casuarina per acre over 5 years. These different combinations could exist for a given level of cost. As total cost rises (due to more fertilizer use), a whole new set of production possibilities can occur. Within each practice, there is one best combination for each cost outlay and one best overall benefit when costs vary. This represents 'the best of the best' of the joint production possibilities from a standpoint of NPV. Suppose the best combinations for casuarina-vegetables and casuarina-maize are those as shown in Table 1. Determining the desirable AF practice involves comparing the NPV, BCR and IRR. The results in Table 1 illustrates how economic analysis may indicate one practice is better given a certain economic criterion while another is better when a different criterion is used. For example, casuarina-vegetable combination provides the highest NPV while casuarina-maize gives the largest BCR. Choosing one over the other depends on the situation. The sensitivity analysis might be useful to check the robustness of the system if some of the assumptions change. Suppose an interest is to know the viability of the system when different discount rates are used, say for example 8 per cent, 12 per cent and 15 per cent or when either benefits or costs or both vary. Table 2 presents the results of sensitivity analysis on the economic evaluation of casuarina-vegetables. Thus CBA helps to evaluate different systems and to identify the best AF practice to apply.

Suppose the farmer has limited resources and constraints. For example, there may be a certain limits on land, budget available, labour as well as requirement of

The selected options may have a varying density of casuarina and different yield of food crop/vegetables and casuarina per acre over 5 years. These different combinations could exist for a given level of cost.

Table 1: Economics of Casuarina Cultivation (Rs./acre)

Year	Casuarina-Tomato		Casuarina-Maize	
	Costs	Benefits	Costs	Benefits
1	5500	2500	4000	3000
2	3000	2500	3100	3000
3	750	300	500	200
4	750	600	500	500
5	2500	18000	1500	12000
Total	12500	23900	9600	18700
	At 12% Discount rate		NPV	5344.5
			BCR	1.63
	IRR (%)			77.78

Table 2: Sensitivity Analysis on Evaluation of Casuarina and Tomato Cultivation

Discount Rate (%)	NPV	AV	BCR	(a) Changes in Discount Rate		
				NPV	AV	BCR
0	11400	2280	1.91			
8	7425.12	1721.92	1.65			
12	5938.6	1470.91	1.54			
15	4988.5	1294.04	1.47			

Vertical Axis = % Change in Gross Returns	(b) Changes in Costs/Benefits Stream		
	NPV in Rs. at 12% discount rate	Horizontal Axis = % Change in Costs	Vertical Axis = % Change in Gross Returns
10%	6532.46	7622.37	8712.28
0%	4842.69	5938.6	7028.51
-10%	3164.92	4254.83	5344.74

Linear Programming Technique

certain production levels of fuel wood and food crop (these constraints are not considered in CBA). Considering constraints, requirements and limited resources, LP technique determines whether a mix of these best AF practices (specified through joint production analysis) is optimal overall.

Table 3 shows the (hypothetical) amount of resources available and production requirements for the present case. The LP formulation of this problem is:

$$\begin{aligned} X &: \text{acres of casuarina - vegetables} \\ Y &: \text{acres of casuarina - maize} \\ \text{Maximize NPV} &= 5938.60 X + 5344.50 Y \end{aligned}$$

Subject to:

$$\begin{aligned} 240 X + 200 Y &\leq 1100 && \text{Family Labour (hours)} \\ 12500 X + 9600 Y &\leq 50000 && \text{Budget (in Rs.)} \\ 12 X + 008 Y &\leq 45 && \text{Fuel wood (in tonne)} \\ 125 X + 165 Y &\leq 750 && \text{Protein (kg.)} \\ X + Y &\leq 5 && \text{Land (in acres)} \\ X, Y &\geq 0 \end{aligned}$$

Table 3: Constraints and Requirements

Constraints	Amount of Resources Used or Product Produced		Total amounts required/available
	Casuarina-Tomato	Casuarina-Maize	
Land (acre)	1	1	5
Family Labour (hours)	240	200	1100
Budget (in Rs.)	12500	9600	50000
Fuel Wood (tonne)	12	8	45
Nutritional Protein (kg) from Foodcrop	125	165	750

Using LP, one can determine what is the best given the objective of maximizing NPV, but allowing for a mix of the two best AF practices while considering con-

straints and requirements of the farmer. The LP results are shown below:

Linear Programming Results

Objective Function

$$\text{Total NPV Rs. } 26586.67$$

Optimal Production:

$$\begin{aligned} \text{Casuarina - Vegetables} &= 1.224 \text{ acres} \\ \text{Casuarina - Maize} &= 3.614 \text{ acres} \end{aligned}$$

Resource Constraints:

Amount used	Amount Produced	To be Produced
Land (acre)	4.838	0.162
Family Labour (hours)	1016.67	83.33
Budget (in Rs.)	50000.00	0.00

Production Requirements:

Amount Produced	To be Produced
Fuelwood (tonne)	43.61
Protein (kg.)	749.38
	0.62

Conclusions

AF is a relatively a new research area in economics. This article outlines the recently developed methodologies for determining optimal AF systems. The methodology consists of two computation methods, namely CBA and LP method. The CBA is useful to evaluate different AF practices and rank them to identify the best production combination for suitable land. In return, these best combinations can be used as decision variables in an LP model that considers additional constraints and requirements. The LP analysis then specifies what is the best in the broader context of the problem. Coupled together as a package of these techniques provides a guideline for developing optimal

wood that he could buy in the market. There is a shortage of 1.39 tonne of fuel-wood that he could buy in the market. There is a shortage of 1.39 tonne of fuel-wood that he could buy in the market. There is a shortage of 1.39 tonne of fuel-

Acknowledgements

AF systems. Besides, one could consider the differences in farming systems and risk attitudes of farmers towards their allocation decision. Such a consideration could largely enhance the successful adoption of agroforestry practices.

this manuscript.

I am thankful to Dr. R.N. Poduval and Dr. C. Rajayan for giving me an opportunity to work in the project 'Economic Modelling for Agroforestry in Tamil Nadu' and learn the subject. I thank Mrs. Saraswathi for typing

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Kerala's Demographic Transition: Determinants and Consequences by Zachariah, K.C. and S. Irdaya Rajan, (eds.), Sage Publications India Pvt. Ltd., New Delhi, 1997, p. 367; Price Rs. 450 (cloth bound).

Kerala has considerable international and national attention because of its unique demographic transition and its success in the field of education, health and family planning. However, it has a relatively poor record in industrial development and agricultural growth which goes against the widely held belief that declines in fertility and mortality rates are primarily a consequence of high economic growth rates. The present book reviews this situation. The book comprises sixteen research papers, including an overview contributed by scholars of eminence in India and abroad. The book is divided into four parts. While papers in Part A are on demographic transition in the State, those in Part B are concerned with specific determinants of demographic changes. Papers in Part C deal with consequences of demographic transition in Kerala and those in Part D are related to migration.

In the chapter on "Demographic Transition since Independence", Mari Bhat and Irdaya Rajan carefully evaluates the fertility and mortality trends in Kerala. According to them the credit for the observed demographic transition should basically go to its expanding female literacy. In another paper, K.C. Zachariah, argues however, that the fertility decline in the State was caused as much by historical developments, particularly a series of socio-economic changes, as by recent Government policy interventions.

Comparing the fertility differentials in Kerala and Madhya Pradesh, D. Radha Devi raises a pertinent question as to why fertility is high even among graduate women in Madhya Pradesh and comparatively low even among illiterates in Kerala.

Consequences of demographic change have been analysed by different authors by considering age at maternity, low birth weight babies and increase in the number of elderly persons. Regarding length of mater-

nity, Mishra and Rajan comment that the effective reproductive span in Kerala has declined from 13.2 years in 1971, to 9 years in 1981 and to just 4.3 years in 1992. This has implication in that more and more women are now joining the labour force which has accentuated further unemployment problem in the State.

Net out-migration from Kerala has also played an important role in its demographic transition. Until 1941 Kerala was a net gainer through migration but thereafter continual decrease of in-migration and other factors caused the rate of out-migration to increase over time. In particular, emigration to Gulf countries has brought both economic and social change in the State. Thomas Isaac analyses this situation by considering (a) impact of outflow of migrant workers on the domestic employment situation; (b) impact of remittances on consumption, savings, investments and state domestic product; (c) problems and prospects of return migration for the state's economy; and (d) impact of migration on the distribution of assets and income.

An important question arises whether the Kerala model is applicable to other states of India. The experience of Kerala in the 1980s showed that a well executed MCH programme can go a long way in reducing fertility in other states of India as well. Involvement of bureaucracy in the family planning programme, particularly in respect of sterilizations, in both Kerala and Tamil Nadu, has been an important factor in fertility reduction which has not been the case in other states. Consequently, fertility reduction in north Indian states may not follow the Kerala and Tamil Nadu path. There has to be a larger role for the programme factors in creating demand for small families. Moreover, all studies of the Kerala experience, without any exception, emphasize the critical role which literacy and female education has played as the determinants of fertility and mortality decline. This then becomes a pre-requisite for the demographic transition in other states.

The book is a welcome addition to literature on demographic transition and should be useful not only to

On the whole the author has taken pains to highlight the importance of SQC tools for continuous improvements. The utility of the book could have been enhanced, if some case histories stressing the importance of SQC approach are added. Over all, the book gives a

In Chapter 9, the opinion of the reviewer is the crux of modern day Quality Control activities for achieving customer satisfaction. Even though the process capability concept is discussed, consequences of unwarranted adjustments without knowing process capability should have been highlighted. The illustrations are good. In this chapter concept of continuous Quality Improvements to achieve zero defects should have been added.

Chapter 4-6 explain the methodology of setting X-R charts, attributes and special kinds of control charts illustrated with suitable examples. The author could have devoted more attention through graphical illustrations the various situations in control charts necessitating corrective actions. Special control charts like sloping control charts should have been mentioned as many mechanical engineering industries use grinding, drilling etc. as processes of producing components.

This book (comprising 10 chapters), intended to provide an insight into various statistical techniques used in shop floor for achieving better quality. Chapter 1 briefly explains in a simple language the concepts of Quality Control and needs of statistics and can be easily understood by the shop floor people. However, the author could have explained the concepts PDCA Cycle and of quality through ISO 9000 definition bringing in the customer focus. The next chapter dealing with the elementary mathematics, ought to have been replaced by Data Planning for achieving better results. The treatment of control charts in chapter 3 is lucid. However concepts of chance and assignable causes, run charts should have been explained in a more detailed manner.

Quality Control on Shop-floor by K.S. Krishnamurthy, Productivity Press (India) Pvt. Ltd., Chennai, 1997, p. 100, Price Rs. 125.

M.K. Premi
JNU Professor (Retd.)
1036, Sector D-1, Vasant Kunj
New Delhi-110 070

makers.

the academicians, but more so to planners and policy

first hand knowledge of control chart to the shop floor people. The price of the book is affordable.

P.R. Lakshminathan
SQC & OR Unit
Indian Statistical Institute
7, S.J.S. Sanswal Marg
New Delhi-110 016

Industrial Organisation by Anindya Sen, (Ed.), Oxford in India Readings: Readers in Economics (Themes in Economics Series), General Editors: (Kaushtik Basu & Prabhat Patnaik), Oxford University Press, New Delhi, 1996, p. , Price Rs. 650.

The Readers in Economics is an extension of the ongoing Themes in Economics series, wherein important published essays and book extracts on specific topics are covered. The need for these arises from the fact that over the years economic journals have become both numerous and expensive.

The present volume of the series would be a theoretical introduction to many of the major issues in industrial organisation, theory of the firm, static oligopoly models, price discrimination, product differentiation, entry deterrence, collusion and innovation. It also shows that tools of industrial economics can be usefully applied to developmental issues, primarily in two areas: to analyse structural features specific to developing countries, and to the relationship between private sector managers and the bureaucracy.

The volume contains 19 select articles written by well known economists along with an introductory note by the volume editor. These articles have been grouped under eight sub headings such as (1) Theory of the firm (2) Static Oligopoly models (3) Price discrimination (4) Product differentiation (5) Entry deterrence and collusion (6) Innovations (7) Industrial organisation and developing Economies (8) Government intervention.

There is only one article, by Williamson dealing with contractual theory of firm and of attempting to pose and answer some questions concerning contractual theory. In the static oligopoly models section there is only one paper by Dixit, deriving general principles for comparative static analysis for oligopolistic markets; in particular stability conditions can be linked to the second-order conditions.

The next two sections concern and product differentiation. Price discrimination is one of the most prevalent of market practices and comes in all kinds of guises. The paper of Maskin and Riley details the quan-

This book is an elaborate study of the dreams like recurring dreams, dreams of the same night, dreams of examination, flying, falling, persecution or chase, missing a train or a plane or both, of death, of unconfounded situations etc. The dream workshops analyse these visuals which reflect our yearnings, the suppressed desires, the tangled situations which engulf the corporate world etc. In these workshops, dreamers are taught to listen to their inner voices with an open mind. Dreams need to be tapped and the answers will arise.

Every human dream and the dreams are the "blue print of attainable reality" says Anjali Hazarika in her book. Dreams are such kaleidoscopic images that connect feelings, thoughts emotions and memories and instances of dreams, to tackle the problems of the executives, managers and bosses of the corporate world who when in a tight spot look for solutions to wriggle out of uncanny situations.

Daring to Dream by Anjali Hazarika, Response Books, Sage Publications India Pvt Ltd., New Delhi, 1997, p. 208, Price Rs. 325.

K.P. Sunny
Deputy Director (Research)
National Productivity Council
Lodi Road, New Delhi-110 003

This book provides an invaluable collection of high quality articles on Industrial Organisation by renowned economists. Since some of the articles are highly mathematical in nature, the mainstream economic students and teachers in Indian Universities may find it a bit difficult to follow. However, those who are having basic knowledge in mathematics can easily follow most of the articles in this book. As a whole this book provides a ready reference on the theoretical issues involved in Industrial Organisation for the third world economists and policy makers.

than Stackelberg leadership. concludes that nationalisation is always socially better Strategies of a Public Enterprise in Oligopoly". This paper in this section is by Fraja and Delbono on "Alternative with some degree of production inefficiency. Fourth article market. This result holds if nationalisation is associated lead to lower profits if the firm operates in a duopolistic by Freshman. This paper shows that privatisation can status and Market structure: The case of Privatisation" section is on the "interdependence between Ownership" discussed in the paper are still valid. Third article in this two-parameter case, most of the qualitative results dis-

In the last section on Govt. intervention there are four articles. First article in this section is by Averch and Johnson on the Behaviour of the firm under regulatory constraint. This paper discloses that the misallocation of economic resources may result from the use by regulatory agencies of the rate-of-return constraint for price control. The next on by Baron and Myerson on "Regulating a Monopolist with unknown costs" assumes the regulator to be uncertain about both the marginal cost and fixed cost of the firm, provided that these two unknowns vary collinearly. Although they have not been able to extend the optimal solution explicitly to the general

In the section on "Innovations", there are two articles, the first one by Dasgupta and Stiglitz concerns Industrial Structure and the Nature of Innovative Activity. The other article by Gilbert and Shapiro is on "optimal patent length and breadth", enhances the scope of traditional concepts.

In the entry deterrence and collusion section there are four articles. The first article is by Dixit on the Role of Investment in Entry-Deterrence. He points out that in the event of actual entry the incumbent might find it better to share the market than fight. Realising this, the new firms would enter. An alternate way to consider a scenario is explained by Milgrom and Roberts where firms are uncertain about each other's costs. This is specially the case when one firm is not yet in the market, but is contemplating entry. Third article in this section by Baumol et al, on perfect contestability is an attempt to generalise the concept of the perfectly competitive market. The last one in this section by Green & Porter on non-cooperative collusion under Imperfect Price Information offers a theory of collusive industry equilibrium.

In the Product differentiation section there are three articles. First one is an article on 'Hotelling's model is an example of the characteristics approach to product differentiation, where each commodity is defined by its attributes or characteristics and consumers have preferences over attributes. The other approach where firms produce differentiated products but compete for the same set of customers. Dixit and Stiglitz's paper is in this tradition. In the third paper Cremer et al, examine a more neglected issue, that of the impact of a public firm in differentiated industry. Moreover, private firms may earn higher profits in the presence of a public firm than otherwise.

as examples of non linear pricing. Another paper by Bulow shows that selling firms will produce goods that are less durable than those produced by renting firms or a competitive market.

For instance to paper on health services concludes that the life expectancy of the people had improved and

In Part-II which deals with sectoral development, there are articles on topics like Agricultural development in Karnataka, Industrial policy and development, Educational policy and developmental research, Health and development in India, Irrigation and development. The papers in this part deal at length the various implications of the policies in certain sectors and how their effect will be on the development process.

The paper with the title 'Development Planning': The Contours ISEC has shown how Gandhian philosophy has relevance in contemporary India with the shift towards Panchayat Raj.

In another article 'Development and Environment', the author highlights how the environment in India was subjected to degradation in the course of economic development like rapid agricultural growth. It mainly emphasises the wrong economic incentives given for the use of chemical fertilizers contributing to the degradation of the soil.

The Institute has been engaging itself in conducting the policy research for Government of India and State governments. In the paper with the title Macro Economic Perspective: Policy tools, the author highlights how the macro economic policy tools alongwith the analysis of national income received the attention of the researchers. The growth pattern of distribution of national income substantially depended upon the policies of the Government. The author also points out the entire inter-dependency of the different layers of Government, in making the macro economic policy.

The book divided into three parts contains research papers on various topics in the field of socio economic development into which the Institute had been actively involved in its past period. Part-I consist of papers related to micro policy issues. Part-II has articles on sectoral development. While Part-III comprises articles related to general issues. Most of the papers are written by workers at the Institute.

The present book has been brought out as a commemoration volume on the occasion of Silver Jubilee of the Institute of Social and Economic Change, Bangalore.

Contours of Social and Economic Development: Policy Issues by P.V. Shenoi (Ed.), Concept Publishing Company, New Delhi, 1997, p. 292, Price Rs. 350.

Anjali Thukral
PGT (English)
DAV Public School
Sector 14, Faridabad
Haryana

Anjali Hazarika finally states "Let your dreams speak for you and let them also have a major share along with intellect and logical reasoning to solve the multi-faceted problems and intriguing situations of the corporate world you face". Sweet Dreams....

Besides teaching the ways of corporate creativity the book discusses the snowflake model of creativity developed by David Perkins, Co-Director of Project Zero at Harvard University. It talks about the six sides of the snowflake, each with its own complex structure. When the dreamer brings his dream to the workshop, he beams it to the bizarre, meaningless or mysterious. Once the dream is interpreted, the situation is understood. To live with ambiguity in the business world requires "patience and daring". The model talks about the dreams with a 'sense of purpose' which leads to promoting deals and even cancelling them. The only snag is to know how to interpret dreams, as they are "bizarre" and speak the language of metaphors. The more versatile the metaphors, the more creative you are. Employing them and revealing them should be great fun-it may also lead to behavioural change & prove helpful to the managers in the companies. The book discusses many dreams of many people and then connects them to the working situation. It also teaches to question your dreams which makes things fall in place.

Keeping track of the dreams serve as early indicators of those issues which have the potential to become stressful ones. Therefore dreams are future-tellers, thus helping the dreamer to be cautious in real life situations to minimise risks. Thus the individual can plan strategies leading to the development of personal and professional self. The dreams predict scenes and situations which one is likely to face in future. They serve as a bridge between the conscious and the unconscious, the literal and the symbolic, the explicit and the tacit", says Anjali Hazarika.

The author is of the view that if executives are free to work at what they love, or at pet projects-it will lead to innovations. Thus work environment if claustrophobic will prove to be a barrier to innovation. Excessive bureaucratic structure, short-term focus on problem solving, technological rigidities, poor nurturing of creative ideas etc. hampers effective progress.

The book provides for delectable reading and is lucid to style.

Dealing with the case studies (in areas like water, energy and forest products) of separate regions/states of India provide a vivid estimation on the current disparities in the natural resources availability across the

The book mainly focuses on the sustainable use of the vital natural treasures by means of an augmented productivity orientation in its exploitation patterns and evolution. For this scientific guidelines for ensuring equity in resources allocation. In order to justify the practicability of this, the available natural resources are being classified into two groups: renewable and non-renewable, for enabling a suitable management strategy. The book devotes elaborately on the importance of natural resources management aspects to the Indian context keeping in view of its population, demographic structures and the socio political environments.

The book under review is an elaborate accounting of the economic and social implications of natural resources management. It addresses the basic questions like what are the factors leading to the degradation of natural resources? What economic and social consequences it can lead to? What are the options available at policy levels to effectively streamline the current resource use pattern towards a healthy environment? The analysis and presentation of these aspects are well arranged by following a sequential path from the historical perspective of policy and institutions of natural resources management through the role of market forces in the same for an invisible hand to the economics of externalities and property right issues in natural resources.

A country which was representing a sub-continent could be an indicator for its vastness in geographical area and its glorious cultural and civilizational antecedents can be proof of its rich natural resource endowments. Probably because of its categorization as underdeveloped (lately developing) and by virtue of its mode of governance, very little attention has been given towards a scientific analysis of its natural resource use or exploitation patterns. However, of late with the gradual elimination of barriers for a global growth and development in the liberal perspective, the outlook towards natural resources use pattern and analysis of the same within the inculcated economic framework has been gained sufficient momentum with the theory and application in different socio political and economic situations.

Natural Resources Economics: Theory and Applications in India, by John M. Kerr, Dinesh K. Marothia, Katar Singh, C. Ramaswamy and William R. Bentley (Ed.), Oxford & IBH, New Delhi, 1997, pp. 636-xxxv, Price (Not mentioned).

K.S. Anandaram
Professor
Vaikunth Mehta National Institute of
Co-operative Management
University Road
Pune-411 007

Many of the case studies reported in the papers are around Karnataka where the Institute is located. In a country like India, the issues vary a lot from one State to another. It could have been of great value if some of these studies had included data from other regions of the country. Even in the absence of such comparative study, the included information of the book is not belittle the contribution made by the authors. The book is strongly recommended for libraries and also to all those individuals who are interested in socio economic development of the country.

In the next part, dealing with general issues, there are papers related rural development, urban development, Employment generation policy, population planning etc. The studies related to rural development have shown the various problems like housing in the rural India. Majority of the houses have only mud-walls and thatched roofs. Even some of the houses built with brick and mortar lack essential amenities like separate toilet, kitchen and so on. The housing problem is a very major one in rural areas. Another area of concern is drinking water. Even in villages where bore-wells have been provided they often break-down and the societies are very slow in putting them back to work. The author suggests certain alternatives for improving the problems of drinking water. In the same section another article on urbanisation and urban development the author highlights the problems of growth in urban population the rapid growth of cities, etc. There are many serious problems like concentration of population, environmental degradation, shortage of housing, pollution, transport, education and other basic amenities.

The Institute has carried out studies covering practically all irrigation projects in Kaveri and Krishna basins. The data collected through these studies have formed the base for drawing certain conclusion related to irrigation and development.

certain infectious diseases which used to take heavy toll of human lives are on the recede. The author has also indicated that the Indian people really do not enjoy better health.

subcontinent has been made. Thereby the constraints on productive, equitable and sustainable management of the resources could be brought out more effectively. The book also emphasises and directs the way natural resource management and issues are to be addressed. The qualitative and quantitative data requirements, analysis and information generation, followed by the orientation of natural resources and environmental theories has been clearly brought out. The appropriate method of collecting data relating to natural resources management from large populations has been identified for suitable basic analytical steps like goal and objective fixing, criteria for sources, identification of suitable alternatives.

If anything is lacking in this book, it is the human attitude to natural resources and its implications to the effective use of the economic tools to anticipate the level of accuracy. The economic and market based management approach of this book is well suited to the liberal development environment to orient the natural resources to the forces of market to arbitrate on its productivity, distribution and sustainability in the time ahead.

C.S. Sunderasan
Assistant Executive
Rajasthan Coop. Dairies Federation
D-18, Pandav Nagar
Patparganj, Delhi-110 092

Competing Through Knowledge, Building a Learning Organisation by Madhukar Shukla, Response Books, New Delhi, 1997, p. 334, Price Rs. 425 (cloth) Rs. 250 (paper).

This book comes at a time when Corporate India is in turbulence and about half of the names featuring in the "top 100" lists of firms routinely made by business glossies (I dare say, often in response to relative shares of advertising contributions to these very glossies) have been replaced between 1987 and 1997.

Management literature is full of examples of how organisations fail to live up to their promise. The question of why they fail when they do, is seldom free from controversy. Since concepts and derived practice constantly challenge each other, the real world of decisions and the virtual world of conclusions contribute to the development of both. Much has been written in recent times on the post-information age, learning organisations and knowledge-centred approaches to sustainable competitiveness. The development and diffusion of knowledge about knowledge has sparked many new fads and fashions and spawned a whole new industry. It

Leaving aside a lengthy and bit irrelevant preamble about the changing Indian economic environment, the book illustrates how conventional solutions become obsolete. Then the different levels and outcomes of corporate learning are elaborated. From theoretical perspectives underlying organisational learning, the author identifies four critical capabilities necessary: scanning capabilities, capabilities for self-reflection and problem solving, capabilities to disseminate and share information, and capabilities to act and experiment.

A remarkable feature of this publication is the author's attention to detail in analysing how awareness translates into information convertible to knowledge and how the dynamic shifts in holding such knowledge create shifts in power. Shukla cites the example of barcodes on retail products which shifted the locus of information away from producers and wholesalers to retailers. According to the author, organisations fail when they turn blind to emerging knowledge by knowingly and unknowingly erecting perceptual barriers to information, and worse, cognitive barriers to available information. This happens over a period of time so that failure is not eventually traceable to a single catastrophic trigger.

The author cites numerous examples of these capabilities. For instance, DCM Data Products kept learning only from the past and persisted with proprietary systems at a time when import liberalisation undermined its business concept. Success has bred failure in other instances too. HMT, the leader in the watch market lost 70 per cent of the market to TITAN-TIMEX; NELCO lost 98 per cent of the market by sticking to the recipe of diode sets when transistors were swamping the market; and, REMINGTON RAND, had to withdraw from the market after accumulated losses arising from sticking to manual typewriters at a time when wordprocessing needs were changing. Employee satisfaction surveys in MODI XEROX, remote sensing of harvests by ITC, and consumer surveys by ELBEE are examples of successful practices. The on-line data sharing between operations and service in HCL-HP and ASIAN PAINTS are cited as successful examples of sharing knowledge. Finally, knowledge based competition is proposed as the basis of strategy. Shukla notes the "fragmentation" of the Indian market almost as if it were a catastrophe. When sheltered monopolies and oligopolies become unable to learn, despite the announced shifts in policy, whose fault is it?

Part II of the book details case studies of six firms viz. ABB British Airways, Chaparral Steel, Citicorp, GE

is time to evaluate and separate fact from fiction. This is what Madhukar Shukla attempts in his recent offering which is well researched and compiled.

In sum, most of the studies in the present volume provide a disjoint perspective on each of the issue dealt with by them. Some studies betray lack of empirical sense: For instance, in the paper by Shankar the role of panchayats in attaining food security for the poor in

Some papers in the remaining sections provide useful details based on an understanding and appreciation of issues at the grass root level (see, for instance, Mukherjee). They come out with some sensible suggestions like the following: The nature and dimension of the problem, of food insecurity faced by the rural and urban populations differ and hence call for different approaches. Vulnerable groups, women and children in particular, need special attention with support facilities for breast-feeding and supplementary foods.

The section on Panchayat Raj institutions provides a wealth of documentary information. Many papers mention every possible issue and solution but lack an analytical perception of their inter-relationships. Majority of the papers are top-sided in focus and do not have an integrated conception of panchayat raj and its role in ensuring food security. Even when they provide factual information, they do not address contemporary policy issues and their solutions. For instance, Nath and others explain the role and responsibilities of the panchayat raj institutions in supervising the administration of the PDS but do not raise and answer questions like the following: How far these institutions have been successful in targeting the PDS and ensuring food security of the poor? If not, why? What accounts for irregular supplies of foodgrains under the PDS? How to ensure availability of foodgrains of reasonable quality at the PDS outlets?

What sets this volume apart from other studies on food security, which in general are concerned with macro issues, is its emphasis on micro operational aspects and the range of policy options available. The papers are classified into seven broad categories dealing with different aspects of the subject. They are: (i) Panchayat Raj Institutions—New Features; (ii) Food Security—Current Situation, Nutritional Aspects, Household Food Security, Public Distribution System; (iii) Agricultural Growth and Poverty Alleviation; (iv) Experiences of NGOs and Other Agencies working with Panchayat Raj Institutions; (v) Decentralised Micro-Level Planning and Its Implementation; (vi) Training Requirements for Micro-Level Planning; and (vii) Conclusions and Recommendations. Thus, the present volume raises some expectation that the papers together are likely to provide a comprehensive perspective on different micro-operational issues, policy possibilities and prospects. But, most papers do not really fulfill this expectation.

The present volume consists of papers presented in a National Conference on "Panchayat Raj—The Key to Food Security and Nutrition", with the objective to develop a strategy for achieving food and nutrition security at the micro-level for the poor through the Panchayat Raj. Towards this end, the Conference laid emphasis on identifying areas which are crucial and which require policy action in designing such strategies. In this process, the rural people are supposed to take an active role in planning from below to determine their own destiny. This is quite important in this liberalised era when even learned scholars have liberally borrowed Western textbook concepts and ideas, and have recommended policies for food security in India with little understanding and appreciation of empirical constraints and realities. For instance, many experts have recommended that it would be possible to reduce government expenditure and budget deficit by curtailing the food subsidies incurred on the public distribution system (PDS) without any compromise on the food security of the poor. According to them, this can be achieved through a PDS targeted by changing its commodity composition in favour of coarse cereals. These experts do not seem to know that even the poorest decile groups in rural India have changed their consumption patterns in favour of coarse cereals and all the decile groups have equal-proportionate shares in the consumption of coarse cereals leaving little scope for commodity-based targeting of the PDS.

Food Security and Panchayat Raj by Pradeep Chaturvedi (ed.), Concept Publishing Company, New Delhi, 1997, pp. xv+304, Price Rs. 400.

Ajeet Mathur
Yliopistokatu 45A3
FIN-33500, Tampere
Finland.

The title, of the book is perplexing. Why not make it "Competing With Knowledge rather than through Knowledge which posits knowledge as some kind of a fog to be pierced through! Nevertheless, Shukla's contribution is a useful compendium surveying the state of the art and a "must read" for practitioners and academics. Management libraries would do well to bulk order this publication for their readership.

and XEROX. Generalisation and processes which may characterise a learning organisation. Snippets from Indian firms are incorporated to compare and contrast the international experience. The reader is left wishing that there were more of these.

farmers who had suffered exploitation earlier. The need of professional managers in the agriculture marketing co-operatives is also discussed in this paper. K.M. Chadha's concern is with the role of co-operatives in the alleviation of rural poverty and unemployment. In the past, this objective was seldom achieved by the rural co-operatives. He emphasises the need for redefining the co-operative philosophy in the context of liberalisation and pinpoints the need of professional management for the successful operations of rural co-operatives. Mohan Kanda has reviewed the agricultural development of India during the past decades. According to him the credit management system of rural agriculture and allied sectors has left much to be desired due to certain system deficiencies. For the rectification of these deficiencies, he has suggested a set of parameters of well-managed credit system. Brij L. Bhadu started his paper by evaluating the performance of co-operative net work in India. In the light of his evaluation and the findings of agriculture credit review committee report, Bhadu points out the deficiency of Rural co-operative and suggests a new programme (Business Development Programme) for the rectification of these deficiencies.

Ching-Yung Liu and Pitayapol Nattaradol examines the problems of agriculture co-operatives in the Republic of China (ROC) and Thailand respectively. Liu identifies the issues of farmer associations in ROC as technical, financial and business related. He emphasises that the farmers can solve these problems through organisational approach: According to Pitayapol the administration and operation of credit services in agriculture are more complex and difficult than of other sectors. However, he emphasises the crucial roles of agriculture credit for improvement of the living condition of farmers. He also explains the lending operation of Bank of Agriculture and Agriculture Co-operatives (BAAC) in Thailand. Further he emphasises the need for strong farmer institutions capable of administering financial service effectively so that institutions such as the BAAC would be able to reduce its cost by functioning as a wholesale bank.

Several papers belonged to countries in which co-operatives had been originally initiated for providing rural credit, but were later extended to cover activities much more diversified. Whether the co-operatives exist as single purpose or multi-purpose organisation, in all these countries provision of credit forms an important activity of these organisations. Jaw-wen Chen from ROC and Min-seok Cheong from Republic of Korea (ROK) raise problems of survival of the co-operatives of countries falling in the high income group. Kahawong and Taworn (Thailand), Sukmadinata (Indonesia) and Saleh (Malaysia) examine issues of agriculture co-

India is dealt with. He also points out that incidence of poverty is greater in food deficit areas; in the same breath. A major limitation of the studies in this volume is their casual approach and their emphasis on documenting facts and figures without making any effort drawing meaningful conclusions and suggestions. They use concepts and jargons without any appreciation of their meaning, context and implications.

M.H. Suryanarayana
Associate Professor
Indira Gandhi Institute of Development Research
General Vaidya Marg
Goregaon (E)
Mumbai-400 065

Improving Managerial Efficiency of Rural Cooperatives by D.S. Sidhu (ed.), 1997, Asian Productivity Organisation, Tokyo, p. 325, Price (Not mentioned).

This book is the outcome of papers presented in the study meeting in New Delhi from 9th to 16th November 1995 on 'Improving managerial efficiency and effective flow of agriculture credit' organised by Asian Productivity Organisation with the collaboration of national Productivity Council and Government of India. Twenty four papers covering various aspects of rural cooperatives were presented in the meeting.

There are three parts. The introductory part summarizes the findings of the papers included under parts II and III. While Ching-Yung-Liu and Pitayapol Nattaradol presented resource papers from Republic of China (ROC) and Thailand respectively, Messrs Singhal, Uberoi, Mahalingam, Chadha, Mohan Kanda and Brij L. Bhadu are the experts who presented resource papers from India.

Singhal looks into the performance of rural co-operatives of India and suggests various measures for improving productivity by optimising cost. Effective and time bound repayments of the dues are also emphasised in his paper. Uberoi portrays the co-operative movement of India in a wider canvas. According to him the co-operatives operating in isolation are suffering from various operational problems. To cover up their limitations he suggests the incorporation of co-operatives in a specified region. The integrated co-operative plan, Uberoi claims, would lead to over-all development of a region. Mahalingam focuses on the scope and potentiality of agriculture co-operatives in marketing, storage and processing sectors, in the context of liberalisation. He notes that the co-operatives ensure remunerative price to the produce of small and marginal

A complete reproduction and analysis of another major interview of Chirban with the icon, Lucille Ball of the serial "I Love Lucy" fame comprises Chapter 5. It explains the ways in which a comprehensive ex-

Probably the most insightful part of the book is chapter 4, which is titled, posturing in the interview. It presents many models to demonstrate the impact of posturing. These are based on Chirban's interviews with the legendary Dr. B. F. Skinner, the American psychologist who propounded the learning theory based on reinforcements. Reading the transcript of Skinner's interview reaches the inner level with the interviewee. Traditional approaches to interviewing place distance between the interviewer and the interviewee. This hinders the process of gaining insights and developing a complete and accurate picture.

In chapter 2, the author compares the IR perspective with traditional approaches for interviewing and identifies themes in relational interviewing, which include: empathy, listening, therapeutic alliance, transference, counter transference, and self-disclosure. Chapter 3 deals with the implementation of the IR approach, and especially answers questions like, how to establish this approach, and what can the interviewer do to efficaciously enhance interaction and relationship towards establishing the in-depth interview.

The book is divided into seven chapters including the introduction. Chapter 1 identifies the IR approach and elaborates the five factors stated above. The case study of a prisoner named Randy provides authenticity to Chirban's IR approach. The case shows that the adoption of this approach by therapists can go a long way in realizing the reformation goals of a prison system. The components of the IR approach that the author highlights are: an IR way of thinking, the role of the person of the interviewer, the collaboration of people, the orientation of the present, the potential for action (i.e. the opportunities in an encounter where the two persons head towards a shared experience), and the energizing pulse.

"...active search for a full understanding of a person's life—the inner view. Comprehending the essence of an individual, his or her emotions, motivations, and needs is the central task (p. xi)...[it] requires the interviewer's (a) self-awareness, (b) authenticity, (c) attunement, (d) posturing in the interaction, (e) engagement of relational dynamics, and (f) integration of his or her person in the process of interviewing...[it] emphasizes the critical importance of both the *interaction* and the *relationship*. It identifies the particular qualities that deepen an interview (emphasis original) (p. xv)."

To cope with this problem, John Chirban, the author of the present seminar book has developed the Interactive-Relational (IR) approach of interviewing. Chirban uses IR approach to mean the following:

Interview is known to be one of the most important methods of social science research. It is also a principal tool in many professional settings such as clinical psychology, journalism, health professions and various spheres of business including human resources management. But to conduct an interview effectively is not an easy task and requires not just adequate preparation. In order to be effective, interview technology must be such as to establish a genuine communication between the interviewer and the interviewee and also to actuate the interviewee to come out with a true picture of the phenomenon focused at. To view others with authenticity it is necessary that the interviewer reaches the inner level with the interviewee. Traditional approaches to interviewing place distance between the interviewer and the interviewee. This hinders the process of gaining insights and developing a complete and accurate picture.

Interviewing in Depth: The Interactive-Relation Approach by John T. Chirban, Sage Publications, Thousand Oaks, California, USA, 1996, pp. xvii + 144, Price \$ 42 (Cloth), 18.50 (paper).

K.V. Velayudhan
Department of Fisheries
Vikas Bhavan, PMG Junction
Trivandrum-695 033

The remaining papers in the volume deals with the problems, of developing countries. Among these countries, India plays a very prominent role in the field of co-operatives. Mahalingam and Dayal discuss some of the issues faced by co-operatives in India. The resource papers deal with the theoretical issues whereas the country papers discuss and take stock of various activities of the rural co-operatives of different countries. In sum, the book under review is of great value to researchers and administrators in their march towards insights in co-operation and progress.

other sectors of economy. To balanced development of industrial and agricultural sectors, thanks to the co-operatives. Further they are moving in the direction of developing strong linkages between industrial and agriculture sectors together with operatives of countries in the middle income group. To them these countries have succeeded in achieving a

For human resource managers, the adoption of the IR approach would generate interesting perspectives in areas such as employee counselling and employment interviews, even as most of Chirban's formulations are based on the application of IR approach in therapeutic setting. The greatest strength of this well-conceived book is its very articulately developed IR approach which may be used for getting newer and fuller perspectives than could be possible by a traditional, more ob-

business.

In the short, in the concluding chapter, the author discusses how the IR approach could be introduced to various settings such as therapy, journalism, health and

ceptability value of the IR approach. on his interviews with his mother—adds to the authenticity of earlier formulations of Chirban based on her mother—who (the son) had questioned this interview by Lucille Ball's son (p. 117) as he view setting. The ultimate attribution of authenticity to inner view. Here the reader can help himself in knowing the impact of IR approach in a journalistic interpretation of interaction and the relationship through

Without doubt, this book should be read by all those who wish to know the acts of others through the technique of interview.

field research will, I am sure, bear better fruits. them. After reading this book, my subsequent entry in ensure the validity of the results of my interviews with dustrial relations when I had to work immensely hard to counters a decade back with disputants actors in in- to PGDBM students. I was also reminded of my lecture on interviewing that I deliver as part of the HRM course search methodology as also the contents of my lecture attempted to substantially revise both my lessons in re- the reality. After reading this book, I feel immensely in developing the potential of the IR approach to obtain jective approach. Also, Chirban has been very cautious

Debi S. Saini
Professor—HRM Area
Institute for Integrated Learning in Management
3, Lodhi Institutional Area
New Delhi-110 003

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New Books Received for Review

Chandra D., *Ahai So this is TQM, Productivity and Quality Publishing Private Ltd, Chennai, 1998, p. 76, Price Rs 125.00.*

This pocket-sized book written in a catechistic manner is aimed at providing a ringside view of quality. Drawn from the long experience of the author as a management consultant to several leading companies both in India and abroad, the book explodes some of the common myths about quality. Written in lucid and simple style, the book answers many of the quality related questions often arising in the minds of the practitioners.

Dhameja N. and Sastry K.S., *Privatization: Theory and Practice*, Wheeler Publishing, New Delhi, 1998, p. 300, Price not mentioned.

This book is a modest attempt to answer questions such as: Is Privatization seen as one potential tool to be used where ever appropriate or is it a mere desire to follow developed countries? It is argued that while public enterprises need a lot of toning up, privatization is not a panacea and is not a define cure for all the economic ills of country. Hence, developing countries following privatization programmes should not only be cautious, but also be selective. The book has two parts: The first part deals with theoretical and conceptual issues, while the second part deals with practice. It draws heavily upon world-wide research and thinking on privatization.

APQ, *Management and Productivity Enhancement: New Approaches. Asian Productivity Organisation, Tokyo, 1997, p. 296, unpriced.*

In the present fast changing and highly competitive environment around the world, productivity improve-ment has acquired a new sense of urgency. Many firms are continuously seeking new ways of achieving higher productivity. The traditional view of productivity that promotes efficient use of resources alone has shown limitations in meeting the needs of the changing times. The approaches to productivity improvement no longer

emphasize mere cost reduction but focus more on strategic measures and customer satisfaction.

Malgavkar P.D., *Quality of Life and Governance: Trends, Options and Institutions*, Konark Publishers Pvt Ltd, Delhi, 1996, p. 350, Price Rs 450.00.

The book explains how it has become imperative to enlarge our vision from "poverty alleviation" to "quality of life" as India has liberalised its economy, is having sound economic growth and seems to be proceeding towards curtailing population growth. Quality of life creates an environment where individuals have an intellectual, mental, physical and financial capacity. After examining the Indian environment, it lists thirteen indicators-food, health care, clothing, housing and supporting construction activities, transport communication women empowerment population stabilisation water for drinking irrigation and industry energy ecology regional and global interdependence-as determinants of the quality of life.

Sindhvani, Trilok N., *The Global Business Game: A Strategic Perspective*, Macmillan India Ltd, New Delhi, 1998, p. 350, Price Rs 295.00.

Globalisation has changed the international business scenario. The existing business arena is filled with many threats, challenges and opportunities. To be successful, business players need to develop an international perspective. This book provides a systematic approach and an insight into the basic issues and complexities of the global business scenario. It also examines the methods using which global business players have evolved winning strategies.

Nilakant V. and Ramnarayan S., *Managing Organizational Change, Response Books, New Delhi, 1998, p. 380, Rs 450 (cloth) and Price Rs 250 (paperback).*

In this era of constant flux, grappling with and managing organisations change has become perhaps the single most important issue facing a manager or

Bandarage A., Women, Population and Global Crises: A Political-Economic Analysis. Zed Books, London, 1997, p. 397, Price £ 42.50/\$ 69.95 (cloth) and £ 15.95/\$ 25.00 (paperback).

It has been widely assumed that over-population is one of the root causes of global crisis. Even amongst feminist and environmental movements, the common wisdom on population has never been seriously critiqued. This book provides that critique; it gives a historical overview of the population question and places the population-poverty-environment-security debate within a broad theoretical perspective.

Vogt J.F. and Murrell K.L., Empowerment in Organisations: How to Spark Exceptional Performance. S. Chand and Company Ltd, New Delhi, 1997, p. 246, Price Rs 600.00.

This book explores the concept of "empowerment" which offers employees a way to achieve recognition, involvement, and a sense of worth in their jobs. As the authors explain in detail, any organisation can learn how to provide an environment that people find empowering—one that enables them to contribute in ways that benefit the organisations while meeting their own individual needs.

Mohan Kumar P.S., Cotton Textile Industry: A Comparative Analysis of Different Sectors. Reliance Publishing House, New Delhi, 1997, p. 239, Price Rs 295.00, US \$ 59.

The book makes a comparative analysis of the productive and financial performance of the various sectors of the select spinning mills in Cotton Textile Industry. Analysing the resource use efficiency of private, public, co-operative, small and medium mills in a unified framework is first of its kind. It is a thoroughly revised and well structured work based on the author's Ph.D thesis.

Seymour D.T., Marketing Research: Qualitative Methods for the Marketing Professional. S. Chand and Company Ltd, New Delhi, 1995, Rs 595.00.

Customer understanding is an important element in the success of any business. Yet, much of the research that is undertaken to obtain this understanding tends to be myopic and restrictive, focusing more on what customers buy and how many times they do it rather than on why they behave the way they do. This extraordinary work focuses on the qualitative, intuitive approaches to market research and shows how they can be integrated with the more numbers oriented methods to produce a fuller, richer understanding of the consumer.

an administrator today. There are increasing demands on organisations—both big and small—to be more flexible, responsive and efficient. The authors have lucidly summarised the existing change perspectives and practices with recent illustrations from the Indian corporate scene.

Giri, Narayan C., Multivariate Statistical Analysis (Statistics: Textbook and Monographs Volume 149). Marcel Dekker Inc., New York, 1996, p. 378, Price US \$ 135.00.

Employing the invariance, this outstanding reference/text offers in depth coverage of both the theoretical and applied aspects of multivariate analysis—explaining concepts with actual data and real world situations. It is an excellent reference tool for applied statisticians and researchers using multivariate data in biometry, biomedical sciences, economics, filtering and stochastic control random signal processing and stock market data analysis and an incomparable text for graduate level student in all disciplines with a foundation in mathematics and statistics taking a one-or two semester course in multivariate analysis.

Ullah A. and Giles D.E.A. (Eds), Handbook of Applied Economic Statistics (Statistics: Textbooks and monographs volume 155). Marcel Dekker, Inc., New York, 1998, p. 635, Price US \$ 195.00.

Highlighting the interface between applied economics and statistics, this one-of-a-kind resource examines important theoretical issues as well as practical developments in statistical inference related to economic models and analysis. Containing over 150 bibliographic citations and authoritative contributions from distinguished international experts, this book has an incomparable reference for all level of students in the respective field.

Ramnarayan S., Rao T.V., Singh Kuldeep, (Eds), Organisation Development: Interventions and Strategies. Response Books, New Delhi, 1998, p. 408, Price Rs 450 (cloth) and Rs 265 (paperback).

Organisations Development (OD) is a process for planned change that aims at building competencies in individuals and teams in the organisational context, and at taking organisations to higher levels of performance. In India, the response to OD has been mixed and only a few organisations have used it as a strategy for planned change. Existing as they do in a highly volatile political and economic environment, Indian organisations need, more than ever before, to be sensitive to the need for change in order to survive.

Those interested in reviewing any of the above titles or other recent arrivals may write to Associate Editor, Productivity Journal, National Productivity Council, Lodi Road, New Delhi-110 003, enclosing a copy of their brief profile.

is currently occurring in this popular field. It is written by experts in the field of team building and addresses a wide variety of team building issues and dynamics. The five major sections are fundamentals; theory and dynamics; applications; clients and consultants; and multiculturalism.

Thomas A., Chataway J. and Wuyts M., Finding out Fast: Investigative Skills for Policy Development. Vistaar Publications, New Delhi, 1998, p. 376, Price Rs 395 (cloth).

Finding out Fast will provide readers with key skills and approaches for research designed to inform policies, particularly on development. Recognizing that policy decisions are typically made under pressure of time and on the basis of incomplete data or with limited resources with which to obtain information, the authors provide guidance on how to locate, evaluate and use relevant information, fast. This is essential reading for development managers in non-governmental organisations (NGOs) and public sector agencies and students of development management and development studies more generally. However, the ideas and approaches will also appeal to anyone involved in policy making and research with developmental goals.

APQ, New Perspectives on Rural Industrialization. Asian Productivity Organisation, Tokyo, 1998, p. 220, unpriced.

Rural industrialization is an important strategy adopted by many developing countries in Asia and the Pacific region to achieve a balanced development between the rural and urban areas. For one, it helps to check the exodus of rural population into cities and towns by promoting employment opportunities in the rural area. Accordingly, policy efforts are now being strengthened to make rural industries more competitive and economically viable units.

Reddy, Brendan W. and Jamison K. (Eds), Team Building: Blueprints for Productivity and Satisfaction. S. Chand and Company Ltd, New Delhi, 1995, p. 202, Price Rs 595.00.

Managers recognize the importance of quick responses to crises, thoughtful planning, and the full use of human resources in solving complex problems. Developing and using the individual, interpersonal, and group skills required to produce a creative, wise, efficient, productive and satisfying team is difficult at best. This book was developed out of a need to examine what

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