

# **Transformational leadership: an exploratory study within Research and Development (R&D) groups**

by

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## ABSTRACT

This research investigated the leadership style in a research and development (R&D) work-unit within a petro-chemical company, using the Full Range Leadership Development Theory as assessed by Multifactor-Leadership-Questionnaire (MLQ). From the literature review conducted, it was concluded that an R&D environment is multi-dimensional and the workforce can be diverse in the field of specialisation and personality characteristics. Subsequently, the literature review also focused on functional diversity and gender differences within technological and/or scientific environments.

Descriptive statistics were provided and the data were then statistically analysed. The research results showed a statistical difference in the perception of the frequency of leadership style between manager-leaders and subordinates. Differences in the mean scores of manager-leaders and subordinates found that the manager-leaders over-estimated the frequency ratings of their transformational leadership style and the leadership outcomes, while they under-estimated the frequency ratings for transactional and laissez-faire leadership style. This indicates that although the manager-leaders consider themselves as more transformational, the subordinates of this R&D unit view their immediate managers as not displaying ideal levels of transformational leadership behaviours. A self-bias phenomenon may be present where the manager-leaders judge themselves as overly favourable. It is recommended that this be addressed within the organisation.

A statistical significant difference was observed in how some male and female employees experienced their manager-leaders' leadership style. The females indicated a higher frequency of laissez-faire leadership style, while some males viewed their manager-leaders as more transformational compared to the female employees. Manager-leaders may need different skills to manage females and in general an increasing awareness of gender bias within the unit may mitigate stereotypical assumptions.

No statistically significant differences ( $p < 0,05$ ) could be found for the total group between functional areas, being scientists versus engineers. It should be noted that the departments consist of predominantly scientists, while only one department showed a mixture of scientists and engineers.

**List of key terms:** Full Leadership model, transformational leadership style, transactional leadership style, laissez faire, knowledge workers, research and development, diversity, Multifactor-Leadership-Questionnaire.

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## LIST OF ABBREVIATIONS

|      |  |
|------|--|
| CFI  | Cross-functional integration             |
| CR   | Contingent reward                        |
| DOE  | Department of Energy                     |
| En   | Engineers                                |
| HR   | Human resources                          |
| IA   | Idealised influence (attributed)         |
| IB   | Idealised influence (behaviour)          |
| IC   | Individualised consideration             |
| IM   | Inspirational motivation                 |
| IS   | Intellectual stimulation                 |
| LF   | Laissez-faire                            |
| MBEA | Management-by-exception (active)         |
| MBEP | Management-by-exception (passive)        |
| MLQ  | Multifactor-leadership-Questionnaire     |
| mths | Months                                   |
| N    | Number                                   |
| PO&E | Polyolefins and Elastomers               |
| R&D  | Research and development                 |
| Sc   | Scientist                                |
| STI  | Scientific and technological information |
|      | Sensory, thinking and judging            |
| STJ  | preferences                              |
| TF   | Transformational                         |
| TR   | Transactional                            |
| UK   | United Kingdom                           |
| US   | United States                            |

# CHAPTER 1

## INTRODUCTION

### 1.1 INTRODUCTION

Modern organisations face a dynamic environment which is characterised by rapid technological changes, shortening product life cycles and the effects of globalisation. Organisations respond to these external business factors by downswing, restructuring or implementing transformational processes which can lead to a less secure organisational climate. A growing concern is in identifying effective leadership styles necessary to motivate employees in uncertain conditions. Bass (1985a) and Bass & Avolio (2005) indicated that transformational leadership needs to be fostered within an organisation faced with turbulent marketplace, rapid change and uncertainties calling for a flexible organisation. Transformational leadership style was found to be applicable in a wide variety of businesses found in various organisational settings (Bass, 1990).

Companies within South Africa are challenged; its first democratic election has resulted in the opening of the economy for companies to compete globally and its workforce has become increasingly diverse. De Kock and Slabbert (2003:1-2) investigated transformational leadership in a South African petro-chemical organisation in the process of ascending to world-class status. They indicated that becoming world-class is a necessity for business organisations to survive and thrive in the global economy. It was proposed that leadership development in business organisations striving to become world-class should focus on the development of transformational leadership. At the core of transformational leadership is symbolic leadership behaviour focusing on creating a vision and is inspirational in nature. In their study, they emphasised that transformational leadership is not an option, but that it is a strategic imperative.

Technology is changing rapidly and for a technologically based organisation to survive, compete and lead, it requires creativity and innovation. New technological developments are becoming too important to treat technical/scientific workforces' outputs as unplanned, un-co-ordinated or left to chance. The emphasis should be on the best way to develop human potential responsible for science and technology. Leadership is critical in any group

environment, and it was proposed that a transformational leadership style would be more congruent with a better educated employee within a learning environment. An educated workforce would be eager to apply and develop new skills. They would thrive under a manager-leader who transmits a sense of mission, stimulate a learning experience and arouse new ways of thinking (Hater & Bass, 1988:696). In addition, transformational leadership has been positively linked to creativity and innovation, which is critical in a research and development (R&D) environment (Jung *et al.*, 2003:597).

## **1.2 BACKGROUND TO THE STUDY (MOTIVATION)**

The focus of the study will be on knowledge workers employed at a South African petro-chemical company. The knowledge workers will specifically be scientific and engineering workers within the R&D work-unit of the company responsible for product and process innovation and development.

The function of R&D groups is to import scientific and technological information (STI), transform it into technological innovations and then export it to other units of the organisation. Over the years, the process in which R&D occurs has been fairly stable, involving the interaction of engineers and scientists who generally work in project groups or teams. The responsibility for managing the processes and the people in R&D groups falls on the shoulders of the group leader. Despite the fact that technology can be a critical factor to economic success and there is great interest in managing, motivating, attracting and retaining productive R&D knowledge workers, research on leadership styles in R&D appears to be scarce and little empirical information is available to assist managers (Hage *et al.*, 2008:256).

Within an R&D context some important factors need to be considered. New products, patents, or innovations can take years before they are transformed from STI into outputs. Additional time and other activities from marketing and manufacturing are then needed before the company can derive revenue from R&D outputs. The impact of the R&D workforce on the organisation is often future-based and not immediate in nature, making performance measurement and evaluation of R&D projects difficult.

Managers within R&D often advance through a technical path. Skill in handling interpersonal problems among members is not something for which a leader in R&D has been formally trained. Furthermore, changes in the composition of South Africa's working population due to socio-political factors since the first democratic election 1994, resulted in greater diversity with respect to gender, culture and educational background in the workforce, compared to 20 years ago. Leading creative, innovative individuals within diverse groups require managers to possess certain skills in addition to technical expertise.

In general, scientific/technical employees have specific distinguishing characteristics, such as the need for autonomy, achievement/goal orientation, first, loyalty to profession and second to the organisation, respect for knowledge, association with logic and isolation from corporate society (Thite, 2000:235). Thus, indicating that the management of scientific/technical employees may be challenging.

### **1.3 PROBLEM STATEMENT**

Scientists/engineers are often given the responsibility for people and projects without additional training and often managers believe that supervision skills are a learn-as-you-go experience. Thus the transition from technical expert to technical manager of others may be less smooth. It can be a different career from that of a specialist scientist contributing to science to a generalist requiring re-orientation in thinking from things to people.

Literature reports indicate that transformational leadership style is effective in the fast changing global arena encompassing rapid changing technology, shift in work force expectation, increasing work force diversity, an increased need to do business internationally and becoming world-class. Transformational leadership style was also reported as effective within an R&D context (Hage *et al.*, 2008:261; Jung *et al.*, 2003:527). Transformational leaders can provide a common vision for a project that will enable individuals from different disciplines to work together to bring about technological innovation. Intellectual stimulation provided by the leader can encourage team members to look at problems from a different perspective, which can enhance innovation. Importantly, in a South African context, transformational leadership skills were deemed as a necessity in motivating an increasing diverse workforce in becoming world-class (De Kock & Slabbert, 2003:4).

#### **1.4 OBJECTIVES OF THE STUDY**

Transformational leadership style was reported as effective within an R&D context. The primary objective of the study was to evaluate the transformational leadership style within an R&D work-unit in a petro-chemical organisation. The secondary objective was the assessment of employees from the scientific versus engineering functional areas and females versus males differing from how they perceive the leadership style of their manager-leaders. Our research findings could have implications on future leadership training within the R&D work-unit.

#### **1.5 SCOPE OF THE STUDY**

The scope of the study is to evaluate the transformational leadership style of an R&D work-unit. This will encompass the managers' assessment of their transformational leadership style and how the workforce perceives their managers' leadership styles. The composition of the population worker-force consisted of scientists, engineers and technicians. This study will add to the limited literature on the leadership process of diverse R&D workers outside North America and Europe.

#### **1.6 RESEARCH METHODOLOGY**

In addressing the purpose of the study the following research methodology was followed:

1. A detailed literature search was performed to gain theoretical knowledge and understanding.
2. Participants were requested to complete demographic information to establish the diversity of the population. Experimental knowledge was attained on the transformational leadership style by doing an empirical study. Transformational leadership was measured through the Multifactor-leadership Questionnaire (MLQ) measuring instrument developed by Bass and Avolio (2005). The questionnaire consisted of statements about typical leadership behaviour.
  - Group leaders were asked to complete the MLQ leader answer sheet. They were asked to indicate how often they behave in a certain manner.
  - Group members were asked to complete the MLQ answer sheet. They were requested to indicate how often their managers behave in a certain way.

- All the tests were sent to the Statistical Consultation Services of the North-West University for analysis.
- 3. Finally, integration of the theoretical and experimental knowledge was done to obtain an enriched view of the current leadership style within the R&D work-unit.

## **1.7 LAYOUT OF THE STUDY**

The study is divided into five chapters.

### **Chapter 1**

#### **Introduction**

This is an introductory chapter providing the objective of the study. The subsequent chapters are organised as follows:

### **Chapter 2**

#### **Literature review**

The chapter focuses on leadership consisting of the following major topics:

- Leadership
- Transformational leadership
- Technical manager-leaders as Transformational leaders
- Diversity

### **Chapter 3**

#### **Research methodology**

The research methodology chapter describes the methodology employed in the investigation on the transformational leadership style within the petro-chemical's R&D work-unit.

### **Chapter 4**

#### **Analysis of results**

This chapter contains the results, descriptions of the results and some explanations on the research findings.

## **Chapter 5**

### **Discussion, recommendations and conclusions**

The mini-dissertation ends with a discussion, conclusions, and remarks on further research on leadership within the organisation. The chapter also discusses implications on future leadership training within the organisation based on the findings of the research.

### **1.8 SUMMARY**

In this chapter, the background and objectives of the study were discussed. The research methodology, in addressing the research objectives and layout of the study, was provided. Chapter 2 is a literature review dealing with leadership, transformational leadership and technical/scientific leadership.

# CHAPTER 2

## LITERATURE STUDY

### 2.1 INTRODUCTION

In today's turbulent business environment there is an increasing need for leaders who can meet the demands and challenges within their organisation. This chapter is dedicated to literature reports on leadership, transformational leadership and technical/scientific leadership.

### 2.2 LEADERSHIP

#### 2.2.1 Leadership defined

In discussing the concept, a clear definition of leadership remains elusive, since numerous definitions of leadership appear in the open literature. Gregoire (2004:397) indicates that leadership is the ability to inspire and guide others towards building and achieving a shared vision. Within the article the author dealt with leadership and management as two different concepts.

House (1995:141) differentiated between management, supervisory leadership and general leadership. Management was indicated as the behaviour of a person in a position of authority that results in compliance of the followers with their prescribed roles and responsibilities. Supervisory leadership is intended to provide feedback for day-to-day activities of subordinates. General leadership gives purpose, meaning and guidance by articulating a collective vision that appeals to the ideological values, motives and self-perception of followers.

In the past, researchers suggested that leadership and management have separate roles within an organisation. Management and supervision were regarded as planning, organising, directing and controlling subordinates' working activities to attain specific goals. Traditionally, the view was that individuals were born with leadership characteristics. An outstanding leader was characterised to have, vision, passion, self-sacrifice, confidence, determination and perseverance, selective motive arousal, risk-taking, is developmentally

orientated, acts as a role model, demonstrates integrity and persuades alignment and serves as symbolic figurehead amongst others.

Leadership is a complex process of actions driven by situational and person-centred variables. Scherr and Jensen (2007) stated that a leader is an ordinary human being with both a commitment to produce a result whose realisation can be extraordinary given the current circumstances as seen by the participants, and the integrity to see this commitment through to its realisation. Leadership was defined as a set of actions (inclusive of words) taken directly or by empowering others to fulfil a vision which affects results and consequences that otherwise would not have occurred. A *successful* leader will create an environment or culture in which the aspects of leadership are highly valued, nurtured, created, applied and effectively implemented.

Anderson (2006:1078) indicated that most definitions of leadership include one or more of the elements of goal attainment, group or organisation, structure and interpersonal relationships. The formal leader is responsible for results in accordance with organisational goals and the leader can only achieve this through the efforts of subordinates and the actions of other people. Anderson's (2006:1079) premise was that goal attainment can be affected by enthusiastic or reluctant employees and the question "what makes a manager effective" remains largely unanswered. For example, a technically competent, job-centred, insensitive manager can achieve high productivity. He concluded to say that the management of organisations is about actions and the associated accomplishments.

In contrast, Coetsee (2003:7) stated that modern management views have changed and that the focus is on team members' success. Management cannot be successful without being good leaders and leaders are less effective if they cannot manage. It was concluded that leadership and management have become indistinguishable, and Coetsee (2003:8) referred to modern managers as manager-leaders.

Scherr and Jensen (2007) proposed an appropriate balance between leadership and management for effective leadership. Grobler *et al.* (2002:640) referred to management as coping with complexity, while leadership is about coping with change. For future survival and growth an organisation needs to continually change and compete effectively. New

leadership can no longer focus on power but on achievement; this requires a meaningful participation of all stakeholders and ongoing consultation. The authors indicated that the challenge for over-managed and under-led organisations within a South African context is to combine strong leadership and strong management and use the one to balance the other.

The open literature reports treat leadership and management as separate topics. Researchers such as Coetsee (2003:10) and Grobler *et al.* (2002:240) indicated that effective leaders require both strong management and leadership skills. In the discussions, modern managers are referred to as manager-leaders and subsequently will be referred to in both the leadership and management literature.

In conclusion, a number of different views exist on leadership, indicating that the topic of leadership may be complex. This is not surprising since a number of leadership theories were formulated and developed over the years. In the next section, some leadership theories are discussed.

### **2.2.2 Leadership theories**

The topic of effective leadership has been actively debated in the open literature (Gregoire, 2004:399).

#### **2.2.2.1 Trait approach to leadership**

The trait approach attempted to identify personal characteristics of effective leadership. The “Big Five” model was developed to interpret and categorise leadership traits. Leadership personality traits were grouped into five groups: surgency (energy, assertiveness and extroversion), conscientiousness (dependability, integrity and need for achievement), agreeableness (optimism, helpfulness and affiliation) adjustment (emotional stability, self-esteem and self-control) and intelligence (open minded, inquisitive and learning orientated). Bono and Judge (2004:906) indicated that extraversion may be an important trait in predicting transformational and transactional leadership. Thoresen (2004:841) related the big five personality traits to job performance at maintenance and transitional job stages. In the maintenance sample conscientiousness predicted

performance growth, while for the transition sample agreeableness and openness to experience predicted performance growth.

#### 2.2.2.2 Behavioural approach to leadership

The behavioural approach was based on the proposal that effective leaders perform certain identifiable behaviours. Leadership behaviour was categorised into two dimensions: one focusing on the human dimension (relationship orientated) and the other on the job (task orientated). In a modern organisation, change behaviours were also deemed as important. Yukl *et al.* (2002:17) proposed leadership behaviours for the task, relationship and change orientated categories, which is shown in Table 2.1.

**Table 2.1:** Description of three categories of leadership behaviours

|                            |  |
|----------------------------|--|
| <b>Task behaviour</b>      | <ul style="list-style-type: none"> <li>- Plan short-term activities</li> <li>- Clarify task objectives and role expectations</li> <li>- Monitor operations and performance</li> </ul>  |
| <b>Relations behaviour</b> | <ul style="list-style-type: none"> <li>- Provide support and encouragement</li> <li>- Provide recognition for the achievement and contributions</li> <li>- Develop member skill and confidence</li> <li>- Consult with members when making decisions</li> <li>- Empower members to take initiative in problem solving</li> </ul> |
| <b>Change behaviour</b>    | <ul style="list-style-type: none"> <li>- Monitor the external environment</li> <li>- Propose an innovative strategy or new vision</li> <li>- Encourage innovative thinking</li> <li>- Take risks to promote necessary changes</li> </ul>   |

(Source: Yukl *et al.*, 2002:19).

One of the most important activities for change behaviour include, monitoring the external environment to identify threats and opportunities for the organisation. Change endeavours can be risky, especially when change is not obvious to most people and the investment is high in maintaining the current status quo. The ability to articulate a compelling vision to influence followers' commitment towards a proposed strategy or change and encouraging innovative thinking has been associated with transformational leadership (Yukl *et al.*, 2002:16).

### 2.2.2.3 Power/Influence approaches to leadership

It attempts to explain effective leadership with respect to the type and amount of power held by someone in a leadership position and the influence a leader exerts over others (Gregoire, 2004:401). Many types of power have been identified such as legitimate, reward, coercive, information, ecological, expert and referent power. More recent work suggests methods to influence subordinates include tactics of persuasion, consultation, ingratiation and coalition-building to influence the work of others.

### 2.2.2.4 Contingency/Situational approaches to leadership

Some researchers found that the traits and behaviour theories only partly explain why manager-leaders are effective; this they ascribed to the fact that situations were largely ignored (Gregoire, 2004:398). Research suggested that forces in the manager-subordinates and the situation affected leadership style in a given situation and that one type of leadership was not effective in all situations. Models that developed from the contingency/situational approaches are the *Contingency model* (focuses on the relationship between the least preferred co-worker and leadership effectiveness), *Path-goal theory* (leaders' behaviour will affect the subordinates' job satisfaction and efforts), *Leader Substitute theory* (focuses on situations such as the subordinates' tasks and organisations that reduce the importance of leadership), *Multiple Linkages model* (interacting effects of managerial behaviours and situational variables that determine the performance of a work unit) and the *Cognitive Resources theory* (the performance of the leader's group is determined by the interaction among leader traits, leader behaviour and the leadership situation).

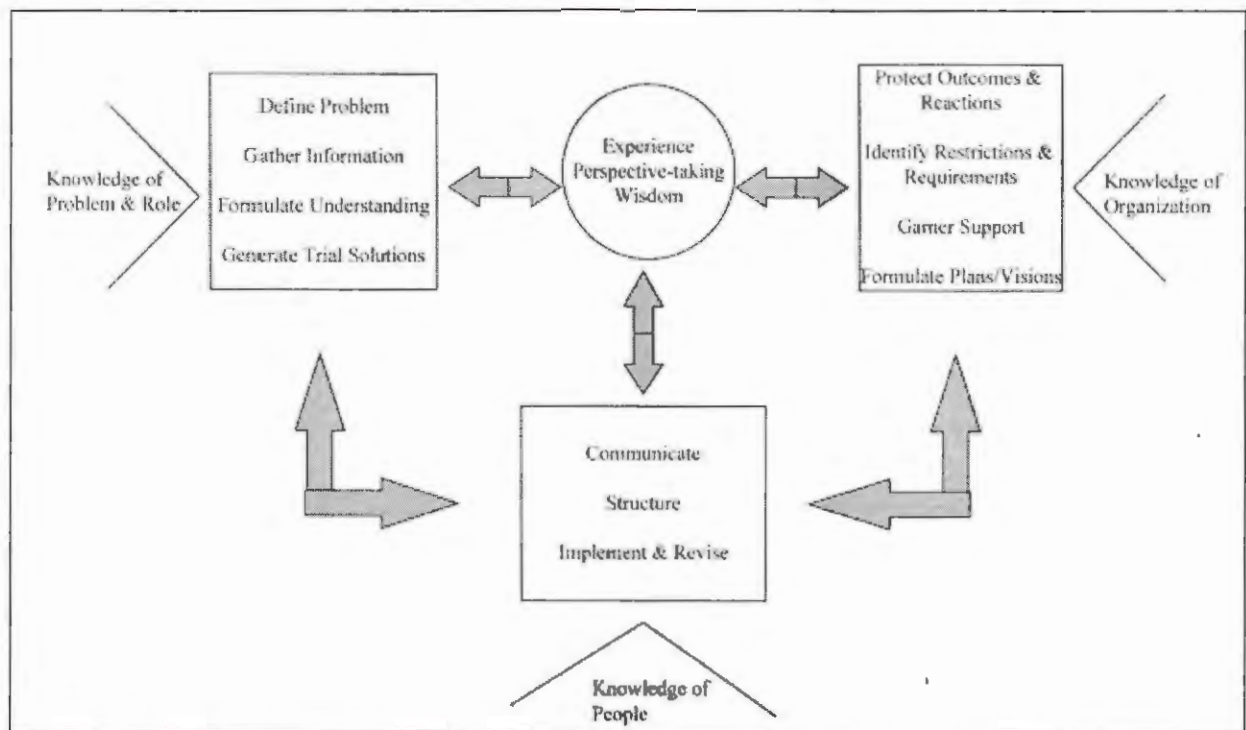
### 2.2.2.5 Reciprocal approaches to leadership

The reciprocal approaches to leadership focus on the interaction between leaders and followers and on the emotional components involved in the interactions. It reflects more the modern view on leadership research. Burns (1978) introduced and later Bass (1985c:463) expanded the concept of transactional and transformational leadership. Transactional leadership uses rewards and punishment to influence employee behaviour, while transformational leadership motivates employees through idealised influence, inspirational motivation, intellectual stimulation, and individualised consideration.

In conclusion, the modern organisational environment is characterised with complexity, conflict and dynamism. As organisations evolve, so too will the views on leadership theories be altered. A strong driver for modern organisations is the challenge to increase its efficiency. The focus on leadership skills and competencies indicates that leaders can become better leaders, in part because skills and competencies represent capabilities that can be developed. Furthermore, skills development concentrates on the job of the leader and the skills it requires, instead of the person holding the job (being, the leader) (Mumford *et al.*, 2000:11).

### **2.3 Leadership skills for the modern manager-leader**

Mumford *et al.* (2000:12) proposed an overview of the key capabilities, knowledge and skills required for the modern manager-leader to solve problems (Figure 2.1). The model proposed that the manager-leader starts to address complex organisational issues by defining the problem and formulating a solution framework or set of ideas that might be used to understand the problem and develop initial solution strategies. In this phase, the manager-leaders, with the help of others, focus primarily on the problem, its significance, origins, and potential solutions. The focus at this point is on the problem, it is important to recognise that experience, knowledge of the job, the nature of the organisational environment and the manager-leader's understanding of it shape the way manager-leaders represent the problem.



**Figure 2.1:** The model of leader problem solving (Mumford *et al.*, 2000:11)

A manager-leader's performance depends on the implementation of a plan. However, implementation occurs in the efforts of others. It requires flexibility and adjustment in plans as dictated by the demands of a changing environment.

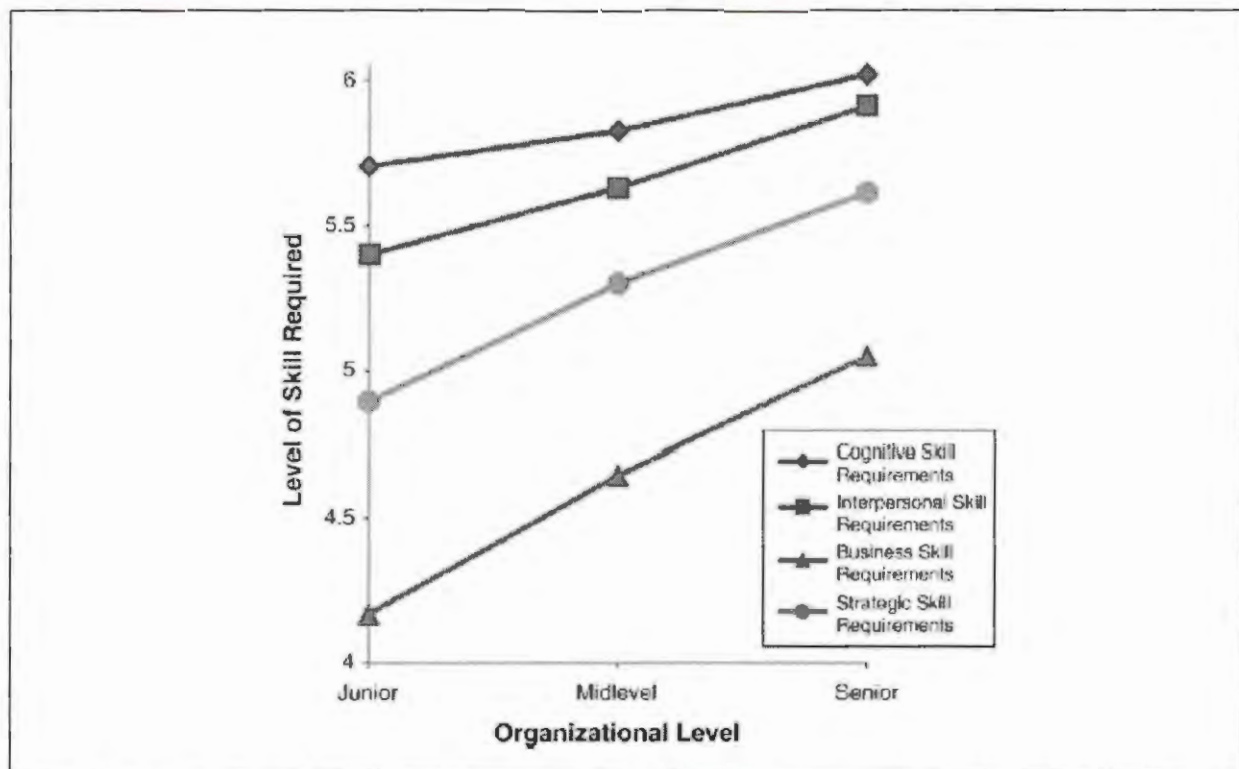
Mumford *et al.* (2000:14) mentions that the skills needed to solve organisational managerial-leadership problems include: (i) *problem-solving skills* associated with identifying problems, understanding the problem, and generating potential solutions; (ii) *social judgement skills* associated with the refinement of potential solutions and the creation of implementation frameworks within a complex organisational setting, and (iii) *social skills* associated with motivating and directing others during solution implementation. Each of these sets of skills is associated with various forms of knowledge. It was proposed that knowledge and skills grow as a function of experience, like leaders progress through their careers. Marshall-Mies *et al.* (2000:138) mentions that the skills required for effective manager-leaders includes general problem solving skills, planning and implementation skills, solution construction skills and social judgement skills.

In a South-African context, O'Kennedy (2001:69) assessed the general competencies manager-leaders need to succeed in a technologically-based organisation. The study highlighted, that manager-leaders must embrace the changes technological developments will bring, not only in keeping up but in leading the challenges organisations face. Future challenges will be associated with globalisation and workforce diversity. Therefore, managers need to exhibit sensitivity to a multi-cultural workforce and the task will be to align different employees around a common goal. The success of the manager-leader will be embedded in leadership competencies rather than managerial competencies. In this study, manager-leaders perceived a number of competencies as important.

- Business management skills – The basic business knowledge
- Change management skills – Cope with rapid change
- Customer service skills – Managers focus on the needs requirements and expectations of their customers
- Development skills – Managers need to develop their employees
- Empowerment skills – Allow employees to make decisions and take responsibility for their actions
- Industrial relations – Build a good relationship with union representatives in their organisations
- Information management – Stay abreast of any new developments and implement new technology in the organisation
- Managerial skills – Continuously organise, plan and review
- Marketing skills – Market the organisation's products and services locally and internationally
- Motivational skills – Have good people management skills to motivate people
- Networking skills – Managers need to work internally and externally in the organisation
- Strategic management skills – Dealing with change in an effective and pro-active manner
- Technical skills – Effective management and harnessing of technology
- Visioning skills – Enable dealing with change in an effective and pro-active manner

Leadership skill requirements across organisational levels differ. Mumford (2007:154) investigated four distinct categories of leadership skill requirements (cognitive skills,

interpersonal skills, business skills and strategic skills) in a large sample (N = 1023) of leaders across three organisational levels. Findings of the study is illustrated in Figure 2.2, which plots the estimated marginal means for each leadership skill requirement type at each level in the organisation. As can be seen, the figure shows that leadership skill requirements increase with organisational level.



**Figure 2.2:** Level of skills requirement over three organisational levels (Mumford *et al.*, 2007:154)

Cognitive skills and interpersonal skills were required to a greater degree across all levels than business and strategic skills. Results indicated that the relationship between leadership skill requirements and organisational level is stronger for strategic skills and business requirements; that is, these skills have the steepest slopes across levels, than for interpersonal and cognitive skill requirements. This suggests that as manager-leaders are promoted up through jobs in the organisational hierarchy, the acquisition of strategic and business skills will be more critical than the acquisition of interpersonal and cognitive skills.

Charan *et al.* (2001:36) reported that the hierarchy within the organisation takes six career passages or pipeline turns. Each of these passages requires that people acquire new skills, time application and work values. Subsequently, the transition into each of these

turns is associated with challenges. Table 2.2 provides an overview of the skills, time application and work values required for the transition of individual contributor to first-line manager.

Concern areas raised in the transition from individual contributor to manager were: overpowering subordinates with technical expertise, managers competing with their direct reports, completing tasks and not letting go of the tasks and responsibilities that earned you the management title. In this transition manager-leaders must cease to think only of themselves. A key factor in building effective leadership at all levels is the early identification of leadership candidates, providing them with growth assignments, giving them useful feedback and coaching them. Importantly, the challenge that modern organisations face is to make sure that people in leadership positions are assigned to a leadership position that is appropriate for their skills, time application and work values.

**Table 2.2:** The transition from individual contributor to first-line manager

| <b>Individual contributor</b>   | <b>First line manager</b>  |
|---|--|
| <p><b>Skills</b></p> <p>Technical or professional proficiency, team play, relationship building for personal benefit, using company tools, processes and procedures</p> | <p><b>Skills</b></p> <p>Planning, job design, selection, delegation, performance monitoring and measuring, coaching and feedback, rewards and motivation, communication and climate setting, relationship building for the units benefit, acquisition of resources</p> |
| <p><b>Time application</b></p> <p>Daily discipline, meet personal deadline</p>  | <p><b>Time application</b></p> <p>Annual planning, make time for subordinates, set priorities for team, communication time with other units</p>  |
| <p><b>Work values</b></p> <p>Getting results through personal proficiency, quality of technical work, accept company values</p>   | <p><b>Work values</b></p> <p>Getting results through others, success of direct reports, managerial work, success of unit and self, and visible integrity</p>   |

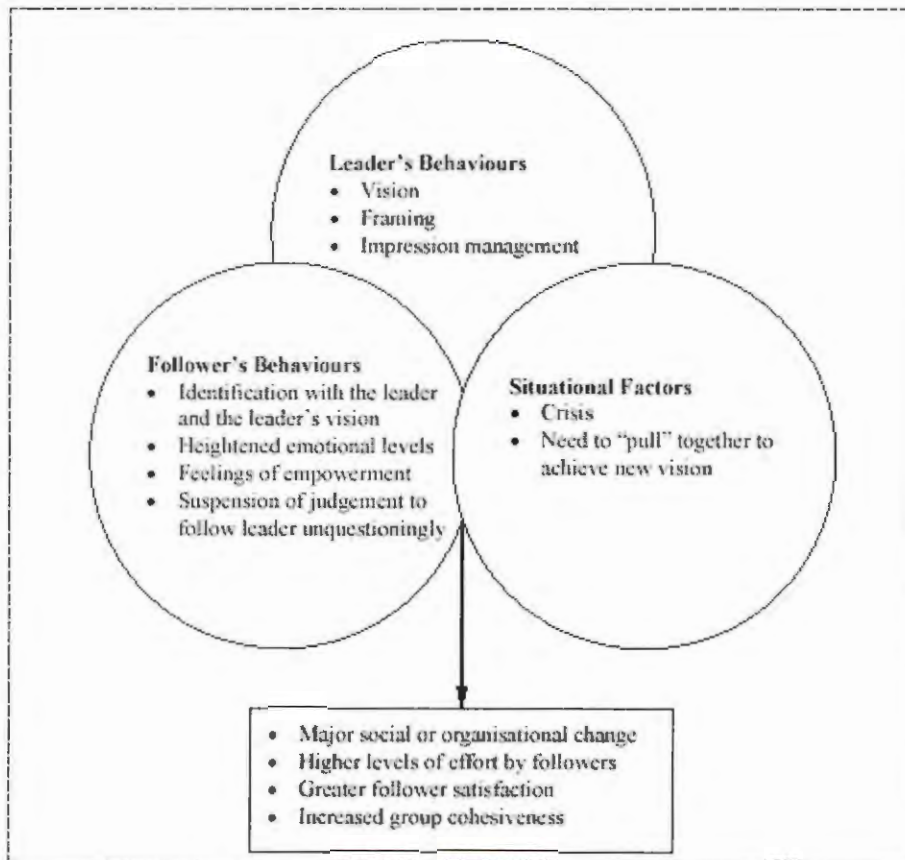
(Source: Charan *et al.*, 2001:36)

Grobler *et al.* (2002:643) indicated that South African organisations require visionary leadership and the combination of a transformational leadership and transactional leadership approach may be the answer to the worker commitment and productivity crisis in South Africa. Robbins (1996:76) was of the opinion that the trait behavioural and contingency approaches, does not adequately explain how best leaders can influence subordinates. The view was that transformational leadership provides a more a holistic view of leadership.

## **2.4 TRANSFORMATIONAL LEADERSHIP**

Transformational leadership theory assesses the behaviours associated with transformational, transactional and laissez-faire styles. As shown in Figure 2.3, transformational leadership integrates trait, behavioural and situational approaches (Hellriegel *et al.*, 2004:125). In particular, the needs of the follower influence the leadership process more than a transaction between the leader and the follower. These are principles that are not constrained by culture or political boundaries. Transformational leaders are recognised as change agents and good role models (Bass, 1990).

Transformational leaders influence the change in others by reversing their perceptions. To initiate the change process people must be willing to entertain ideas outside their comfort zones, which are in conflict with their tried and tested assumptions. Change requires a shift in perceptions and transformational leaders motivate followers to perform beyond their expectations. Thus the follower's perception of his self efficacy, confidence as well as their developmental potential is enhanced through the transformational process.

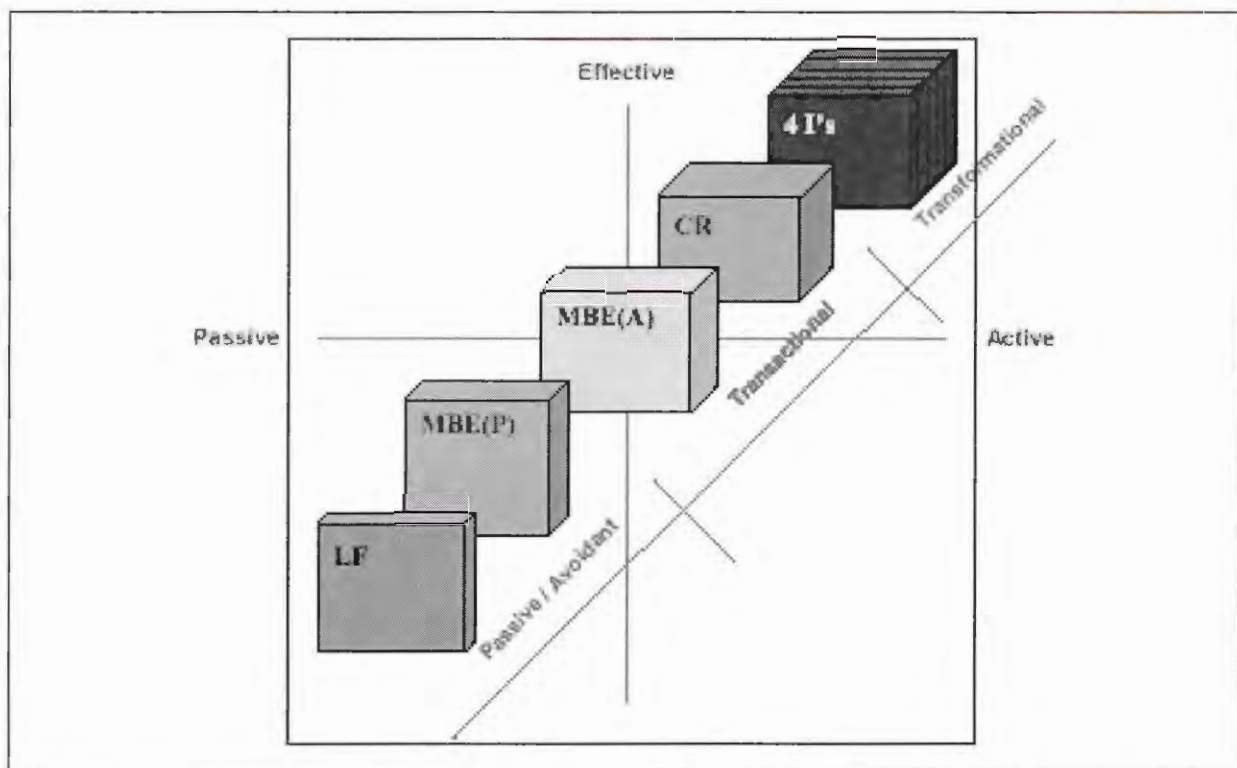


**Figure 2.3:** Transformational Leadership model (Hellriegel *et al.*, 2004:215).

Transformational leaders were indicated to meet the emotional needs of their followers. Pro-active-in-nature transformational leaders seek to optimise the individual, group and organisational development and innovation (Bass, 1990).

The transformational leadership approach is referred to as the Full-range Leadership model as it is seen to develop leaders and followers to heightened levels of potential (Bass & Avolio, 2005:169; Ozarall, 2003:337). This in part can be related to the followers' empowerment by the leader, identification with the leaders and the organisational unit, reduced withdrawal behaviours, a sense of a mission, team orientation, appreciation of others, teaching, responsibility, recognition, enhanced communication, creativity and innovation, and an arousal of a new and strategic way of thinking (Kar *et al.*, 2003:246; Menguc *et al.*, 2007:315; Hater & Bass, 1988:699; Simic, 1999:49; Ozarall, 2003:335).

The Full-range Leadership model indicates that every leader displays transformational, transactional and laissez-faire (LF) styles to some extent. The relationship of these styles to effectiveness and activity (passive/active) is shown in Figure 2.4. LF is low in effectiveness and absence of leadership, and should be used the least. In this situation, the leader leaves the responsibility for the work to followers and avoids setting goals, taking a stand on issues or making decisions (Madzar, 2001:221). Transformational leadership is active and more effective and should be used the most.



**Figure 2.4:** Three leadership categories and the associated effectiveness (Bass & Avolio, 2005:169)

The leader with an optimal profile displays transformational components most frequently followed by transactional leadership styles (MBE-P, MBE-A, CR). The poorly performing leader tends towards inactivity and ineffectiveness; that is, laissez-faire (LF) leadership.

#### 2.4.1 Transactional leadership

Transactional leaders recognise the needs and wants of their subordinates and they clarify how the needs and wants will be satisfied through rational or economic means, if the desired efforts are expended for the required task (Bass & Avolio, 2005:171). The following

categories were identified: content reward, management by exception-active and management by exception-passive. Content reward refers to leadership focused on the exchange of resources for efforts and performance. Management by exception-active monitors the performance of subordinates and takes action when necessary. With management by exception-passive, managers have a less active role, intervening only when problems become serious.

Transactional leadership has a few shortcomings and the leadership style has been associated with lower levels of performance (Bass, 1985b:26). This leadership style can fulfil the self-interest of their subordinates and gain the reputation of a successful leader. However, transactional leaders that do not have the power to deliver lose their reputation as an effective leader. Bass (1990) indicated that, when the transactional leadership style was rather mediocre, managers get things done by rewarding for good performance, while disciplining for poor performance. Transactional leadership focuses on exchange-based and leader-controlled relationships. This leadership style is characterised by a leader who remains quiet when standards and procedures are adhered to; however, when performances are below par, threats of disciplinary actions are then often used to bring the group's performance up to standard, which in the long-run can be counterproductive (Madzar, 2001:223).

#### 2.4.2 Transformational leadership

Transformational leaders recognise the existing needs and seek to satisfy the higher needs of their followers. The transformational leader moves his/her followers beyond immediate self-interest through aspects such as idealised influence (charisma), inspiration, intellectual stimulation and individualised consideration (Bass, 1999:9).

##### 2.4.2.1 Idealised influence

Transformational leaders inspire their followers with a compelling vision of what can be accomplished. Followers identify, they invest their trust and confidence in the leader and his/her mission (Bass, 1999:10). The relationship between the leader and follower is based on understanding and not on formal institutional rules, rewards or punishment. Manager-leaders tap into the emotional needs of the subordinates to increase the awareness and understanding of mutually desired goals amongst followers. The manager-leader serves as

a charismatic "role model" and the followers will attempt to imitate the leader (Simic, 1999:49). As a role model the manager-leader then demonstrates high moral and ethical behaviour.

#### 2.4.2.2 Inspirational motivation

Inspirational leaders provide visions of what is possible and that it can be attained. They clearly articulate the expected goals and give understanding on what is right and important. They promote positive expectations on what needs to be accomplished (Bass, 1999:10).

#### 2.4.2.3 Intellectual stimulation

Transformational leaders stimulate their subordinates to think about problems in new ways. They arouse a greater cognisance of problems, awareness of their own thoughts and imagination and recognition of their beliefs, assumptions and values. Through the leader's intellectual stimulation the status quo is questioned and new creative and innovative methods are explored to accomplish the organisation's goals.

#### 2.4.2.4 Individualised consideration

Transformational leaders focus on one-on-one relationships. It includes mentoring, communicating timely information to others as a way of providing continuous follow-up, and feedback. It links an individual's current needs to the organisation's mission. The manager-leader must know what motivates individual followers. The transformational leader, through his/her behaviour, demonstrates acceptance of individual differences and assigns tasks according to the subordinates' affinities (Simic, 1999:49).

The first component of transformational leadership is charisma, linking this particular leadership style to the trait approach. Judge and Bonon (2000:755) investigated the relationship between the Big Five traits (extraversion, agreeableness, conscientiousness, emotional adjustment and open to experience) and transformational leadership. The study's findings indicated that agreeableness displayed the strongest relationship with transformational leadership. Agreeableness is strongly related to charisma and this can be linked to transformational leadership through the association with individualised consideration. Agreeableness is closely tied with the group, the quality of team members' interaction with others and the actual team performance. Extraversion and openness to

experience showed a significant relationship with transformational leadership. Neither neuroticism nor conscientiousness was positively related to transformational leadership. Achievement motivation is one of the facets of conscientiousness and this may be a hindrance to transformational leadership. Bono and Judge's (2004:901) findings also indicated that extraversion maybe an important trait in predicting and understanding transformational and transactional leadership.

Within a South African context, Van Eeden *et al.* (2008:256) assessed the leadership styles and personality traits of a management team in a process of transformation. Average to high scores in strategic thinking, an innovative approach and critical evaluation of information were coupled with moral concerns, a sense of responsibility, and perseverance were noted for managers exhibiting transformational leadership style. These managers also showed, at least, reasonable resilience as well as ambition and motivation. The transformational leaders indicated assertiveness, a need to influence others and allowing others to participate in decision making. These managers were characterised by a need for affiliation, responsiveness in interaction, trust in and tolerance towards others as well as being reasonably caring.

Bono and Judge's (2004:257) work indicated that transformational leadership skills can be learned and that it is critical to gain understanding of how these leadership skills can be developed. It is in agreement with Bass's (1990) views that within an organisation transformational leadership should be encouraged and developed, since it makes a difference in the firm's performance at all levels. Transformational leadership can be increased by suitable organisational and human resource policies, which can have implications on the organisation's training and developmental activities, job designs and organisational structure.

#### **2.4.3 Implications of transformational leadership style on the organisation**

Applying the model of transformational leadership within an organisation can present opportunities for enhancing the corporation's image, with respect to improvement in recruitment of new entrants, selection of employees and promotions. This again can have implications on the organisation's training and development activities as well as the design of the job description and organisational structure. In turn, the organisation's policies and

practices must support and promote employee empowerment and creative flexibility (Bass, 1990; Bass, 1999:13).

- **Implications on the image of the organisation**

A firm with transformational leaders throughout the organisation conveys the message to their customers, suppliers and employers that it is future orientated. The organisation portrays the image that it places a premium on its intellectual resources, flexibility, development of its people, and that all employees are working towards a common goal. This implies that the organisational culture is transformational, which is driven and supported by top management. The behaviours of top management can serve as symbols of the organisational culture, which is then emulated across the organisation.

- **Implications for recruitment**

During interviews candidates may be attracted by energetic, dynamic leaders who show individualised consideration. Especially the more intelligent prospects will be attracted by the intellectually stimulating contacts they experienced during the recruiting and hiring process.

- **Implications for the selection, promotions and transfers**

Measures to identify transformational leadership can be incorporated into managerial assessment, selection, placement and guidance programmes. Direct reports, peers and/or supervisors can be asked to evaluate the manager's current leadership style using the Multifactor-Leadership-Questionnaire (MLQ). Feedback can be used for coaching and mentoring managers; or responses can be considered regarding a manager's promotion or transfer to a position of greater supervisory responsibility.

- **Implications for development**

Lower-level employees tend to model their leadership style after that of their immediate supervisor. If higher level managers are transformational in their behaviour, lower level managers are likely to follow their example. However, organisations need to support transformational behaviour, especially those leaders who are willing to take responsible risks and not follow the conventional path.

- **Implications for training**

Developing both the willingness and ability to be more transformational was noted as not easy (Bass, 1985b). Bass (1990) placed strong emphasis on the fact that

transformational leadership can be learnt. Training to increase transformational behaviour begins with examining the trainees' perception of ideal leadership. A manager can assess his own leadership style and in addition employees and/or colleagues evaluate the manager's leadership style. Differences between how employees evaluate their managers' leadership style and how managers perceive their own leadership style can be analysed and addressed. This is then followed by plans to improve their behaviours to be more transformational. It can be done on an individual basis with a counsellor or in workshops with other managers who are working towards becoming more transformational.

Furthermore, training in leadership with transformational leadership as subject should be considered at tertiary level for under-graduate students. Mentoring was also found to be important in developing transformational leadership behaviours. It was reported that for IT professionals, the relationship between transformational leadership and mentoring was significant. The data showed that participants who had/have mentors scored in the higher range in the different components of transformational leadership (Educause, 2004:6).

In conclusion, reports indicated that transformational leadership inspires followers to perform beyond expectations and it can lead to increased organisational effectiveness. The following trends were reported for the typical transformational leader.

- They raise followers' value of specific goals.
- They help followers transcend their own self-interest for the sake of the team.
- They motivate followers to higher-order personal needs.

Bass (1990) indicated that transformational leadership can be learned and developed. Hater and Bass (1988:695) proposed that transformational leadership would be more congruent with a better educated workforce within a learning environment. An educated workforce would be eager to apply and develop new skills. They would thrive under a manager-leader who transmits a sense of mission, stimulate a learning experience and arouse new ways of thinking.

The focus of the study is highly educated knowledge workers, specifically scientific technical employees in a research and development (R&D) work-unit of a petro-chemical company.

## **2.5 Leadership of knowledge workers**

In the past, manual workers dominated organisations and performed according to instructions. Today, the shift has been towards knowledge workers that are educated to use knowledge, theory and concepts rather than physical or manual work.

Technology is changing at an alarming rate. Business drivers dictate reduced product cycle time, while organisations have continuous pressure to adapt to their external environment and to perform financially. In today's turbulent business environment technologically based organisations have to be competitive and importantly sustain its competitive environment; more than ever, it depends on the innovative nature of the organisation.

By the nature of their work knowledge workers do not produce a "thing"; rather, the focus is on ideas, information and concepts. A knowledge worker can be a specialist and may be effective only if he/she has learned to do one thing very well (Drucker, 1967; Recklies, 2001). Specialisation is fragmented and the output can only be meaningful if put together with the output of other specialists.

Drucker (1967) indicated that an effective knowledge worker will actively pursue colleagues in other areas of specialisation with the question, "What contribution from me do you require to make your contribution to the organisation? How do you need it, and in what form?" The knowledge worker who takes responsibility for his contribution will relate his narrow area of specialisation to the broader area of knowledge. To enable effectiveness, specialists within the organisation have to learn the direction, perceptions, needs and limitations of other specialists to facilitate the use of their own work. The focus on the contribution to the whole requires communication, teamwork, self-development and the development of others.

The task of a manager-leader of knowledge workers is to transform the knowledge of specialists into value for the organisation as a whole. Recklies (2001) considered managing knowledge workers as challenging and highlighted the following considerations:

- **Leading self-organised employees**

Knowledge workers select, compile and transform their own tasks. These tasks can be performed in different manners to produce the final answer. People will develop their own style and this can result in different methodologies to the same problem.

- **Measuring productivity**

Knowledge workers' work is difficult to quantify or even measure. Suitable tools to measure and manage performance should be considered.

- **Hierarchies are not important any longer**

Organisational hierarchies have become less relevant for organising knowledge work. The emphasis is on working together. Demand for knowledge workers is high making them less dependent on their employers. They have the option to leave, and traditional contracts to regulate the employee-employer relationship may not be suitable.

- **Knowledge workers have different values**

Knowledge workers' passion is their area of specialisation and they would prefer to focus on the technical aspects of their work rather than the managerial questions like budgets and performance managements. They are motivated to become experts in their fields and to gain high reputations by their peers.

- **Managers do not understand all tasks of their team members**

The manager-leader may have a general understanding of the tasks people perform. Consequently, the manager-leader may have to lead people without having a true understanding of all the aspects of their tasks.

In conclusion, knowledge workers are very often specialists and have to work together with other specialists in different fields for their outputs to be meaningful. Therefore, the value and excitement of diversity should be appreciated. Furthermore, knowledge workers have a high commitment towards their profession, while traditional hierarchies are less important to them.

### 2.5.1 Research and development (R&D)

In this study, the focus is on technical leadership and is defined as the leadership of employees engaged in scientific/technical occupations such as in the field of engineering, information technology and R&D. The focus area is on scientific knowledge workers within R&D.

#### 2.5.1.1 R&D environment

The R&D environment is multi-dimensional. Its strategic role within an organisation is to defend, support and expand existing business, drive new business, and broaden and deepen a company's technological capabilities. Managing R&D strategically means integrating R&D into technology, business strategy and managing the R&D processes (Roussel *et al.*, 1991:15).

Within R&D, scientists and engineers generally work in project groups or teams with a project leader. Roussel *et al.* (1991:16) categorised project groups in research groups that tend to focus on radical innovation or developmental groups that are concerned with modifications and incremental innovations (see Table 2.3). The project group imports certain scientific and technological information (STI) and transforms it into technological innovations in the form of ideas, products or processes and then exports it to other units of the organisation.

**Table 2.3:** Three types of R&D expressed in business terms

| Type of R&D | Technical success   | Time frame          | Competitive potential | Competitive advantage |
|-------------|---------------------|---------------------|-----------------------|-----------------------|
| Incremental | High (40-80%)       | Short (6-24 months) | Modest but needed     | Short                 |
| Radical     | Modest (20-40%)     | Medium (2-7 yrs)    | Large                 | Long, patentable      |
| Fundamental | Difficult to access | Long (4-10 yrs)     | Large                 | Long, patentable      |

(Source: Roussel *et al.*, 1991:15)

On the other hand, Kim and Oh (2001:19) proposed a three-layer R&D classification as basic, applied, and commercial R&D. Table 2.4 summarises the characteristics of each R&D type.

For example, the main characteristics of basic R&D are experimental and that the researcher pursues abstract and theoretical findings. It requires long periods of time and has a broad applicability.

**Table 2.4:** Summary of the different types of R&D

|                 | <b>Basic R&amp;D</b>   | <b>Applied R&amp;D</b>  | <b>Commercial R&amp;D</b>   |
|-----------------|--|---|---|
| Characteristics | Experimental research<br><br>Observation of the fact<br><br>Requires individual research and concentration | Core technology development based on basic R&D<br><br>Basis of commercial product | Commercial product development<br><br>Evaluated by market success |
| Time frame      | Over 10 years  | 5-10 years  | 1-5 years   |
| Applicability   | High generic   | Medium  | Low applicability only to specific products                       |
| Example         | Research on fundamental attributes of carbon dioxide   | Development of substitutes for Freon refrigerant                                  | Development of energy-saving multi-purpose refrigerator           |

(Source: Kim and Oh, 2001:19)

Roussel *et al.* (1991:23) stated that for technological innovation to occur, interdisciplinary groups should work together and this process has been relatively stable over the years. However, different R&D management practices have evolved during the years. Roussel *et al.* (1991:23) distinguished between first-generation management which was characterised by a lack of strategic framework and business integration, second-generation R&D management provided the beginning of a strategic framework for R&D and enhanced communications between business and R&D management. A third-generation R&D management seeks to respond to the needs of existing business, the corporation and then contributing to the identification and exploitation of technological opportunities.

The third-generation management creates a spirit of partnership and mutual trust between general and R&D managers. The company works on integrating corporate / business / R&D / technology strategies that take into account synergies and trade-offs between projects across business and corporate programmes. Partnerships bring together different perspectives when making important decisions and they break the isolation of R&D from the rest of the organisation (Roussel *et al.*, 1991:23). With the goal of establishing what constitutes a good research environment with the purpose to improve the management and performance of R&D, Jordaan (2005:503) attempted to understand research organisations, particularly large multi-disciplinary laboratories. In his study, 36 elements were identified and then categorised in four segments (see Table 2.5).

**Table 2.5:** Attributes that foster excellent research environment

| <b>Human Resources</b>           | <b>Creativity/Cross-fertilisation</b> | <b>Internal support system</b>   | <b>Set and achieve relevant goals</b> |
|----------------------------------|---------------------------------------|----------------------------------|---------------------------------------|
| Respect for people               | Time to think and explore             | Research competencies            | Stable funding                        |
| Optimal mix of staff             | Freedom to pursue new ideas           | Equipment/Physical environment   | Planning and execution                |
| Management integrity             | Autonomy to make decisions            | Salaries and benefits            | Project management                    |
| Team / Collaboration             | Cross-fertilisation of ideas          | Allocation of internal funds     | Good relations with sponsor           |
| Good internal communication      | External collaboration                | Informed and decisive management | Reputation for excellence             |
| High quality technical staff     | Critical thinking                     | Rewards and recognition          | Fundamental research                  |
| Professional development         | Identification of new opportunities   | Efficient laboratory systems     | Clear research vision and strategy    |
| Career achievement opportunities | Sense of challenge and enthusiasm     | Laboratory services meet needs   | Invest in future capabilities         |

(Source: Jordaan, 2005:502)

Furthermore, Jordaan (2005:502) has also established that scientific or technological research can be different in the management dilemmas and tensions within the projects. Differences can be distinguished between size of the research project, programme, and the complexity of the research task and team. Merging these dimensions, four archetypes of research projects for either scientific or technological research was proposed. A visual depiction of the four research profiles is shown in Figure 2.5.

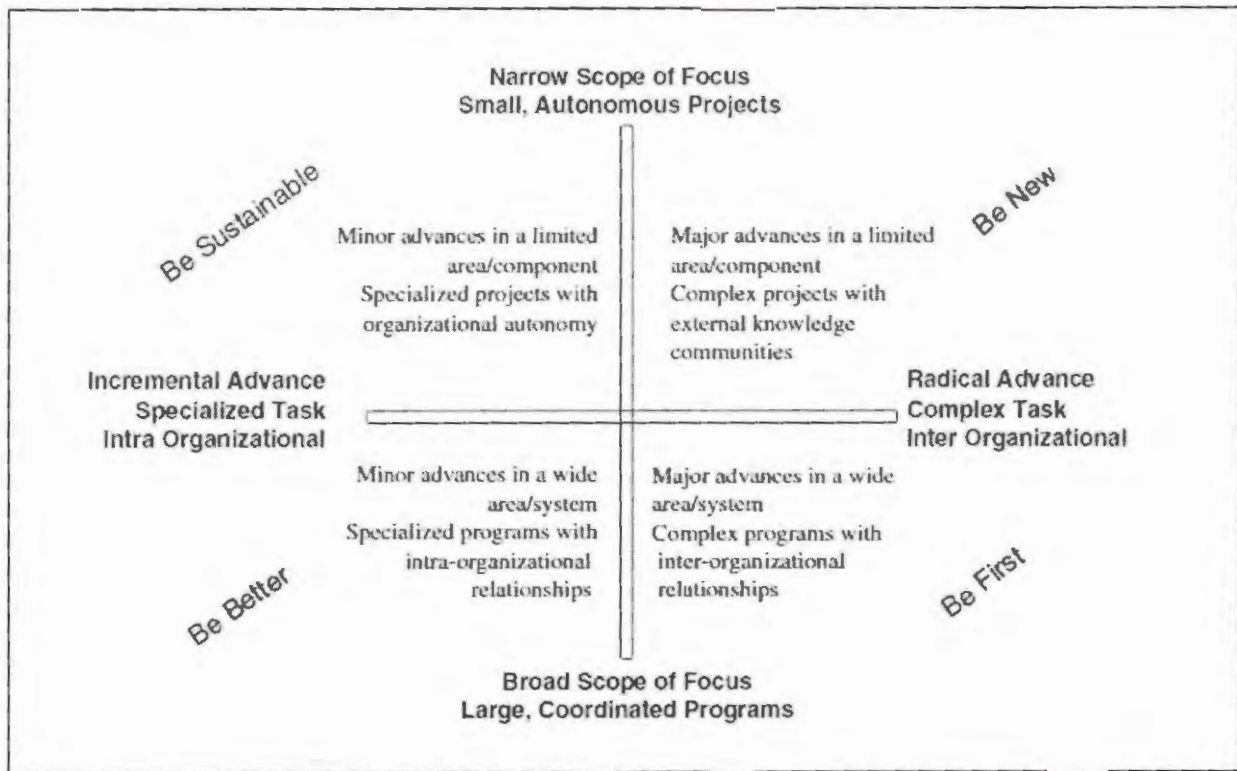


Figure 2.5: An overview of the four research profiles (Jordaan, 2005:502)

- Be new**

Fundamentally or radically new ideas, instruments, techniques or theories are generated in a limited or narrow area. Projects are small, complex and require diverse knowledge.
- Be first**

Research completes and introduces into the knowledge base a theory, scientific tool, product or process different from the existing. The projects are large in size and require complex and diverse knowledge.

- **Be better**

Research incrementally improves or standardises an existing model, technique, product or process at a system level. The tasks and teams are specialised and the programmes are large.

- **Be sustainable**

Research generates incremental advances in knowledge to master, extend or share existing ideas or technologies in a limited or narrow area. The task and teams are specialised and occur within small projects.

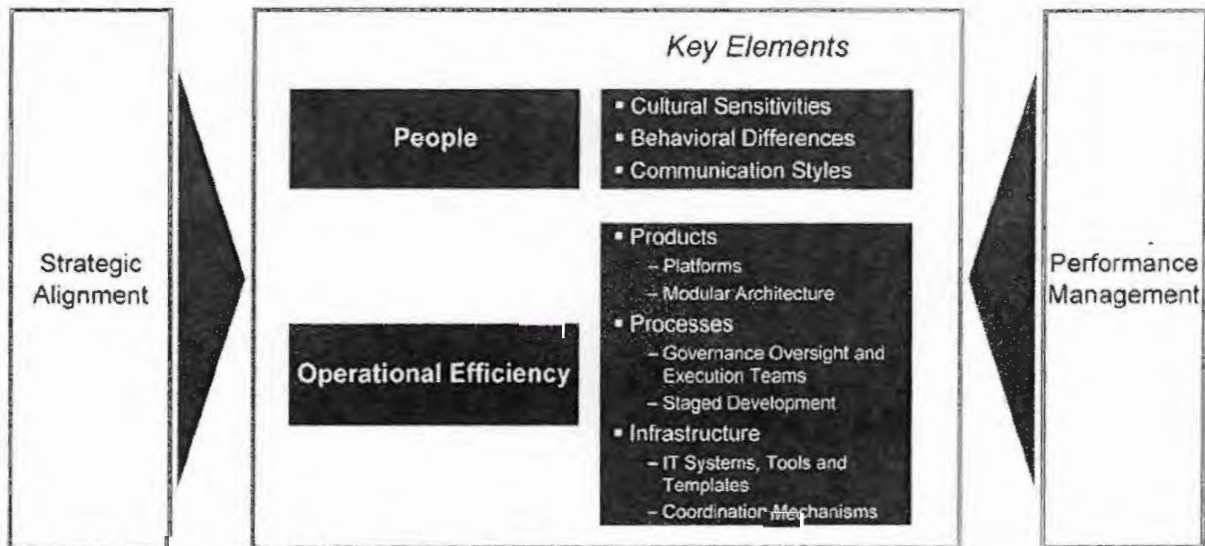
Jordaan (2005:24) reported a general lack in empirical evidence on factors that motivate R&D workers, despite the fact that there is interest in managing, retaining and attracting R&D workers. In functions of sales and operations people's priorities are in productivity and cost reduction, while the drivers for success in an R&D environment deals with issues such as innovation, leading-edge skills and collegiality.

The U.S. Department of Energy (USDOE) wanted to understand what constitutes a good R&D environment and subsequently surveyed 2200 R&D workers in 40 organisations. The following conclusions were drawn in addressing what matters to an R&D worker (Jordaan, 2005:24):

- Articulate a clear vision. Develop and sustain strategies to reach the vision.
- Invest in future capabilities with respect to building core competencies, scientific equipment, people and ideas.
- Managers must challenge workers without overwhelming them.
- Champion long-term research and fund long-term work.
- Systematically identify partnerships, projects and opportunities that can cultivate ideas, customer contact and entrepreneurship without burdening them.
- Performance appraisals should be appropriate rather than a "one size fits all" approach.
- Managers should be technically competent to make timely and informed decisions.

- Recognise that in addition to paying competitive salaries, researchers appreciate non-monetary rewards, particularly recognition of the value of their work.

Globalisation is becoming a strategic imperative for most organisations. R&D intensive organisations are recognising the importance of a global distribution of their R&D centres. Kar *et al.* (2003:246) investigated how companies positioned its global R&D activities for success. He indicated that the organisation should optimise its global R&D activities by balancing the people management with operational efficiency, while the performance needs to be aligned with the corporate strategy and reinforced through effective performance management systems.



**Figure 2.6:** Optimising global R&D operations requires balancing the people management and operational efficiency, alignment with corporate strategy and effective performance management system (Kar *et al.*, 2003:249)

Kar *et al.* (2003:248) emphasised that each company should structure and execute its global R&D strategy in a manner suitable to meet their specific goals, and in implementation they should consider the following questions:

- Do we have a global strategy that is aligned with the business strategy and how well does our R&D model support the business strategy?

- Do we have the right number of centres at the right locations staffed optimally focused on the right goals?
- Do the R&D centres optimally work on the right products and projects?
- Do the different centres collaborate well and how do they perform as an entire network?
- How do our global R&D model compare against our competitors and best-practice companies?

Schedlitzki (2006) investigated the leadership styles across 12 chemical companies from the UK and Germany. It was found that a substantial degree of consistency exists in leadership behaviour within each category. All the chemical laboratory managers across the 12 companies appeared to have similar leaders' description with slight differences; from organisation and country-to-country.

- Production or plant managers were hands-on and controlling due to the sensitivity of the chemical processes.
- Marketing managers mixed their approaches towards subordinates, little supervision is required but a hands-off approach cannot totally be followed due to close exposure to financial markets and clients.
- The R&D departments were characterised by high skills levels, strong intrinsic motivation and a creativity/innovation driven culture that is shaped by creativity, respect for knowledge and similar thinking/analytical patterns stemming from similar educational backgrounds. The occupation, for example being a scientist, was an important self-categorisation driver and it was continually reinforced by the social interaction with colleagues, superiors and subordinates. Laboratory managers' leadership style were described as laissez-faire, fairly relaxed, hands-off, leading by example and being concerned with utilising self-motivation and creativity of their subordinates. There was no need for the managers to be directive as most of the laboratory technicians found their motivation in the work that they did. Managers identified their main responsibility to be the coordination of tasks/projects and the provision of theoretical advice if needed.

### 2.5.1.2 Research and innovation

The goal of research is to increase public knowledge, which can enhance the scientific prestige of the researcher and the laboratory. Technology aims to innovate and capture economic benefit. Unfortunately, with a laissez-faire management approach the costs of research can be high, while contributing to the company's profits can be minimal and it can be difficult to correlate between new product success and research.

Innovation through creativity is an important factor in the success and competitive advantage of a technological-based organisation. Creativity is the process in which novel and useful ideas are generated, and innovation is the successful implementation of creative ideas within an organisation. Therefore, creativity is at the individual level, while innovation is at the organisational level (Gumusluolu & Lisev, 2009:461).

In a research laboratory, creativity, invention and innovation are critical to peer recognition, project and laboratory success, and a technologically based organisation's survival. Within the complexity of the R&D environment and the growing importance of R&D activities for the company's success, management's most critical task is to recognise and develop innovation (Abetti, 2002:10; Perez-Freije & Enkel, 2007:1087).

Broadly speaking, Mumford *et al.* (2002:705) indicated that there are two key steps involved in creative work: (a) creative processes or the activities underlying initial idea generation and (b) innovation processes or the activities underlying the implementation of new ideas. Creative work can be demanding, time consuming, require high levels of motivation, investment in expertise and is resource intensive. On the other hand, creative people have their identity bound up in the work being done and their work-related achievements. This has two implications for understanding creative people: (a) opportunities for professional achievement and the associated recognition are powerful motivators for creative people and (b) the locus of evaluation for creative people is typically the profession rather than the particular organisation in which they currently find employment. Characteristics associated with creative people are autonomy and achievement orientated, coupled with a lack of concern about power and affiliation; this may make the creative person an "odd man out" in many organisational settings.

Manager-leaders serve a number of other roles when people are engaged in creative work, amongst others, evaluating their ideas, integrating their ideas with the needs of the organisation and creating conditions where people can generate ideas (Mumford *et al.*, 2002:705). The problem confronting leaders of creative workers appears to be engaging motivation through involvement, participation and a professionally meaningful mission. Manager-leaders will have some difficulty in evaluating and directing work of creative people, without technical skills; thus the technical skills of the manager-leader can have a powerful influence on the performance of followers. However, technical skills are not enough for the leadership of creative ventures. Manager-leaders must be able to get diverse people to work together, they should be able to build support for risky new ventures and create a climate supporting idea generation. It was suggested that leadership of creative efforts call for an integrative style, which permits the leader to orchestrate expertise, people, and relationships in a way as to bring new ideas into being. Characteristics of the manager-leader should include intellectual stimulation, support, involvement and environment where people can express their creative capacity.

The increased importance of effective and efficient innovation activities and an increased pressure on R&D to contribute to the company success, have given rise to the need to implement performance measurement and control systems for innovation. Four different areas for innovation control systems were reported: (a) the strategic management of technologies, (b) idea portfolio management, (c) project management, and (d) innovation performance measurement. A summary of the different control systems and its purposes are shown in Table 2.6.

**Table 2.6:** A summary of the core elements of innovation control systems

| <b>Control focus</b>                 | <b>Key issues</b>  |
|--------------------------------------|--|
| Strategic management of technologies | <ul style="list-style-type: none"> <li>-Identification of the firms relative industry attractiveness, trends and internal competitive capabilities</li> <li>-A penetrating analysis of the technologies strengths and weaknesses</li> <li>-Assessment of the technologies relative importance for the overall corporate strategy</li> <li>-Qualitative-subjective evaluation through portfolios</li> </ul>   |
| Project portfolio management         | <ul style="list-style-type: none"> <li>-The link between the firms technological capacities, its customers needs and ultimately, market opportunities</li> <li>-Project selection and prioritization, resource allocation across projects and implementation of the business's strategy</li> <li>-Evaluation by means of qualitative-subjective portfolios and quantitative-objective commercial value measures</li> </ul>   |
| Project management                   | <ul style="list-style-type: none"> <li>-Managing project information in respect of costs, time and quality</li> <li>-Mostly systematised by means of project management tools</li> <li>-Quantitative-objective data are widely used</li> </ul>   |
| Innovative performance measurement   | <ul style="list-style-type: none"> <li>-Acquisition and analysis of information regarding the achievement of the R&amp;D objectives and plans</li> <li>-Identity tradeoffs and priorities with regard to conflicting goals</li> <li>-Metrics are widely used to reflect the overall R&amp;D performance</li> <li>-Frameworks like the balance scorecard (BSC) offer an appropriate framework to cluster metrics</li> <li>-Quantitative-objective data are widely used</li> </ul> |

(Source: Perez-Freije & Enkel, 2007:1092)

Perez-Freije and Enkel (2007:1091) investigated organisations that achieved success in innovation, the rate of innovation, and developmental efficiency after the implementation of an innovation control system. It was indicated that firms should understand different factors that may have an impact on the innovative process. Table 2.7 provides an overview of the

different core elements and the effects that it may have on a resource-efficient and creativity-enhancing innovative control system.

**Table 2.7:** Different core elements and the effects that it may have on an innovation control system

| <b>Core elements</b>  | <b>Resource-efficient innovation control system</b>                    | <b>Creativity-enhancing innovation control system</b>                                     |
|-----------------------|--|---|
| Leadership            | -Management as suppressor<br>-Impersonal relationships                 | -Management as moderator<br>-Quality of leader-member exchange                            |
| Structure             | -Mechanistic organisation<br>-High degree of formalisation             | -Organic organisation<br>-Favorable change attitude                                       |
| Job design            | -Role-making process with individuals not integrated into a work group | -Mutual trust and respect<br>-Cooperation/collaboration between individuals and workgroup |
| Problem solving       | -Systematic problem solving  | -Intuitive problem-solving  |
| Environment           | -Tight resource allocation   | -Absence of constraints<br>-Incentives and inducements<br>-Challenges                     |
| Compensation          | -Fixed salary  | -Compensation in the form of bonus and profit sharing                                     |
| Innovation            | -Focus on internal capabilities  | -Focus on open innovation<br>-High absorption capacity                                    |
| Personnel involvement | -Defined role expectations   | -Intrinsic motivation<br>-Cognitive abilities   |

(Source: Perez-Freije & Enkel, 2007:1087)

It was suggested that management should actively remove barriers to the implementation of their innovation control system. The innovation control system should fit the company's industry dynamics and support the decision-making process. It was found that in a slow-changing environment the innovation control measures of successful companies focused

on risk reduction and efficiency. Companies in medium to fast-changing environments used metrics and measures that indicate the need for adaptation, but also forced efficiency. In fast-changing environments, a high creativity level is necessary to react flexibly and effectively to the changing demands.

#### 2.5.1.3 Scientific/Technical employees

As noted for knowledge workers in general (Recklies, 2001), scientific/technical employees have specific distinguishing characteristics, such as the need for autonomy, achievement/goal orientation, first loyalty to profession and second to organisation, respect for knowledge, association with logic and isolation from corporate society (Thite, 2000:239).

Keller and Holland (1983:742) investigated professional employees responsible for the majority of the innovative technological outputs, such as patents, processes and products, generated within their respective R&D environments. A significant overlap in roles of communicators and innovators was found such that communicators tended to be innovators and *vice versa*. Their results suggested that communicators/innovators wanted to “do things differently”; they required a low need for clarity and exhibited a high self-esteem. They had a higher level of education, read more and were central in the communication networks.

Kay (1990:5) indicates that technically creative people is characterised by a single-minded pursuit of a particular objective. They are unlikely to concern themselves with issues which are not motivated by the problem at hand. Furthermore, they may be limited in their ability to achieve collective objectives. Due to their preoccupation with their personal objectives they can become frustrated if they are dependent upon the co-operation of others. Technically creative people have to prove themselves in a very competitive academic environment, in which individual achievement is the basis for success and not how other people accomplish their objectives. It is suggested that creative people have problems in managing others, but have no problems in managing themselves. Technically creative people are “driven” to succeed, work excessively long hours and neglect other aspects of their lives. A number of characteristics of hi-tech professional people were reported.

- **Recognition as prime motivator**

To achieve success in a highly competitive profession, one is forced to specialise. The narrower the field of specialisation, the greater becomes the opportunity to get to the top. Winning recognition in a chosen field is a major motivator of successful creative people. At the extreme, it serves to satisfy inflated egos and drive people to narrow interest.

- **Achievement for its own sake**

Creative people in hi-tech fields derive great satisfaction from having or better defining and solving a difficult or scientific problem. "Perfectionism" is often encountered in creative professionals when carried to the extreme.

- **Achievement versus relationships**

In their formal training and education, personal relationships may be burdened by the need for frequent review and evaluation of the work of colleagues and peers. Solitary work-style places little emphasis on developing personal relationships beyond what is necessary to solve problems. Hi-tech professionals tend to focus upon common technical or scientific interest.

Shneider (2009:219) discusses four stages of a scientific discipline and the four types of scientists associated with the stages. It was indicated that knowledge on the different types of scientists and the evolutionary paths of the disciplines may be helpful to populate projects and to minimise tension. Furthermore, a culture must be present that value in equal proportions scientists in all four stages.

- The first-stage scientist introduces a new subject matter into the scientific domain. They create a new framework of thinking. Their theories are forward looking and may be incomplete or even somewhat inaccurate. First-stage ideas are based on new observations and experimental results.
- Scientists at the second evolutionary stage develop techniques enabling the language of the new science to be useful and sophisticated to a broader spectrum. The main characteristics are ingenuity, inventiveness and the ability to implement ideas.
- In the third evolutionary stage methodologies developed in the second stage are applied and it finds new applications. Most of the actual data and useful knowledge is generated in the third phase. Personal qualities of the scientists are among

others, precision, and mistakes are unforgivable. Leaders in their field are detail-orientated, hard working and neat.

- At the fourth stage, the scientists transform previously generated knowledge into practical applications. The scientists' main goal is to continue to build on the knowledge. They re-view and re-evaluate ongoing developments and they help to focus future research.

#### 2.5.1.4 Challenges faced by technical leaders

Project teams are often cross-functional and it is important to bring about the right mix of scientists, engineers and other specialists to transform STI into technological innovations. The responsibility for managing the process and the people in R&D normally falls with the group/project leaders.

An important consideration is that R&D activities, such as new products, patents and innovation can take years before transformed from STI into outputs. Activities from marketing and manufacturing are required before any revenues can be derived from R&D outputs. In addition, project leaders are often selected based on their technical expertise rather than their leadership skills. This may cause conflict for individuals, for example, an individual with a high need for autonomy may find working as a scientist/engineer very fulfilling, but may not be satisfied working as a manager.

Brown's (1981:258) findings suggested that the manager-engineer's leadership style is different to that of non-engineering-trained colleagues. Engineering manager-leaders base their style on intellectual insights into the needs and motives of their subordinates and find less pleasure in interacting with people. The challenge for technical manager-leaders is leading creative individuals requires more than technical expertise.

Reports indicate that the transition for technical personnel (engineers and scientists) into management positions may be difficult (Sedge, 1985:56). The reasons for the transition into management were stated as an increase in money, status, ambition and authority. Technical professionals believed that the levels of authority in management were better defined, while engineers were frequently given responsibility without the authority.

Effective manager-leaders share at least three major attitudinal characteristics: a high need to manage, a high need for power and a high capacity for empathy (Badaway, 1982:14). However, for many engineers and scientists power comes from “professional” success, their technical skills and through recognition by their peers. Managerial-leadership success can be determined by the close interrelated technical, administrative and interpersonal skills. It was found that the relative importance of these skills is related to the management level. Technical skills were proposed to be inversely related to the management level, thus technical skills were more important to lower level managers. Upper level management success is more related to the persons’ vision and ability to understand how the entire system works and the capacity to organise and coordinate between different divisions. How much a person knows on the technical detail becomes less important, while interpersonal skills are more important for when the manager-leader interacts with subordinates. As indicated in general for knowledge workers (Recklies, 2001), Badaway (1982:27) continues to explain the challenges engineers and scientists have as managers.

- Scientists and engineers are more comfortable dealing with objects than dealing with people. Technologists are doers and they prefer doing things for themselves and find it difficult to delegate responsibility to others.
- They have a bias towards objective measurement. Engineers and scientists are comfortable working with things that they can objectively control and measure. Managers must rely on intuition and judgement in dealing with attitudes, biases, perceptions, emotions and feelings.
- Scientists and engineers have a tendency to wait for all information before they make a decision. In management, it is proposed that one will never have all the facts and it involves some form of risk taking.
- Effective manager-leaders always focus on what needs to be done, when it should be done, and managers must get things done through other people. Technologists often want to stay professionally competent and want to keep intimate contact with their specialties, trying to do two jobs at the same time. The price technical managers pay is sacrificing some of their technical competencies for being managerially competent.

McAlister (1984:40) investigated the reasons why engineers fail, that is, failure was defined as not moving up in salary or position. The inability to effectively communicate was

indicated as a prime factor for the failure of engineers. This was ascribed to the fact that by nature and their training, engineers tend to focus on things rather than people, logic rather than emotion and facts rather than feelings. Many engineers believe that their technical skills are the major consideration for success. However, the quality of engineers' work may suffer due to a poor relationship with their supervisors, inflexibility, narrow experience, too much independence and the lack in realisation that teamwork is the catalyst to success.

In conclusion, manager-leaders of R&D teams are faced with complex situations. They are challenged to lead and develop the competencies of creative people, but as with any manager-leader they also have to achieve results within time and budget constraints. As noted, transformational leaders inspire followers to perform above organisational expectations and beyond their own-self interest, which can contribute to aligned-commitment of subordinates and increased organisational effectiveness within the R&D environment.

#### 2.5.1.5 Achieving R&D leadership

A hands-off approach to managing R&D workers, as noted by Schedlitzki (2006), may not have a broad future applicability. Due to the changing technology, innovation has become critical for a technologically-based organisation's survival and managing research activities are becoming very important.

The role of an effective manager-leader was indicated to be interdependent as evaluator, motivator and director. Brush (1979:120) mentions a number of functions a technical manager-leader needs to fulfil:

- **Selling**

The manager-leader represents the group boosting its value to upper management, peers and people outside the organisation. The manager-leader must also sell the goals of upper management to subordinates.

- **Administration**

These are tasks associated with already-established rules and regulations as well as established management tools that are necessary to get specific tasks done.

- **Technical professionalism**

Manager-leaders need to know what the work requires as well as the language of the trade so they can ask the relevant questions and give direction. This entails expertise or training in one's field.

- **Influence and control**

The manager-leader controls by directing and giving orders, without the need for justification.

- **Training and development**

Assessment of employees' training needs and providing more informal on-the-job training and encouragement will help subordinates to live up to their capabilities.

Many literature reports on R&D leadership do not touch on the role the leader has in achieving results quickly and/or within budget. In an attempt to address the lack in literature reports, Stoker *et al.* (2001:1141) compared R&D teams' goals and their high degree of autonomy to self-managing "to manage self" teams. The relationship between leadership styles, individual characteristics and outcomes variables, within more than 80 self-managing teams and about 600 employees were investigated. In all teams there was job rotation and teams were responsible for the execution of several managerial tasks, such as the day-to-day planning, quality control and maintenance. It was found that team members experienced more effectiveness, job satisfaction and were more committed to the organisation when the leader was seen to offer considerate, charismatic and consultative leadership. Charisma was found as an effective leadership style, which they suggested may be relevant for R&D teams especially if set results need to be achieved within time and budget constraints. They propose that leadership style combining consultative and charisma might be key for the effective functioning of R&D teams to stimulate innovation, setting of clear goals and to give direction.

Visser (2003) reported that experienced engineers at Eskom exhibited higher levels of transformational leadership characterised by charisma, compared to inexperienced post-graduate engineering students at the Rand Afrikaans University (now University of Johannesburg). It was suggested that inexperienced engineers should prepare themselves for management roles by obtaining knowledge and developing management skills as early as their tertiary studies.

Technical specialists' decision to move into technical management can be assisted by using assessment battery tools and career counselling. Sedge (1985:56) investigated two engineering career groups, that is, individuals with a career in engineering and engineers which moved from technical positions to management (engineering-managers). They found that the variables distinguishing the two groups were (a) affiliation and dominance needs and (b) investigative and enterprising interests. The affiliative need scale indicated a significant ability to predict the engineer-manager group. It was also found that engineering-managers scored higher on dominance and psychological mindedness. Job satisfaction for the engineering group was associated with investigative and artistic interests. Engineering-managers share with other managers, confidence, persuasiveness, aggressive self-presentation and preference to leadership roles; however, results suggested that technical managers are more analytical and less intuitive to management situations.

Companies are pursuing different options to improve its R&D strategies. Some examples of how some companies approach their R&D strategies are indicted below.

Hage *et al.* (2008:256) discusses balancing diversity, integration and leadership in R&D with the approach of co-locating the basic research unit within the manufacturing department. It was indicated that R&D leaders should be able to demonstrate an effective and decisive combination of technical expertise, strong leadership and strategic business acumen. Transformational leadership was significantly and positively related to organisational innovation, empowerment and support for innovation. On R&D leadership specifically, Hage *et al.* (2008:258) indicated a number of aspects that need to be taken into consideration.

- **Long-term scientific vision**

The formation and articulation of a long-term scientific vision to enable partnerships and department's vision extend into the future.

- **Cognitive mentoring of researchers**

It is based on the general perception by employees that they are being cared for and supported by the organisation. It has been demonstrated that a higher perception of support from the organisation are positively associated with high individual performance, organisational commitment and innovation.

- **Emotional support of researchers**

It refers to information that assures beliefs that an individual are cared for and connected to others. This has been positively correlated to organisational commitment, turnover and job satisfaction.

- **Managerial practices**

A manager-leader needs to have the ability to garner resources, enable good working relationships within different teams and the organisation as a whole.

Abetti (2002:24) discusses General Electric's (GE) technology leadership and the role management had in recognising and developing creative talent. The manager-leaders had a huge impact in encouraging creativity within the research laboratories.

- The manager-leaders had faith and, supporting long-term research, this allowed for more freedom to be creative.
- The manager-leaders recognised the abilities of individuals
- The manager-leaders assigned creative and talented individuals to creative mentors
- The manager-leaders created opportunities to expand theoretical knowledge through further studies.

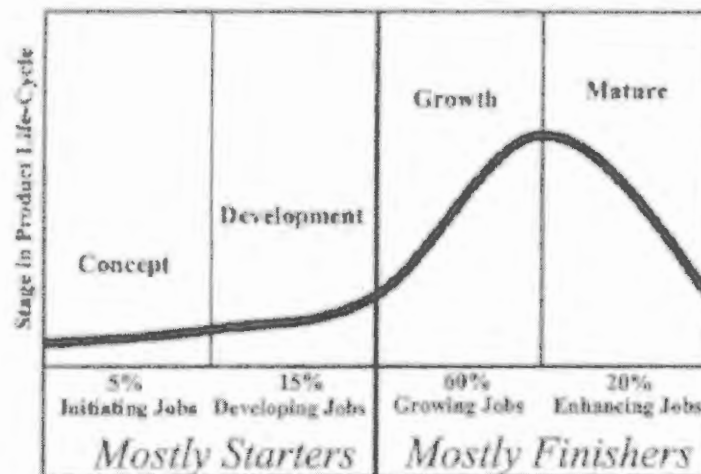
In 1991, Dow Chemical's Polyolefins and Elastomers (PO&E) business started with a turn-around strategy. Business units' profitability was declining; they had no new polymer developments in over five years and their competitors had caught up (Stevens & Swogger, 2009:35). It was found that the PO&E's R&D leadership culture lacked the will to be innovative. Recognising this, management decided to raise the level of creativity. The approach that Dow followed was labelled as Speed-based development that allowed for very rapid product development cycle times.

Dow recognised that scientists differed in personalities, which is in agreement with what Shneider (2009:217) reports, indicating that the personalities of scientists differ. Dow identified two personality types, one as a starter characterised via the MBTI-based creativity index instrument and finishers characterised as STJs (people with sensory, thinking and judging preferences) (Stevens, 2009:35). Starter personality types were identified as creative, intuitive, visionary and curious. They tend to be difficult to manage

and difficult to follow when in leadership positions. When properly directed, they can open up new markets and create new breakthrough processes. Finisher personality types are more pragmatic, better focused and more task-orientated. They like detail, agendas and are consistent workers. These personality types get the job done and capture the cash.

Management matched leadership roles with job roles. Starters were assigned to job roles involving innovation and developments, such as what new types of polymers are needed to satisfy customers' needs. Finishers rely on well established procedures to solving problems, which can include continuous improvement and incremental advances such as commercialising existing products, keep plants running well and implementing procedures.

PO&E's R&D leadership proposed that the R&D group should be approximately 20-30% starters and 70-80% finishers, while in R&D, leadership roles should be 60% starters and 40% finishers (Stevens, 2009:35). Figure 2.7 shows the leadership needs with the product life cycle and it implied that human resources portfolio of a project needs to be continually rebalanced. Overall, more finisher personality types are needed in long-established businesses, especially non-R&D functions. More starter type of personalities is needed in leadership of new businesses.



**Figure 2.7:** Personality types with product life cycles (Stevens, 2009:39)

Boeing set two objectives in 1997: run a healthy core business and ensure future growth. The idea was to promote and sustain innovative work in the company. Leadership was indicated as the key to success. The technical manager-leader had to help the organisation

go into the right direction and develop the right culture that stimulates innovation. He/she needed to define the organisation and what the organisation stands for to his subordinates. The following elements were identified to get people, teams and cultures to be more innovative and to take appropriate risks (Swain, 2007:25):

- Educational opportunities
- Recognition programmes
- Challenging work assignments
- Lessons learned
- Frequent, open and honest communication

In addition to the traditional R&D leadership skills, it was indicated that the modern R&D leader-manager will also have to have “inter skills” (Van der Feltz, 2007:265).

- **Interdisciplinary**

It consists of a clear understanding of the different functions and the departmental relationships within R&D groups.

- **Interpersonal**

Clear communication, alignment and the development of trusted working relationships with peers, partners and subordinates are required.

- **International**

Language and cross-cultural skills are critical.

The effective leveraging of talent across multiple centres is critical in a company’s R&D globalisation strategy (Kar *et al.*, 2009:14). Most importantly was noted the identification of the appropriate leadership. Challenges that can be expected are high staff turnover, language, culture, and making partnerships work across diverse organisations, geographies and time zones. Effective R&D collaboration requires a healthy exchange of tacit knowledge and challenging other people’s ideas and prior experiences. It was found that companies that successfully establish their global centres have mastered the “soft” management skills that address hiring and retention, accountability and trust, communication and cultural diversity.

## **2.6 Technical manager-leaders as transformational leaders**

The workforce in an R&D/technical environment is highly educated and these educated employees are more concerned about interesting work and the development of their abilities. Manager-leaders who simply reward these technical specialists' performance as contracted are not likely to energise followers who want and need personal enrichment. As indicated, transformational leadership can result in performances that exceed organisational expectations. In the following section literature reports on technical manager-leaders as transformational leaders are discussed below.

Leadership in R&D settings versus administrative setting was investigated in a telecommunications organisation that produces and develops hardware. Both the employee characteristics and the work context varied considerably, the R&D environment compared to the administrative environment (Berson & Linton, 2005:51). R&D departments employed engineers and technologists, while the administrative included, among others, managers from financial, marketing, human resources and other administrative functions. Transformational leadership was found to be important for a quality environment in both the administrative and R&D settings. In addition, transformational leadership style was found to have a positive impact on job and overall satisfaction within the R&D environment.

Kearney *et al.* (2009:77) investigated transformational leadership in 62 R&D teams in a multinational pharmaceutical company. They found that when transformational leadership was high, team performance was significantly positively related to diversity regarding nationality and educational background. It was concluded that transformational leadership can help turn team diversity into an asset, by fostering the utilisation of a large pool of ideas and perspectives.

The transformational leadership approach or the full-range leadership model was indicated to heighten levels of worker performance and motivation. It was indicated that transformational leadership can be learned and is more congruent with a better educated workforce within a learning environment. The focus is the evaluation of transformational leadership of highly educated knowledge workers, specifically scientific technical employees in an R&D environment. Knowledge workers within an R&D environment, that

is, scientists and engineers, are often specialists in their field and their outputs can only be meaningful if put together with the output of other specialists.

Table 2.8 shows some literature reports on the investigation of technical manager-leaders as transformational leaders.

**Table 2.8** Some literature reports on technical manager-leaders as transformational leaders

| Author                                   | Description  |
|--|--|
| Kearney (2009:77)                        | Investigating diversity and transformational leadership in 62 R&D teams  |
| Howell and Avolio (1993:891)             | Transformational leaders and innovation  |
| Jung <i>et al.</i> (2003:525)            | The role of transformational leadership in enhancing innovation in companies in the electronics industry   |
| Keller (2006:202)                        | R&D projects engaged in instruments, semi-conductors, energy and petrochemical investigations. Transformational leadership predictor of technical quality                          |
| Thite (2000:239)                         | Transformational leadership in IT  |
| Berson and Linton (2005:51)              | R&D versus administrative environment. Within the R&D environment consisting of engineers and scientists transformational leadership related to establishing a quality environment |
| Gumusluoglu and Lisev (2009:461)         | Transformational leadership, creativity, and organisational innovation. R&D within software developing companies   |
| Pirirola-Merloa <i>et al.</i> (2002:251) | Leadership, team climate and performance in R&D teams  |
| Madzar (2001:231)                        | Investigated homogeneous sample in medical technology. Transformational leaders did indeed enhance their subordinates' pro-activity  |

In conclusion, knowledge workers within an R&D environment, that is, scientists and engineers, are often specialists in their field and their outputs can only be meaningful if put together with the output of other specialists. Often interdepartmental interaction is required to transform R&D into revenue. Furthermore, the R&D environment is multi-dimensional and the compilation of technical specialists can be diverse in their field of specialisation and personality characteristics. Therefore, it is proposed that within the complex R&D environment, diversity should be appreciated.

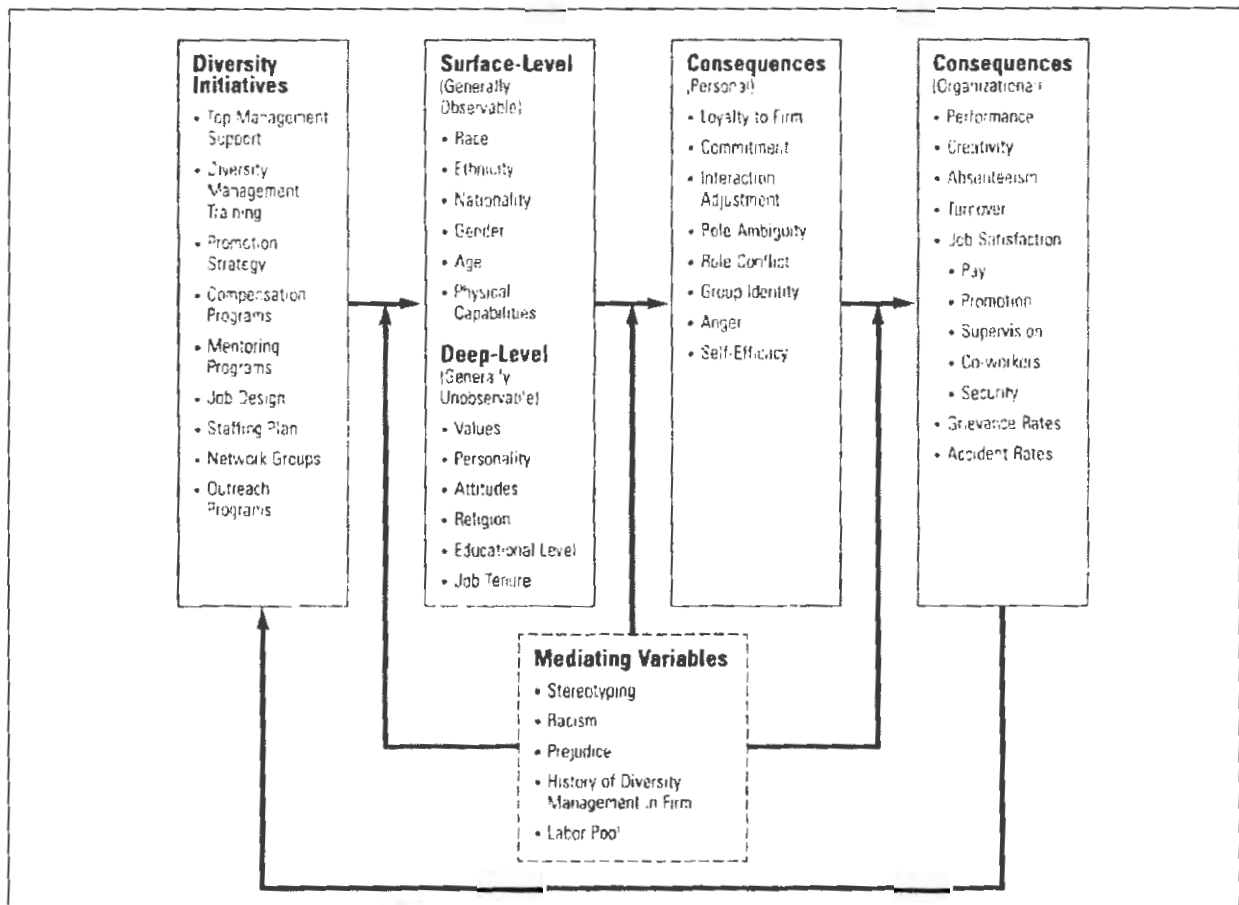
## **2.7 DIVERSITY**

Organisations today must attract and hire from a pool of workers, which has become increasingly diverse. Cox and Beale (1997:35) define diversity as a mix of people in one social system that has distinctly different, socially relevant group affiliations. Bassett-Jones (2005:169) indicated that diversity encompasses differences in ethnicity/nationality, gender, function, language, religion, lifestyle or tenure. It is recognised that different management skills are needed to effectively deal with different diversity challenges (Bassett-Jones, 2005:169; Cox & Beale, 1997:35). Managing diversity entails creating a climate in which the potential advantages of diversity for organisational or group performance are maximised while the potential disadvantages are minimised.

Figure 2.8 lists a number of diversity initiatives that an organisation may implement and the effects that it can have on both personal and organisational outcomes. Within the scheme the authors refer to surface-level diversity, which can be observed, such as race, gender and nationality. Deep-level diversity cannot be observed and is related to people's values, attitudes, educational level and personality, and other aspects.

The listed consequences of the diversity initiatives are substantial on both a personal and organisational level (Ivancevich & Gilbert, 2000:69). The absence of diversity initiatives can lead to the under-utilisation of the workforce in total. This is then not a legal issue, but a managerial and leadership concern. Cox and Beale (1997:35) reported that effectively managing diversity can potentially enhance revenues. Organisations that have a low capacity to manage diversity in work teams can lead to higher cost structures. Linkage between managing diversity and organisational cost were noted by Cox and Beale (1997:35):

- High employee absenteeism and turnover
- High barriers to effectively contribute in the work-place due to unresolved inter-group dynamics
- Minority groups that may experience harassment behaviour
- Discrimination suits or allegations within the organisation may be high
- The communication efficiency may be reduced



**Figure 2.8:** Schematic depiction of the personal and organisational consequences diversity initiatives can have (Ivancevich & Gilbert, 2000:69)

The concern diversity poses is that it may damage the cohesiveness of a team and lead to conflict within the group. Cohesiveness can make groups vulnerable to “groupthink”, while diversity can effectively inhibit it. However, diversity of perspectives can generate more alternatives and greater critical evaluation of concepts. Ng and Burke (2005:1195) found that high achievers and minority groups rated organisations with diversity management systems as more attractive to potential employees. In attracting high achievers especially,

for technological-based organisations higher emphasis should be placed on implementing diversity management systems (Ng & Burke, 2005:1195).

Bassett-Jones (2005:169) noted that combining diversity with understanding of individual strengths and weaknesses, working relationships based on trust can enhance creativity and problem-solving. A creative and innovative environment recognises individual differences as a potential source of different perspective and frame of reference. Signs of a healthy environment include people easily expressing individual identities, ideas and a willingness to question assumptions, having problems in the open and the presence of effective techniques for constructively working through disagreements as well as managing a diverse knowledge base. In the absence of a strong core value system and sense of purpose, diversity can cause serious disagreements and factionalism within an organisation.

It was noted that team diversity was found to have positive impacts on performance: heterogeneous teams can create diversified ideas and make better decisions for the team. Kuo (2004:266) noted that members with heterogeneous age differences have a negative impact with the communication frequency of members, while team members with high education levels have positive feelings towards members of the same education level. Kuo (2004:268) was of the premise that the positive overshadows the negative in that it is better for a team with a diversified job functional background to contribute towards constructive suggestions to promote knowledge sharing.

The impact of diversity on team performance in five high-technology companies, consisting of 409 individuals was investigated (Ancona & Cadwell, 1992:321). A high level of functional diversity was directly associated with lower performance for management ratings of innovation and for team ratings of their overall performance. The authors indicated that innovation requires two sets of activities: creative problem solving and the implementation of these solutions. It was noted that diverse groups have more creative potential to problem solving, but they may have less flexibility and more conflict during teamwork compared to homogeneous groups.

The literature investigation indicated that males dominated the scientific environment. This trend is/was also relevant in a South African context. More females opt to obtain scientific tertiary education and subsequently enter into academic and scientific working environments. Furthermore, literature on managing a scientific workforce often does not differentiate between scientists and engineers. Schedlitzki (2006) reported that within R&D departments, the function, for example, being a chemist/engineer, was an important self-categorisation driver and it was continually reinforced by the social interaction with colleagues, superiors and subordinates. In the section below, gender diversity and functional diversity are discussed.

### **2.7.1 Gender diversity**

In the open literature the disparity in the workplace between female versus male are actively debated. Mixed gender teams were reported to result in conflict and can cause nervous human relationships (Kuo, 2004:269). Johnson *et al.* (2008:39) indicated that male leaders are perceived as more effective and often – strength, a more masculine leadership prototype, appeared more important than sensitivity – the more feminine leadership prototype. Women were found to be more participative, have a democratic leadership style and men have a more autocratic and directive leadership style (Hooijberg & Ditomaso, 1996:6). Bass (2005) suggested that female leaders are more transformational than male leaders. They, however, continue to state that women are more likely to exceed their male counterparts in leadership qualities to attain the same positions of responsibility and levels of success as men.

Research findings indicated that females are socialised to display care and consideration, while boys are socialised to compete and perform. Men tend to attach greater importance to equity and fairness, while women place greater importance on needs. The differences in socialisation also appeared to influence the communication style between the sexes. Women were concluded to focus on establishing a rapport, while men focused on establishing report relationships. Differences in the socialisation, thinking and communication can lead to conflict between the sexes (Hooijberg & Ditomaso, 1996:1).

Ditomaso *et al.* (2007:175) investigated scientists and engineers from industrial research and development laboratories of 24 large US-based firms for structural positions of

different demographic groups on their access to the allocation of favourable work experience and decisions made on their performance. In the US, R&D has been dominated by US-born white men, but this trend has been changing with an increase in women, US-born minorities and immigrants. In this study, structure was referred to the relative status and competitiveness among groups. It was emphasised that the performance in science and engineers is often based on reputation and consensus among multiple evaluators and thus the opportunity for group preference to be introduced is substantial. The study found that in the science and engineering fields, the structural positions of white men provided them with greater access to favourable work experience and giving them the benefit of the doubt in the evaluation of their performance with respect to innovation and promotability into management. US-born white females had average access to task-orientated work experience, while US-born black females appeared to be in the least favourable position with evaluations as less promotable and innovative. Simard (2002) indicated that due to bias and stereotyping, women are less likely to be hired and promoted, especially for roles that are traditionally stereotypically masculine, such as engineering.

The position for females within an academic scientific environment was also noted to be a concern. In this regard, women in academic science with respect to job satisfaction, productivity and felt influence over unit decisions and resources. These three outcomes were indicated as critical in the success of women within academic science. Outcomes of negative gender-related experiences were reported as sexual harassment and gender discrimination within the workplace and these factors had the strongest influence on overall job satisfaction. Gender discrimination was also related to women scientists' level of felt influence in their department. It may signal to women their lesser value relative to men in their department, which may translate into women feeling that their opinions are not valued.

### **2.7.2 Functional diversity**

Modern organisations rely on teams rather than individuals to perform certain tasks. The question remains, how should teams be formed?

With R&D organisations the two functionalities can be of importance; scientists versus engineers. In discussing managing R&D units, researchers often make no distinction between scientists and engineers. Keller (1997:539) argued that scientists and engineers

have different goals, reference groups and responses to motivating factors. Scientists have a more cosmopolitan view, with their primary loyalty with their scientific field or professional peer community outside the organisation. Engineers, on the other hand, tend to be local with a primary identification with their company, its goals and superiors in the hierarchy. Scientists are highly involved in their work, thus job involvement was found to be a motivator for job performance to scientists rather than engineers.

In product development teams, it was noted that the most important diversity variable is the functional mix. The integration of diverse disciplines or cross-functional integration (CFI) can be defined as the magnitude of interaction and communication, the level of information sharing, the degree of co-ordination, and the extent of joint involvement across functions. CFI aims to transform tacit knowledge into collective knowledge and is considered as important in especially new product development tasks. Knowledge is central in all the stages of creativity and innovation and is considered as a valuable strategic resource (Hirunyawipada *et al.*, 2009). Cross-functional teams offer the advantage that the team has direct access to expertise that would not be available if all team members were from the same area. Increased functional diversity was associated with greater external communication of team members with other groups; this was related to higher managerial ratings of the team's innovation (Ancona & Cadwell, 1992:321). However, teams made up of individuals from different "thought-worlds", which can be the case within an R&D environment, may find it difficult to develop a shared purpose and an effective group process.

Keller (2001:547) tested 93 research and new development groups and found that functional diversity had no direct effect on technical quality, but did lead to increased job stress. The increased job stress can result in lower group cohesiveness. However, the researchers suggested that having not-too-comfortable conditions caused by functional diversity combined with speed to market can lead to enhanced worker effectiveness.

On the other hand, Carbonell and Rodriguez (2006:225) investigated teams and their relationship to speed of execution of projects with varying levels of technological complexity. The study focused on characteristics of the people assigned to the team (staff-related factors) and decisions on the way the team is put together or how it works together

(structural-related factors). Staff-related factors comprised the degree of interaction of internal and external interest groups on project teams and the relative experience of members assigned to work on projects; this includes functional diversity and team experience. Structural-related factors included the team's co-location, the team's dedication, and the team's stability through the development process. The study found that an increase in functional diversity had a positive impact on the speed of innovation. It was found that when the functional diversity becomes too high, innovation speed diminished. In addition, the more complex and difficult the projects were, the greater functional interdependence was needed to speed up execution. Functional diversity was less beneficial for simple projects with clear-cut solutions.

Hirunyawipada *et al.* (2009) indicated that goal congruence and task cohesion can be enhanced during CFI goal formulation. In goal formulation, the leadership of the teams is important and it was emphasised that the leader should exhibit a transformational leadership style. CFI team members should be selected based on individuals that possess the appropriate expertise regarding their functions as well as those that have diverse organisational networks. This can ensure the availability of rich experience and knowledge. Multiple functions/disciplines present in CFI teams greatly reduce homogeneity of membership; this can relate to reduced chances of groupthink. The length of time the team members spend together can, however, increase interpersonal cohesion within CFI teams. This cohesion can be reduced by actively managing the CFI teams. Noted in the research were key steps to manage interpersonal cohesion (Hirunyawipada *et al.*, 2009):

- Aligning personal values of the team members with the team's vision
- Stimulating intellectual capabilities within the team
- Creating a working mechanism whereby individuals are treated with respect
- Providing an enabling environment that supports innovation

In conclusion, in today's turbulent business environment there is an increasing need for leaders who can meet the demands and challenges within their organisation. The great challenge facing South African managers is the improvement of employees' performance, which includes unlocking employees' full potential while simultaneously motivating the

workforce. Researchers indicated that a balance between management and leadership is required to be effective as a manager and that transformational leadership can lead to performance above organisational expectations. Importantly, researchers are recognising the relationship between diversity, creativity, innovation and competitive advantage. Core to a R&D environment is creativity and innovation, where creativity is a precondition for innovation and creativity can be enhanced by diversity.

In this chapter, the full leadership model and transformational leadership were discussed. This was then followed by an overview of the characteristics of the scientific workforce, R&D environment, the challenges technical manager-leaders may experience and reports in the literature on technical managers as transformational leaders. Diversity within an R&D environment focusing of gender diversity and functional diversity were then looked into.

## **CHAPTER 3**

### **RESEARCH METHODOLOGY**

#### **3.1 INTRODUCTION**

Struwig and Stead (2000:3) reported that research is an open system of thought where researchers actively debate each other's work in a struggle to find the right questions to ask. It is an important way in which thinking develops. Data and the sources are critically examined to understand what the data means. Often researchers go through great lengths to get systematic, valid and reliable data. The researcher then interprets and attempts to explain what the data means. The aim of quantitative research in particular is to obtain valid generalisations. Generalisation can be established through the development of an explanatory theory. The application of the theory turns the facts into research.

In this study, the main focus is the evaluation of the leadership style within an R&D environment in a petro-chemical company. Chapter 3 describes the research methodology used in this study to evaluate transformational leadership within an R&D environment. The population, sample and the sampling approach is described as well as the measuring instrument.

#### **3.2 PURPOSE OF THE RESEARCH**

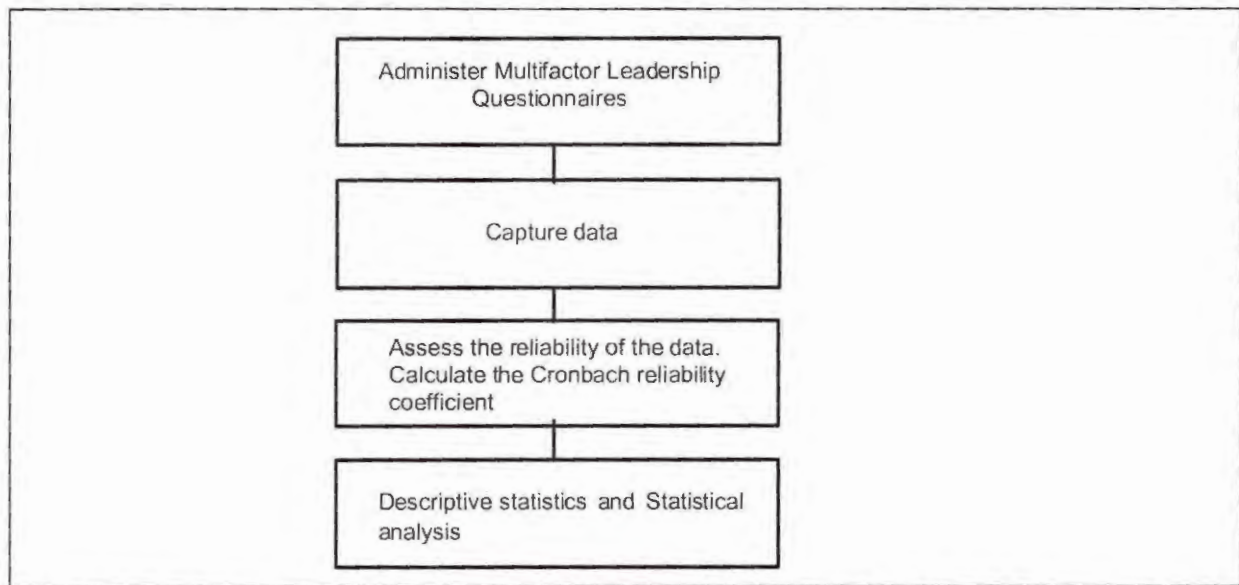
As mentioned by Elkins and Keller (2003:587), the R&D organisation transforms scientific information and knowledge into technological innovations in the form of ideas, products or processes. Project leaders are generally chosen based on their technical expertise. By the nature of their work and their education, R&D people identify with the technical aspects of the organisation and less on "people issues". The technological landscape is changing at a fast pace, influencing the organisation's long and medium-term business strategies, which have an impact on the organisation's R&D activities. R&D management has to make difficult decisions dealing with projects and project teams to align the R&D strategy with the bigger organisational strategy. It can affect R&D employees negatively if the "people issues" have not been dealt with. Literature indicates that transformational leadership style may be effective in a fast-changing environment consisting of complex multi-functional and multi-dimensional aspects. The researcher believes that within the R&D environment

consisting of highly skilled diverse knowledge workers, manager-leaders require an aptitude for interpersonal relationships. It is believed that transformational leadership is an effective leadership style to stimulate, motivate the workforce, improve performance and retain technically qualified personnel. In this study, the MLQ is employed as a measuring instrument, which has extensively been used in the open literature to measure transformational leadership. The study aims to assess how manager-leaders perceive their leadership style, compared to how subordinates assess their manager-leaders' leadership style. Secondly, we want to establish if there is a difference in how the (i) engineering functionality and scientific functionality, and (ii) females and males, perceive their manager-leaders' leadership style. In establishing the leadership style of the manager-leaders it would aid the organisation to provide training to develop specific leadership skills which may enhance the performance culture of multi-functional teams.

### **3.3 RESEARCH DESIGN**

As indicated, the purpose of the study was to assess the leadership style of technical manager-leaders in a diverse R&D environment. The research methodology employed a quantitative research approach.

In the investigation, the quantitative research population consisted of manager-leaders and their subordinates within an R&D environment. Figure 3.1 provides a schematic diagram of the research method. The method entails population and sample selection, questionnaire administration, data collection, data capturing and data statistical analysis.



**Figure 3.1:** A schematic representation of the general research design

Quantitative research is designed to ensure objectivity, generalisability and reliability (Weinreich, 1996:1). It examines constructs (variables) through the use of a measurement tool such as a questionnaire and/or some structural observation. In the investigation, research participants were randomly selected from the study population in an unbiased manner. A cross-sectional design with a survey as the data collection technique was used to achieve the research objectives. Cross-sectional designs are used to examine groups of subjects in various stages of development simultaneously, while a survey is a data-collection technique in which questionnaires are used to gather data about an identified population (Burns & Grove, 1993). Information collected is used to describe the population at that point in time. This design can also be used to assess interrelationships among variables within a population. According to Bless and Higson-Smith (2000) and Shaughnessy and Zechmeister (1997), this design is best suited to addressing the descriptive and predictive functions associated with the correlational design, whereby relationships between variables are examined.

### **3.3.1 Ethical considerations**

A guarantee was given to all the respondents that their names would not be revealed in the reports. In order to ensure the success of the research, the respondents remained

anonymous apart from being linked to a particular departmental manager-leader. Finally, the organisation will be provided with a copy the research findings.

### 3.4 SAMPLING PROCEDURE

Struwig and Stead (2001:109) noted that, in collecting primary data for quantitative research, it is impractical to consult all people within a specific category, that is, the population. It is more appropriate to obtain information from a selected group of people from the population, known as a sample, to be in the study. If a sample is chosen according to sound scientific guidelines the sample is representative of the population and can be safely generalised to the entire population.

The population consisted of manager-leaders with more than one year experience and with two or more subordinates. The subordinate population was compiled of workers with more than one year working experience. Table 3.1 shows the manager-leader, subordinates, population, sample size and the corresponding responses.

**Table 3.1:** The targeted population, sample and responses rates

|            | Manager-leaders | Subordinates |
|------------|-----------------|--------------|
| Population | 60              | 296          |
| Sample     | 54              | 211          |
| Responses  | 40              | 142          |

The entire indicated manager-leader population was targeted and the sample size was related to manager-leader availability, that is, work and travel commitments. The subordinates sample was a convenient random selection. As shown in Table 3.1, 40 managers successfully completed and returned the questionnaires, resulting in a response rate of 74%. A sample of 211 subordinates was targeted and responses of 142 were received, resulting in a response rate of 67%.

### 3.5 MEASURING INSTRUMENT

#### 3.5.1 Multifactor-Leadership-Questionnaire (MLQ)

The MLQ is based on the work of renowned leadership theorists like Bass, Avolio and Yammarino (Avolio & Bass, 1997). The MLQ was formulated from the Full Range

Leadership Development Theory (Bass & Avolio, 1997). In Chapter 2, it was proposed that the Full Range Leadership Development Theory is a suitable theoretical construct of leadership. The MLQ has been improved and tested since 1985 with the result that many versions of the questionnaire have been developed. The latest version, Form 5X (Revised), was used in this study.

The MLQ contains 45 statements that identify and measure key aspects of leadership behaviours. Each statement corresponds to one of the nine components of transformational, transactional or laissez-faire leadership factors. The transformational leadership style is divided into idealised charismatic behaviours and attributes. Factors representing transformational leadership include idealised influence (attributed), idealised influence (behaviour), inspirational motivation, individualised consideration and intellectual stimulation. Transactional leadership style is represented by two factors called contingent rewards and management-by-exception. Management-by-exception is also divided into Management-by-exception-active (MBE-A) and Management-by-exception-passive (MBE-P).

The MLQ consists of two versions known as the 'rater version' and the 'self-rater version'. In this study, leaders completed the self-rater MLQ, by rating themselves in terms of the transformational, transactional or laissez-faire leadership factors. Subordinates completed the rater version of the same questionnaire. In order to gain an accurate picture of the leader's ability, the rater MLQ was completed by three or more respondents (Bass, 1985a). The leader, for example, would be given the statement, 'I talk optimistically about the future', whereas the subordinates' questionnaire would say, 'The person I am rating talks optimistically about the future'.

Examples of items from the transformational, transactional and laissez-faire leadership are shown in Table 3.2.

**Table 3.2:** Examples of items from the transformational, transactional and laissez-faire leadership styles

| <b>Transformational leadership</b> |  |
|------------------------------------|--|
| Idealised influence (attributed)   | I instil pride in others for being associated with me                                    |
| Idealised influence (behaviour)    | I specify the importance of having a strong sense of purpose.                            |
| Inspirational motivation           | I talk optimistically about the future.  |
| Individualised consideration       | I spend time teaching and coaching.  |
| Intellectual stimulation           | I re-examine critical assumptions to question whether they are appropriate.              |
| <b>Transactional leadership</b>    |  |
| Contingent rewards                 | I provide others with assistance in exchange for their efforts.                          |
| Management-by-exception-active     | I focus attention on irregularities, mistakes, exceptions and deviations from standards. |
| Management-by-exception-passive    | I fail to interfere until problems become serious.                                       |
| <b>Laissez-faire leadership</b>    |  |
| Laissez-faire                      | I avoid getting involved when important issues arise.                                    |

The MLQ comprises a 5-point Likert scale and the respondents were instructed during the administration of the questionnaire by the researcher to mark the most suitable answer.

The scale ranges from 0 to 4 as follows;

0 - Not at all

1 - Once in a while

2 - Sometimes

3 - Fairly often, and

4 - Frequently if not always

### 3.5.2 Demographic information

The participants were requested to complete a section on demographic information consisting of questions on their gender, ethnicity, education, function and background. This was to investigate the relationship that exists between leadership style and the scientific and engineering functional areas.

### 3.5.3 Validity and reliability

In quantitative research, validity refers to the extent to which the research design is scientifically sound. Whitelaw (2001:108) indicated that the validity of an instrument refers to how well an instrument measures the particular concept it is supposed to measure. However, before it can be valid, the instrument must be consistently reproducible, in other words, reliable.

Avolio and Bass (1985a) confirmed the reliability of the MLQ by using a large population (N = 1394). The MLQ scales exhibited high internal consistency and factor loadings. The total items and for each leadership factor scale reliabilities ranged from 0.74 to 0.94. Furthermore, according to Avolio and Bass (1997), reliability of the MLQ has been proven many times through retesting, internal consistency methods and alternative methods.

The internal consistency of the MLQ subscales was investigated using a group consisting of approximately 1200 employees from several diverse organisations (commercial businesses, health-care organisations, welfare institutions and local governments). Reliability (Cronbach's alpha coefficient) for the subscales of transformational leadership ranged from 0.72 to 0.93; transactional leadership ranged from 0.58 to 0.78; and laissez-faire leadership was 0.49 (Den Hartog *et al.*, 1997:19).

The MLQ was tested in a South African environment and Cronbach's alpha reliability coefficient of the three main scales within the MLQ, namely transformational, transactional or laissez-faire, scored 0.944, 0.736 and 0.803 respectively (Ackermann *et al.*, 2000). The authors applied the MLQ to investigate the leadership style within an electricity utility organisation in South Africa. In this particular study, a good average Cronbach's alpha value of 0.902 was obtained.

### **3.6 DATA COLLECTION**

In the current study, a questionnaire was used to gather the necessary information. A list of manager-leaders and subordinates were obtained from the Human Resource Manager. The researcher drafted a letter (see Appendix 2) that was sent via e-mail to the relevant manager-leaders and employees in the sample (see Table 3.1). This letter informed the managers and employees in the sample about the purpose and confidentiality of the research.

In addition, the researcher held meetings with the HR manager and the management team where the reasons and methods of the study were discussed. In an attempt not to disrupt business operations and to ensure that the respondents receive the documents in the shortest possible time, questionnaires were physically handed out to respondents. Each questionnaire was accompanied by a covering letter (see Appendix 2) explaining the purpose of the study. The letter contained instructions on completing the questionnaire and the importance of answering all questions. It was also requested that the answered questionnaires be placed in sealed boxes scattered at different R&D departments. An e-mail was forwarded to remind participants to complete the questionnaire. This method was non-personal, addressed cost, time and geographical constraints.

### **3.7 DATA CAPTURING**

Upon completion of the questionnaires the scores were captured in a Microsoft Excel spreadsheet for statistical analysis with respect to the demographic information, Leader and Rater MLQ questionnaire.

### **3.8 DATA ANALYSIS**

The statistical analysis was carried out with the SPSS programme (SPSS Inc., 2003). Descriptive statistics (means, standard deviations, skewness and kurtosis) were used to analyse the data. Cronbach alpha coefficients were used to determine the internal consistency, homogeneity and unidimensionality of the measuring instruments (Clark & Watson, 1995:235). Sekaran (2000:101) indicated that Cronbach's reliability coefficient less than 0.6 are considered poor, reliabilities within 0.7 ranges are considered acceptable and those coefficients over 0.8 are considered good. Coefficient alpha contains important

information regarding the proportion of variance of the items of a scale in terms of the total variance explained by that particular scale.

Pearson product-moment correlation coefficients were used to specify the relationships between the variables. In terms of statistical significance, it was decided to set the value at a 95% confidence interval level ( $p \leq 0,05$ ). Effect sizes (Steyn & Ellis, 2003) were used to determine the practical significance of the findings. A cut-off point of 0,30 (medium effect, Cohen, 1988) was set for the practical significance of correlation coefficients.

Multivariate analysis of variance (MANOVA) was used to determine the significance of differences between the experiences of different leadership styles of demographic groups. MANOVA tests whether or not mean differences among groups in a combination of dependent variables are likely to have occurred by chance (Tabachnick & Fidell, 2001). In MANOVA, a new dependent variable that maximises group differences is created from the set of dependent variables. Wilk's Lambda was used to test the likelihood of the data, on the assumption of equal population mean vectors for all groups, against the likelihood on the assumption that the population mean vectors are identical to those of the sample mean vectors for the different groups. When an effect was significant in MANOVA, one-way analysis of variance (ANOVA) was used to discover which dependent variables had been affected. Seeing that multiple ANOVAs were used, a Bonferroni-type adjustment is made for inflated Type I error. Tukey tests were done to indicate which groups differed significantly when ANOVAs were performed.

Chapter 3 describes the research methodology used in this study to evaluate the leadership style within an R&D environment. The sample and the sampling approach are described as well as the instrument and its applicability discussed.

Our methodology employed a quantitative research approach. The targeted population for the study was professional manager-leaders and their subordinates in the scientific and engineering functional areas.

The measuring instrument consisted of a section enquiring on the demographic information of the participants and the Multifactor-Leadership-Questionnaire (MLQ). An overview was

given on the statistical analysis performed. In addition, mention was made to ethical concerns that needed to be taken under consideration in data gathering.

Chapter 2 discussed the theoretical background of the research topic, while this chapter described the method of data collection. The following chapter will present the results obtained in our investigation into the leadership style within R&D groups.

# **CHAPTER 4**

## **ANALYSIS OF RESULTS**

### **4.1 INTRODUCTION**

Chapter 3 discussed the methodology followed within this research study. A schematic description of the research design was represented in Figure 3.1. The chapter also alluded to ethical considerations; the measuring instrument and its reliability and validity; the process of data collection; capturing and analysis and the calculation of Cronbach's alpha coefficient. Chapter 4 presents the research results. Descriptive statistics were used to summarise quantitative data and relationships which are not apparent in the raw data.

### **4.2 CHARACTERISTICS OF THE TARGETED SAMPLE**

#### **4.2.1 Response rate**

As shown in Table 3.1, 54 manager-leaders were targeted in the leaders' survey, 40 managers completed and returned the survey. This resulted in a response rate of 74%. A sample of 221 subordinates was targeted and a total of 141 questionnaires were completed and returned, resulting in a response rate of 67%. The total sample size, including leaders and their corresponding raters, equals 182 respondents, of which 181 responses could be utilised (99%). Over 78% of the respondents were raters.

#### **4.2.2 Demographic data**

Table 4.1 summarises the demographic data of the total sample. These statistics revealed that 66% of the participants were males, 53% were between 25 and 35 years, 52% were white, 43% were in senior positions (Level 5) and, in total, 78% had obtained their Masters/Doctorate and 79% were scientific. Years in R&D (46%), years in current position (73%), years in management function (26%) and years reporting to current manager (62%) all showed maximum percentage values at 1 to 5 years, with the specific maximum percentage in brackets.

**Table 4.1:** Demographic information

| <b>Item</b>      | <b>Category</b>      | <b>Frequency</b> | <b>Percentage</b> |
|------------------|----------------------|------------------|-------------------|
| Gender           | Male                 | 119              | 65,70             |
|                  | Female               | 60               | 33,10             |
|                  | Missing values       | 2                | 1,10              |
| Age              | 24 years and younger | 1                | 0,60              |
|                  | 25 to 35 years       | 95               | 52,50             |
|                  | 36 to 45 years       | 55               | 33,70             |
|                  | 46 to 55 years       | 21               | 11,80             |
|                  | 56 years and older   | 2                | 1,20              |
|                  | Missing values       | 7                | 3,90              |
| Ethnicity        | Black                | 54               | 29,80             |
|                  | White                | 94               | 51,90             |
|                  | Coloured             | 8                | 4,40              |
|                  | Asian/Indian         | 19               | 10,50             |
|                  | Missing Values       | 6                | 3,30              |
| Formal education | Technical            | 12               | 6,60              |
|                  | Bachelors            | 7                | 3,90              |
|                  | Honours              | 13               | 7,20              |
|                  | Masters              | 67               | 37,00             |
|                  | Doctorate            | 74               | 40,90             |
|                  | MBA/MBL              | 6                | 3,30              |
|                  | Missing values       | 2                | 1,10              |

**Table 4.1** (continued): Demographic information

| <b>Item</b>                  | <b>Category</b>    | <b>Frequency</b> | <b>Percentage</b> |
|------------------------------|--------------------|------------------|-------------------|
| Organisational level         | Level 7 and below  | 7                | 3,90              |
|                              | Level 6            | 40               | 22,10             |
|                              | Level 5            | 77               | 42,50             |
|                              | Level 4            | 49               | 27,10             |
|                              | Level 3 and above  | 2                | 1,10              |
|                              | Missing values     | 6                | 3,40              |
| Functional area              | Scientific         | 143              | 79,00             |
|                              | Engineering        | 36               | 19,90             |
|                              | Missing values     | 2                | 1,10              |
| Years in R&D                 | Less than 1 year   | 4                | 2,20              |
|                              | 1 – 5 years        | 83               | 45,90             |
|                              | 6 – 10 years       | 51               | 28,20             |
|                              | 10 – 15 years      | 28               | 15,50             |
|                              | 15 – 20 years      | 3                | 1,70              |
|                              | More than 20 years | 9                | 5,00              |
|                              | Missing values     | 3                | 1,70              |
| Years in management function | Less than 1 year   | 14               | 7,70              |
|                              | 1 – 5 years        | 47               | 26,00             |
|                              | 6 – 10 years       | 16               | 8,80              |
|                              | 10 – 15 years      | 4                | 2,20              |

**Table 4.1** (continued): Demographic information

| <b>Item</b>                        | <b>Category</b>    | <b>Frequency</b> | <b>Percentage</b> |
|------------------------------------|--------------------|------------------|-------------------|
| Years in current position          | Less than 1 year   | 29               | 16,00             |
|                                    | 1 – 5 years        | 133              | 73,50             |
|                                    | 6 – 10 years       | 15               | 8,30              |
|                                    | 10 – 15 years      | 1                | 0,60              |
|                                    | 15 – 20 years      | 0                | 0,00              |
|                                    | More than 20 years | 0                | 0,00              |
|                                    | Missing values     | 3                | 1,70              |
| Years reporting to current manager | Less than 1 year   | 51               | 28,20             |
|                                    | 1 – 5 years        | 113              | 62,40             |
|                                    | 6 – 10 years       | 12               | 6,60              |
|                                    | 10 – 15 years      | 1                | 0,60              |
|                                    | 15 – 20 years      | 0                | 0,00              |
|                                    | More than 20 years | 0                | 0,00              |
|                                    | Missing values     | 81               | 2,20              |

### **4.3 DESCRIPTIVE STATISTICS**

The mean and standard deviations for the different leadership styles were determined and are summarised in Table 4.2.

#### **4.3.1 Comparison between the manager-leader and employee responses**

Bass and Avolio (2005) suggested research validated benchmark mean scores for the MLQ were, >3.0 to <3.75, 1-2 and 0-1 for transformational, transactional and laissez-fair leadership styles respectively. Table 4.2 shows that the subordinates perceived their manager-leaders as having lower mean scores for transformational leadership (2.47)

compared to the acceptable benchmark, while the managers-leaders' perception of their transformational leadership style (3.06) corresponds with the MLQ benchmark, although on the low side. The transactional and laissez-faire leadership styles of the manager-leaders appear to be in range with the MLQ mean benchmark, but on the high side. The subordinate sample perceived their manager-leaders to exhibit transactional and laissez-faire leadership style more often compared to the lower frequency indicated by the manager-leader sample.

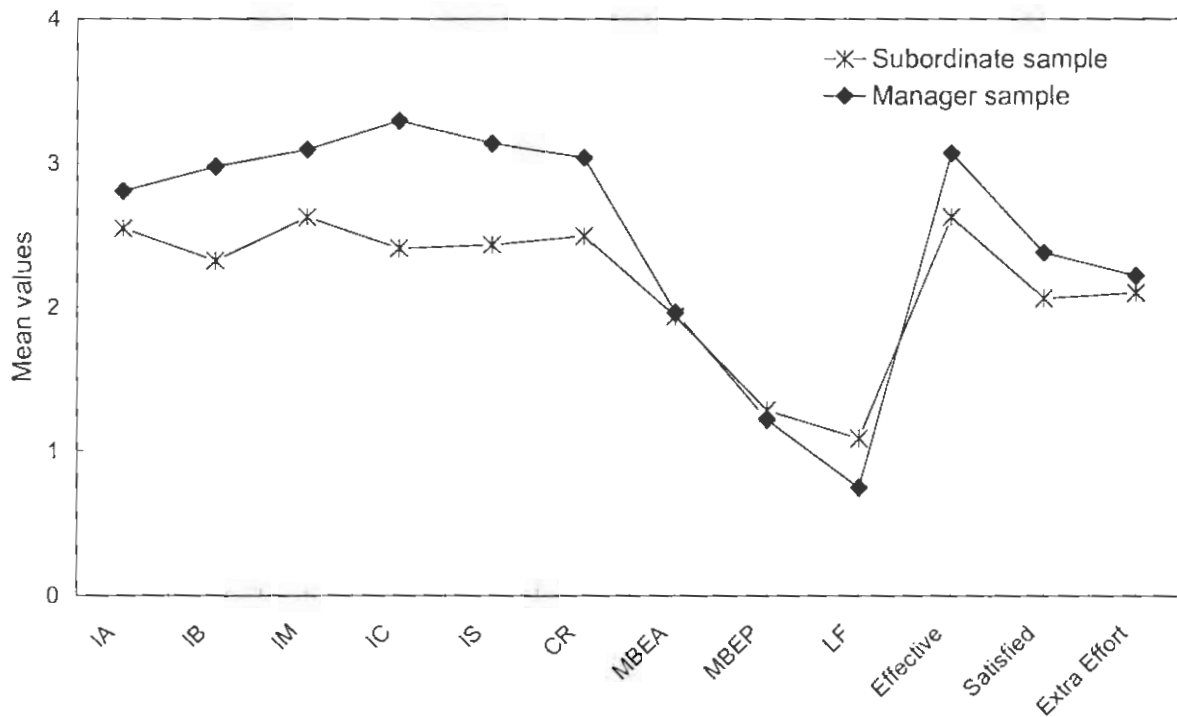
**Table 4.2:** Sample sizes, mean, standard deviations for the MLQ for both the manager-leader and subordinates

| <b>Leadership style</b> | <b>Subordinates<br/>(N = 141)</b> | <b>Manager-leaders<br/>(N = 40)</b> |
|-------------------------|-----------------------------------|-------------------------------------|
| Transformational        | 2.47                              | 3.06                                |
| Transactional           | 1.91                              | 2.07                                |
| Laissez-faire           | 1.09                              | 0.75                                |

Figure 4.2 shows the mean values of the subscales for transformational and transactional leadership styles as well as the laissez-faire and the outcomes of the leadership styles for both the manager-leaders and the subordinates. For the most effective leader, Bass and Avolio (2005) suggested mean scores of greater or equal to 3 for individualised consideration (IC), intellectual stimulation (IS), idealised influence (behaviour) (IB), idealised influence (attributed) (IA), and inspirational motivation (IM). The strongest manager-leaders achieve rater outcomes in excess of 3.5.

It can be seen that with respect to the subscales of transformational leadership style the manager-leaders' scores were very close to 3 and in some cases more than 3, such as individualised consideration (3.29) and intellectual stimulation (3.14). Associated with the high scores observed for the manager-leaders in the transformational subscales, they showed a high score for the effectiveness leadership outcomes (3.09). However, the subordinates' scores for the transformational subscales, effectiveness, satisfaction and extra effort ranged between 2 and 3. This indicates that although the manager-leaders consider themselves as more transformational leaders, the subordinates of this R&D unit

view their immediate managers as not displaying ideal levels of transformational leadership behaviours.



**Figure 4.1:** Comparison between the subordinate and manager-leader samples with respect to individualised consideration (IC), intellectual stimulation (IS), idealised influence (behaviour) (IB), idealised influence (attributed) (IA) and inspirational motivation (IM), contingent reward (CR), management-by-exception (active) (MBEA) and management-by-exception (passive) (MBEA), laissez-faire (LF) and leadership outcomes

An ideal score of 2 was suggested for contingent rewards (CR), which is lower than both the subordinates' and manager-leaders' mean scores of 2.5 and 3.04 respectively. The suggested range for management-by-exception (active) (MBE-A) were 1-2 and the mean scores obtained for the manager-leaders and the subordinates were about 1.9. Suggested scores for management-by-exception (passive) (MBE-P) and laissez-faire (LF) are between 0 and 1; however, MBE-P scores of ~1.2 were observed for both the subordinate and manager-leaders samples. The managers scored within the ideal range for laissez-faire at 0.75, while the subordinates' score was slightly above the ideal case at 1.09. The mean for the contingent rewards suggests that some employees perceive their immediate managers as doing an above average job of clarifying expectations and recognising accomplishments. In the case of the MBE-A mean, it indicates that some employees

perceive their managers as taking corrective action in a timely manner. The mean scores for MBE-P and LF suggest that some employees viewed that their immediate managers tended to wait too long before resolving a problem or taking corrective action.

Clearly it can be seen from the mean scores (Figure 4.1) that the manager-leaders have a higher perception of their transformational leadership style compared to the subordinates' views.

Table 4.3 shows a comparison between the mean scores of experienced manager-leaders (above two years) and less experienced manager-leaders (equal or less than two years). For the three leadership styles the experienced and less experienced manager-leaders showed similar mean values, indicating that the level of experience appears not to influence the manager-leaders' perception of their leadership styles. The mean values for both the experienced and less experienced manager-leaders were in close range of the ideal full leadership model. Although, some of the manager-leaders of both the experienced and less experienced sample may exhibit more transactional leadership style as expected for the ideal MLQ benchmark (Bass & Avolio, 2005).

**Table 4.3:** Sample sizes and mean scores of the MLQ for experienced manager-leaders and less experienced manager-leaders

| <b>Leadership style</b> | <b>Experienced<br/>(N=20)</b> | <b>Less experienced<br/>(N=20)</b> |
|-------------------------|-------------------------------|------------------------------------|
| Transformational        | 3.03                          | 3.04                               |
| Transactional           | 2.12                          | 2.09                               |
| Laissez-fair            | 0.75                          | 0.74                               |

The findings contradict Visser's (2003) reports that more experienced manager-leaders rated themselves as more transformational leaders at 3.1, as compared to the less experienced manager-leaders (mean = 2.8).

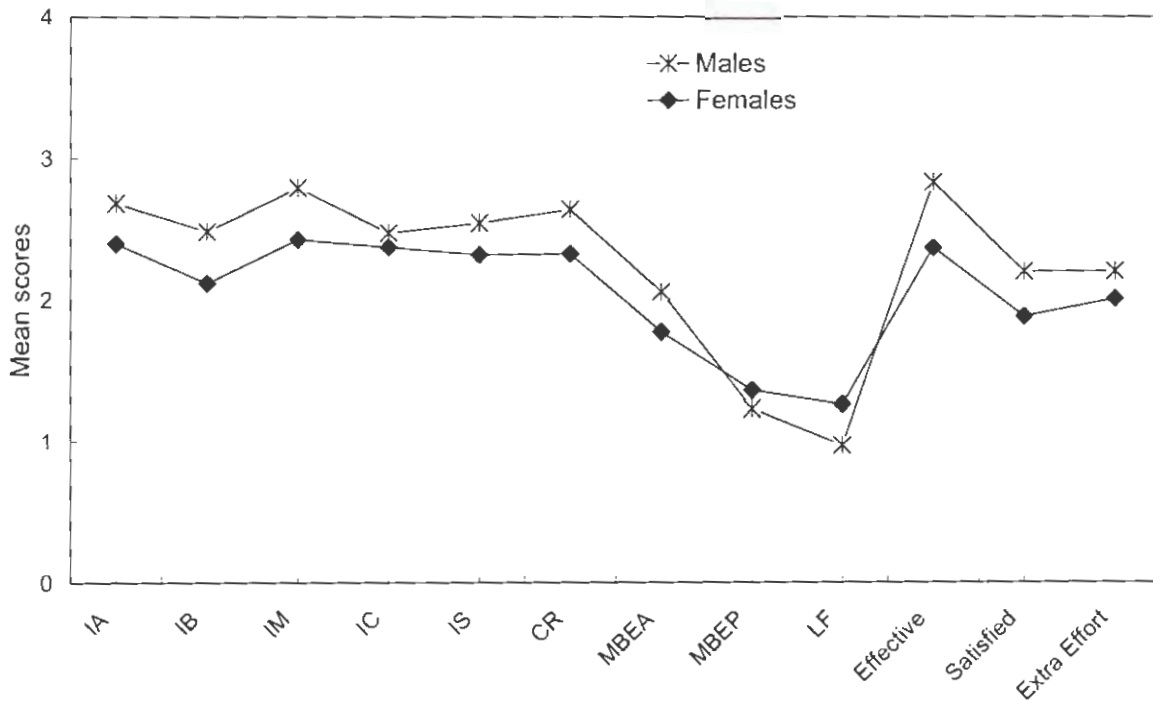
Notwithstanding the manager-leaders' perception on their leadership style, Gregoire (2004:395) indicated that leadership is the ability to inspire and guide others towards

success. Thus leadership is about making your subordinates successful. In the section below, the subordinates within the R&D unit will be discussed.

### 4.3.2 Subordinates

#### 4.3.2.1 Gender diversity

Simard (2002) indicated that technical women may experience biasness in the workplace. Figure 4.2 shows the mean score subscales for transformational and transactional leadership styles as well as laissez-faire and the outcomes of the leadership styles for both the females and males.



**Figure 4.2:** Comparison between the females and males with respect to individualised consideration (IC), intellectual stimulation (IS), idealised influence (behaviour) (IB), idealised influence (attributed) (IA) and inspirational motivation (IM), contingent reward (CR), management-by-exception (active) (MBE-A) and management-by-exception (passive) (MBE-P) laissez-faire (LF) and leadership outcomes

Figure 4.2 shows that some females view their immediate manager-leader as less transformational and more laissez-faire compared to how some males view their manager-leaders. Importantly, some females view the leadership outcomes (effectiveness of leader,

satisfied with leadership style and extra effort of the leader) as lower compared to their male counterparts.

#### 4.3.2.2 Functional diversity

Schedlitzki (2006) reported that within R&D departments the function, for example being a chemist/engineer, was an important self-categorisation driver and it was continually reinforced by the social interaction with colleagues, superiors and subordinates. Table 4.4 shows the mean scores for transformational and transactional leadership styles as well as laissez-faire and the outcomes of the leadership styles for both the engineers and scientists.

It appears from the slight differences in mean scores that some of the engineers perceive their immediate manager-leaders as more transformational and also have a more positive view on the leadership outcomes compared to the scientists.

**Table 4.4:** Sample sizes and mean scores for the MLQ of scientist and engineers

| Leadership style | Scientist (N = 108) | Engineers (N = 32) |
|------------------|---------------------|--------------------|
| Transformational | 2.41                | 2.59               |
| Transactional    | 2.30                | 2.37               |
| Laissez-faire    | 1.07                | 1.10               |
| Effective        | 2.55                | 2.86               |
| Satisfied        | 2.01                | 2.21               |
| Extra effort     | 2.06                | 2.24               |

Cross-functional teams offer the advantage that the team has direct access to expertise that would not be available if all team members were from the same area. Ancona and Cadwell (1992:321) indicated that cross-functional teams can derive advantages from their team diversity. Table 4.5 shows the leadership styles of different department as well as their functional mix.

It can be seen for the different departments that the subordinates view their direct manager-leaders' leadership as very similar with slight variations in the mean scores. However, the department with a mixture of scientists and engineers has a higher transactional leadership score, but some employees have a more positive view of the

leadership outcomes with higher mean scores compared to the departments that are functionally homogeneous.

**Table 4.5:** Sample sizes and mean scores for the MLQ of scientists and engineers per department

| Department     |                    | TF   | TR   | LF   | Effective | Satisfied | Extra effort |
|----------------|--------------------|------|------|------|-----------|-----------|--------------|
| A1<br>(N = 40) | En = 29<br>Sc = 11 | 2.53 | 2.14 | 1.12 | 2.80      | 2.15      | 2.19         |
| A2<br>(N = 26) | Sc = 26            | 2.36 | 1.66 | 1.09 | 2.37      | 2.02      | 2.0          |
| A3<br>(N = 19) | Sc = 19            | 2.61 | 1.79 | 0.85 | 2.66      | 2.11      | 2.13         |
| A4<br>(N = 24) | En = 1<br>Sc = 23  | 2.32 | 1.82 | 1.18 | 2.59      | 2.02      | 2.03         |
| A5<br>(N = 21) | En = 2<br>Sc = 19  | 2.53 | 1.90 | 0.99 | 2.66      | 1.98      | 2.08         |
| A6<br>(N = 9)  | Sc = 9             | 2.28 | 1.85 | 1.17 | 2.47      | 1.93      | 2.10         |

En = engineers, Sc = scientists, TF = transformational, TR = transactional, LF = laissez-faire

#### 4.4 STATISTICAL ANALYSIS

In its current form, the Full Leadership Model represents nine single-order factors comprised of five transformational leadership factors, three transactional leadership factors, and one non-transactional laissez-faire leadership (Antonakis *et al.*, 2003:261). The MLQ (Form 5X) contains 45 items; there are 36 items that represent the nine leadership factors described above and 9 items that assess three leadership outcome scales. The first 36 items corresponds to the nine leadership factors from item 37 up till 45 'extra effort' is measured.

A principal component factor analysis was performed on the 45 items of the MLQ on the total sample of employees working in the R&D division of a petro-chemical industry. Analysis of the Eigenvalues (larger than 1) and the screen plot indicated that three factors could be extracted, explaining 51.77% of the total variance. Next, a simple principle axis factoring analysis was performed on the 45 items of the MLQ on the total sample of this study. These factors were labelled Transformational Leadership, Transactional Leadership

and Passive/Avoidant behaviour. The results of the factor analysis on the MLQ are indicated in Table 4.6. The loading of variables on factors, as well as communalities and percentage of variance, is indicated. Variables are ordered and grouped by size of loading to facilitate interpretation. Labels for each factor are suggested in a footnote.

**Table 4.6:** Factor loadings, Communalities ( $h^2$ ), Percentage Variance for Principal Factors Extraction and Direct Oblimin Rotation on MLQ Items

| Item | F <sub>1</sub> | F <sub>2</sub> | F <sub>3</sub> | $h^2$ |
|------|----------------|----------------|----------------|-------|
| 44   | 0,90           | 0,00           | 0,00           | 0,73  |
| 31   | 0,90           | 0,00           | 0,00           | 0,74  |
| 42   | 0,89           | 0,00           | 0,00           | 0,73  |
| 41   | 0,89           | 0,00           | 0,00           | 0,77  |
| 38   | 0,87           | 0,00           | 0,00           | 0,76  |
| 21   | 0,83           | 0,00           | 0,00           | 0,64  |
| 40   | 0,83           | 0,00           | 0,00           | 0,67  |
| 36   | 0,81           | 0,00           | 0,00           | 0,68  |
| 37   | 0,81           | 0,00           | 0,00           | 0,70  |
| 30   | 0,80           | 0,00           | 0,00           | 0,68  |
| 35   | 0,77           | 0,00           | 0,00           | 0,66  |
| 45   | 0,77           | 0,00           | 0,00           | 0,65  |
| 39   | 0,77           | 0,00           | 0,00           | 0,51  |
| 18   | 0,76           | 0,00           | 0,00           | 0,57  |
| 32   | 0,72           | 0,00           | 0,00           | 0,62  |
| 43   | 0,70           | 0,00           | 0,00           | 0,58  |
| 15   | 0,68           | 0,00           | 0,00           | 0,51  |
| 19   | 0,65           | 0,00           | 0,00           | 0,37  |
| 16   | 0,65           | 0,00           | 0,00           | 0,60  |

**Table 4.6** (continued): Factor loadings, Communalities ( $h^2$ ), Percentage Variance for Principal Factors Extraction and Direct Oblimin Rotation on MLQ Items

| Item       | F <sub>1</sub> | F <sub>2</sub> | F <sub>3</sub> | $h^2$ |
|------------|----------------|----------------|----------------|-------|
| 34         | 0,65           | 0,00           | 0,00           | 0,50  |
| 14         | 0,65           | 0,00           | 0,00           | 0,62  |
| 10         | 0,64           | 0,00           | 0,00           | 0,41  |
| 9          | 0,63           | 0,00           | 0,00           | 0,49  |
| 26         | 0,62           | 0,00           | 0,00           | 0,51  |
| 23         | 0,60           | 0,00           | 0,00           | 0,41  |
| 8          | 0,58           | 0,00           | 0,00           | 0,44  |
| 29         | 0,55           | 0,00           | 0,00           | 0,31  |
| 1          | 0,50           | 0,00           | 0,00           | 0,26  |
| 2          | 0,50           | 0,00           | 0,00           | 0,33  |
| 11         | 0,43           | 0,00           | 0,00           | 0,33  |
| 6          | 0,39           | 0,00           | 0,00           | 0,30  |
| 25         | 0,35           | 0,00           | 0,00           | 0,28  |
| 13         | 0,32           | 0,00           | 0,00           | 0,20  |
| 12         | 0,00           | 0,57           | 0,00           | 0,43  |
| 3          | 0,00           | 0,55           | 0,00           | 0,47  |
| 5          | 0,00           | 0,52           | 0,00           | 0,49  |
| 20         | 0,00           | 0,49           | 0,00           | 0,47  |
| 28         | 0,00           | 0,48           | 0,00           | 0,36  |
| 33         | 0,00           | 0,46           | 0,00           | 0,37  |
| 7          | 0,00           | 0,25           | 0,00           | 0,25  |
| 17         | 0,00           | 0,22           | 0,00           | 0,05  |
| 4          | 0,00           | 0,00           | 0,57           | 0,33  |
| 24         | 0,00           | 0,00           | 0,50           | 0,26  |
| 22         | 0,00           | 0,00           | 0,49           | 0,37  |
| 27         | 0,00           | 0,00           | 0,34           | 0,26  |
| % Variance | 42,36          | 5,70           | 3,71           |       |

Factor labels: F<sub>1</sub> Transformational Leadership; F<sub>2</sub> Passive/Active Behaviour; F<sub>3</sub> Transactional Leadership

#### 4.4.1 Measuring instrument: MLQ

The principal analysis resulted in three factors. Items loading on these factors were related to Transformational Leadership (for example, 'I talk optimistically about the future'; 'Get others to look at problems from many different angles'.), Passive/Avoidant Behaviour (for example, 'Wait for things to go wrong before taking action'; 'Being absent when needed'.) and Transactional Leadership (for example, 'Keeping track of all mistakes'; 'Direct my attention toward failures to meet standards').

The descriptive statistics and alpha coefficients of the total sample of the three factors of the MLQ are indicated in Table 4.7. Acceptable Cronbach alpha coefficients of 0.97 and 0.79 for the transformational and passive/avoidance leadership styles respectively were obtained. The transactional leadership Cronbach alpha was 0.60, which compares well with the guideline of 0.70 (0.55 in basic research), demonstrating that a large portion of the variance is explained by the dimensions (internal consistency of the dimensions). It should be stated that the measuring instrument has been tested in different research projects and is seen as sufficient for this study.

Most of the scales of the measuring instruments have relatively normal distributions, with low skewness and kurtosis. Values of 2 or more (regardless of sign) probably indicate skewness and kurtosis to a significant degree (Brown, 1991). Transformational Leadership was negatively skew with a slightly high kurtosis. A negatively skewed distribution indicates scores bunched up on the low end of the transformational scale, while a positive kurtosis statistical value indicates the distribution is leptokurtic (too tall). However, transformational leadership's Kurtosis was 1.18 which fall within the range between - 1.8 and + 1.8, in this case, the kurtosis was within the expected range of chance fluctuations of the statistics.

**Table 4.7:** The alpha coefficients of the MLQ

| Item                         | Skewness | Kurtosis | $\alpha$ |
|------------------------------|----------|----------|----------|
| Transformational Leadership  | -1,18    | 1,18     | 0,97     |
| Positive/Avoidance Behaviour | 0,91     | 0,98     | 0,79     |
| Transactional Leadership     | 0,11     | 0,20     | 0,60     |

The product-moment correlation coefficients between transformational leadership, passive/active behaviour and transactional leadership are given in Table 4.8.

The three correlated factors: transformational, transactional and passive / avoidance leadership; comprised all of the transformational components; transactional leadership is in the form of contingent reward and active management-by-exception. The transactional factors represent a clear set of agreements, expectations and enforcements. The passive/avoidance leadership factor consists of items that tap into leadership that is passive in correcting mistakes, or in the extreme, avoid taking corrective action (Bass & Avolio, 2005).

Table 4.8 shows that transformational leadership has a statistically significant negative correlation (practically significant, large effect) with passive/active behaviour. This can be expected, since transformational leadership is active and more effective. The passive/avoidant leadership is more passive and "reactive" and this style has a negative effect on desired outcomes. No statistically significant correlations could be detected between transformational and transactional leadership styles.

**Table 4.8:** Product-moment correlation coefficients between the MLQ factors

| Item                           | 1                    | 2    | 3 |
|--------------------------------|----------------------|------|---|
| 1. Transformational Leadership | .                    | .    | . |
| 2. Passive/avoidant Behaviour  | -0,61 <sup>*++</sup> | .    | . |
| 3. Transactional Leadership    | 0,18 <sup>*</sup>    | 0,11 | . |

\*  $p \leq 0,05$  – statistically significant

+  $r > 0,30$  – practically significant (medium effect)

++  $r > 0,50$  – practically significant (large effect)

#### 4.4.2 Leadership styles and the demographic information

ANOVA analysis was conducted to determine differences on some demographic characteristics (such as gender, age, ethnicity, and years in organisation, job level and years reporting to current line manager, and more) and transformational leadership in terms of the total population. The results of the ANOVA analysis are given in Table 4.9.

In analysis of Table 4.9, statistical differences were found in terms of manager versus subordinate capacity and gender groups. Some managers perceived themselves to exhibit more transformational leadership style compared to how the subordinates viewed their immediate managers (also see the mean value comparisons in Table 4.2).

Some male employees experienced their immediate manager-leaders as more transformational compared to some female employees (as shown in Figure 4.2). No statistically significant differences ( $p < 0,05$ ) regarding transformational leadership could be found for the total group between department, ethnicity, formal education, organisational level, years' service in functional area, years in current position, years working for current manager and functional area.

**Table 4.9:** ANOVA – Differences in transformational leadership

| Variable                          | Type III Sum of Squares | Df | F     | P     | Partial Eta squared |
|-----------------------------------|-------------------------|----|-------|-------|---------------------|
| Manager versus subordinate        | 8931,85                 | 1  | 13,62 | 0,00* | 0,07                |
| Department                        | 1110,01                 | 6  | 0,26  | 0,96  | 0,01                |
| Gender                            | 4034,12                 | 1  | 6,02  | 0,02* | 0,03                |
| Ethnicity                         | 1264,98                 | 3  | 0,60  | 0,62  | 0,01                |
| Formal education                  | 5406,44                 | 5  | 1,60  | 0,16  | 0,04                |
| Organisational level              | 5127,75                 | 5  | 1,50  | 0,19  | 0,04                |
| Years service in functional area  | 5259,10                 | 5  | 1,55  | 0,18  | 0,04                |
| Years in current position         | 918,63                  | 3  | 0,44  | 0,73  | 0,01                |
| Years working for current manager | 236,21                  | 3  | 0,11  | 0,95  | 0,00                |
| Functional area                   | 2,60                    | 1  | 0,00  | 0,95  | 0,00                |

\*  $p < 0,05$ 

ANOVA analysis was conducted to determine differences on some demographic characteristics (such as gender, age, ethnicity, and years in organisation, job level and years reporting to current line manager, etc.) and passive/avoidance behaviour in terms of the total population. The results of the ANOVA analysis are given in Table 4.10.

**Table 4.10:** ANOVA – Differences in passive/avoidance behaviour

| Variable                          | Type III Sum of Squares | Df | F    | P     | Partial Eta squared |
|-----------------------------------|-------------------------|----|------|-------|---------------------|
| Man versus subordinate            | 87,95                   | 1  | 2,52 | 0,11  | 0,01                |
| Department                        | 183,82                  | 6  | 0,87 | 0,52  | 0,03                |
| Gender                            | 161,10                  | 1  | 5,08 | 0,03* | 0,03                |
| Ethnicity                         | 56,30                   | 3  | 0,56 | 0,64  | 0,10                |
| Formal education                  | 123,25                  | 5  | 0,76 | 0,58  | 0,02                |
| Organisational level              | 213,71                  | 5  | 1,33 | 0,26  | 0,04                |
| Years service in functional area  | 193,20                  | 5  | 1,20 | 0,31  | 0,03                |
| Years in current position         | 133,36                  | 3  | 1,37 | 0,25  | 0,02                |
| Years working for current manager | 30,87                   | 3  | 0,31 | 0,82  | 0,01                |
| Functional area                   | 34,80                   | 1  | 1,07 | 0,30  | 0,01                |

\*  $p < 0,05$

In analysis of Table 4.10, no statistically significant differences ( $p < 0,05$ ) regarding passive/avoidance behaviour could be found for the total group between manager versus subordinate capacity, department, ethnicity, formal education, organisational level, years' service in functional area, years in current position, years working for current manager and functional area. Statistical differences were however found in terms of gender. ANOVA analysis was conducted to determine differences on some demographic characteristics (such as gender, age, ethnicity, and years in organisation, job level and years reporting to current line manager, etc.) and transactional leadership in terms of the total population.

In analysis of Table 4.11, no statistically significant differences ( $p < 0,05$ ) regarding transactional leadership could be found for the total group between manager versus subordinate capacity, department, gender, ethnicity, formal education, organisational level, years' service in functional area, years in current position, years working for current

manager, and functional area. The mean score values for transactional leadership style for the subordinates/manager-leaders and engineer/scientist were very similar within the ideal score in the range 1-2, but on the high side. Indicating, that in the R&D unit expectations is defined to promote performance. It is also possible that the behaviour may be reinforced through for example their performance appraisal system, resulting in no statistically difference in how our samples perceived transactional leadership.

**Table 4.11:** ANOVA – Differences in transactional leadership

| Variable                          | Type III Sum of Squares | Df | F    | P    | Partial Eta squared |
|-----------------------------------|-------------------------|----|------|------|---------------------|
| Man versus subordinate            | 29,80                   | 1  | 3,24 | 0,07 | 0,02                |
| Department                        | 84,85                   | 6  | 1,54 | 0,17 | 0,05                |
| Gender                            | 0,13                    | 1  | 0,01 | 0,91 | 0,00                |
| Ethnicity                         | 24,18                   | 3  | 0,90 | 0,44 | 0,02                |
| Formal education                  | 67,72                   | 5  | 1,53 | 0,18 | 0,04                |
| Organisational level              | 92,73                   | 5  | 2,17 | 0,06 | 0,06                |
| Years in functional area          | 55,15                   | 5  | 1,24 | 0,30 | 0,03                |
| Years in current position         | 37,84                   | 3  | 1,41 | 0,24 | 0,02                |
| Years working for current manager | 20,49                   | 3  | 0,77 | 0,52 | 0,01                |
| Functional area                   | 0,15                    | 1  | 0,02 | 0,90 | 0,00                |

\*  $p < 0,05$

MANOVA analysis was conducted to determine differences in terms of the experience of transformational leadership, passive/active behaviour and transactional leadership between managers and subordinates based on some demographic characteristics (such as department, gender, ethnicity, organisational level, etc.). Results were first analysed for statistical significance using Wilk's Lambda statistics. ANOVA was used to determine

specific difference whenever statistical differences were found. The results of the MANOVA and ANOVA analysis are given in Table 4.12 and 4.13.

**Table 4.12:** MANOVA – Differences of managers in transformational leadership, passive/active behaviour and transactional leadership

| Variable              | Value | F    | Df    | P    | Partial Eta squared |
|-----------------------|-------|------|-------|------|---------------------|
| Department            | 0,67  | 0,92 | 15,00 | 0,55 | 0,12                |
| Functional area       | 0,88  | 1,71 | 3,00  | 0,18 | 0,13                |
| Gender                | 0,97  | 0,35 | 3,00  | 0,79 | 0,03                |
| Management experience | 0,72  | 1,27 | 9,00  | 0,29 | 0,11                |
| Ethnicity             | 0,76  | 1,11 | 9,00  | 0,37 | 0,09                |
| Organisational level  | 0,71  | 2,15 | 6,00  | 0,06 | 0,16                |

\*  $p < 0,05$

In analysis of Wilk's Lambda values, no statistically significant differences ( $p < 0,05$ ) regarding transformational leadership, passive/active behaviour and transactional leadership could be found for the managerial group between department, functional area, gender, management experience, ethnicity and organisational level.

In analysis of Wilk's Lambda values, no statistically significant differences ( $p < 0,05$ ) regarding transformational leadership, passive/active behaviour and transactional leadership could be found for subordinates between department, functional area, gender, ethnicity and organisational level (SPSS, 2007).

**Table 4.13:** MANOVA – Differences of subordinates in transformational leadership, passive/active behaviour and transactional leadership

| Variable             | Value | F    | Df    | P    | Partial Eta squared |
|----------------------|-------|------|-------|------|---------------------|
| Department           | 0,85  | 1,19 | 18,00 | 0,27 | 0,05                |
| Functional area      | 0,97  | 1,25 | 3,00  | 0,30 | 0,03                |
| Gender               | 0,97  | 1,65 | 3,00  | 0,18 | 0,04                |
| Ethnicity            | 0,98  | 0,29 | 9,00  | 0,98 | 0,01                |
| Organisational level | 0,90  | 1,19 | 12,00 | 0,29 | 0,04                |

$p < 0,05$

In total, 40 manager-leaders and 141 subordinates completed and returned the survey. This resulted in a response rate of 76%. A sample of 221 subordinates was targeted and a total of 141 questionnaires were completed and returned, resulting in a response rate of 64%.

In conclusion, the demographic information showed that 66% of the participants were males, 53% were between 25 and 35 years, 52% were white, 43% were in senior positions (Level 5) and in total 78% had obtained their Masters/Doctorate and 79% were scientific. Data were statically analysed and results on descriptive statistics, reliability and statistical analysis were described.

# CHAPTER 5

## DISCUSSION, RECOMMENDATIONS AND CONCLUSIONS

### 5.1 INTRODUCTION

In the previous chapter the research results were presented. The implications of these results and research limitations are now discussed.

### 5.2 RELIABILITY OF THE FINDINGS

The reliability of the MLQ has been proven many times through retesting (Avolio & Bass, 1997). Previous studies found MLQ (N = 1394) scales exhibited high internal consistency and factor loadings confirming the reliability of the instrument (Avolio & Bass, 1995).

A principal component factor analysis was performed on the 45 items of the MLQ on the total sample and three factors could be extracted: Transformational Leadership, Transactional Leadership and Passive/Avoidant behaviour. The Cronbach's alpha coefficient for these factors varied from 0.97 for transformational, 0.79 for passive/avoidant behaviour and 0.60 for transactional. In the investigation, the average Cronbach's alpha coefficient obtained for the MLQ instrument was 0.78, which is acceptable and comparable with the guideline of 0,70 (0,55 in basic research), demonstrating that a large portion of the variance is explained by the dimensions. In a South African context, Visser (2003) used the MLQ to investigate Eskom engineers (N = 48) and engineering students from Rand Afrikaans University (now University of Johannesburg) (N = 37) and on average reported Cronbach's alpha coefficient of transformational (0.86), transactional (0.57) and non-leadership (0.51).

It was concluded that for the purposes of this research, the MLQ instrument was deemed to be a reliable measure of transformational leadership, transactional leadership and laissez-faire leadership.

### 5.3 DISCUSSION OF RESULTS AND RECOMMENDATIONS

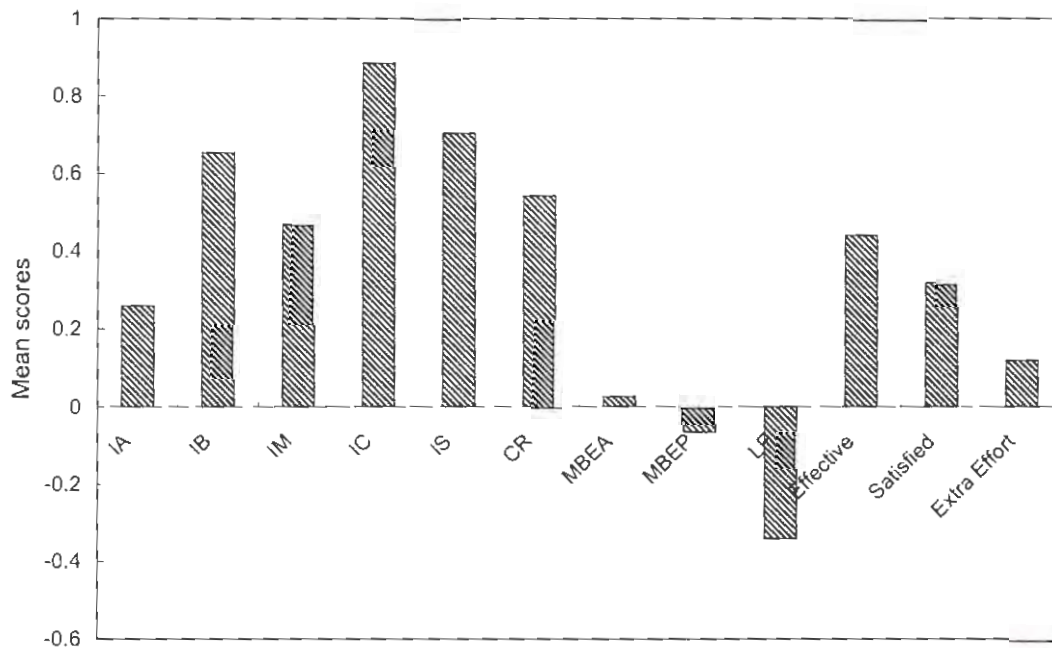
Avolio and Bass (2005) suggested research validated benchmark mean scores for the MLQ were, >3.0 to <3.75, 1-2 and 0-1 for transformational, transactional and laissez-faire leadership styles respectively. The strongest manager-leaders achieve rater outcomes in excess of 3.5. A statistically significant difference was detected in how the subordinates perceived their manager-leaders and how the manager-leaders viewed themselves.

In the study the subordinates perceived their manager-leaders as having a lower mean score for transformational leadership (2.47) compared to the acceptable benchmark, while the manager-leaders' perception of their transformational leadership style (3.06) corresponded with the MLQ benchmark. The transactional and laissez-faire leadership styles of the manager-leaders appear to be in range with the MLQ mean benchmark, but on the high side. Some subordinates perceived their manager-leaders to exhibit a laissez-faire leadership style (1.09) more often compared to the lower frequency indicated by the manager-leader sample (0.75). The subordinates indicated leadership outcomes (effectiveness, satisfied and extra effort) below 3.

It is proposed to facilitate training within the unit to promote transformational leadership, since literature reports indicated that transformational leadership can enhance followers' identification with the manager-leaders and reduce employee withdrawal (Kar *et al.*, 2003:246; Menguc *et al.*, 2007:314; Hater & Bass, 1988:695; Ozaralli, 2003:335). Importantly, for the petro-chemical organisation to show innovative savvy and compete internationally, its R&D should be world-class. Enhancement in the R&D's manager-leaders' transformational leadership style can translate into higher R&D performance.

It can be concluded from the subordinate sample, the high mean scores for transactional leadership style and lower mean scores for transformational leadership compared to the MLQ benchmarks, that some subordinates view their immediate manager-leader as less transformational and more transactional than would be ideally described by the Full Leadership model (Avolio & Bass, 2005).

Figure 5.1 shows the differences in mean scores for the subscales of the different leadership styles for the manager-leaders and subordinates. The positive values are an indication of the manager-leaders over estimation of the frequency ratings, while the negative values are an under-estimation of the frequency ratings.



**Figure 5.1:** Differences in the manager-leaders and subordinate mean scores with respect to individualised consideration (IC), intellectual stimulation (IS), idealised influence (behaviour) (IB), idealised influence (attributed) (IA) and inspirational motivation (IM), contingent reward (CR), management-by-exception (active) (MBE-A) and management-by-exception (passive) (MBE-P) laissez-faire (LF) and leadership outcomes

As can be seen, the manager-leaders have an over-estimation of frequency of their transformational leadership style and an under-estimation of the frequency of their transactional leadership styles. For the transformational leader, subscales individual consideration and intellectual stimulation showed the largest over estimation. This is surprising, since R&D should preferably be a learning environment and intellectual stimulation can enhance creative and innovative methods to attain organisational goals. With individual consideration, the manager-leader demonstrates acceptance of individual

differences and, for example, then assigns tasks according to the subordinates' affinities. This may indicate some concerns with the manager-subordinate interactions.

It appears that the manager-leader sample show some self-bias phenomenon where the manager-leaders judge themselves as overly favourable. Attempts should be made to reduce this phenomenon, which should include regular feedback from subordinates to allow for self-regulation of the manager-leaders' behaviour.

Our results showed that no statistical significant difference could be detected for the two functional areas, scientists versus engineers. It may be that within the work-unit, teams consisting of individuals from different departments work on the same projects. Upon further investigation the departments consisted predominantly of scientists. One department contained a mixture of scientists and engineers and for this sample the mean scores for the leadership outcomes were higher compared to the functionally homogeneous departments. The advantages / disadvantages and the optimal mix of functional diversity within departments require further investigation.

A further consideration that no statistical significant difference could be detected for the two functional areas, scientists versus engineers, is the characteristics of the sample. The sample consisted of 78% having Doctorates and/or Masters, thus highly qualified scientific knowledge workers. Scientific knowledge workers' goals are directed primarily inward, at achieving the goals of the company and advancing within the company. Their need for autonomy is high; they are achievement/goal orientation; have loyalty to profession and second to the organisation; they respect knowledge and an association with logic. Stoker *et al.* (2001:1141) compared R&D teams to self-managing teams "to manage self" and indicated that the principal motivator for knowledge workers is to have an interesting job and a feeling of personal and professional growth.

Knowledge workers may be able to handle many shortcomings in the work situation, if the work itself is challenging. In this R&D work-unit projects may be challenging, even at the forefront of technological breakthrough and innovation, and even to the extent that the workforce professional and organisational goals may be aligned. Professional recognition is important to scientific knowledge workers. The work-unit may have systems in place to

recognise and reward goal achievements, which is associated with some professional prestige. For them, organisational recognition may equate to professional peer acknowledgement. The workforce as well as the manager-leaders may then be willing and are perceived to apply extra effort to achieve goals, since scientific creative people are goal orientated.

Statistical difference was observed for gender groups. Some male employees experienced their manager-leaders as more transformational compared to the females. While some females viewed their manager-leaders' behaviour as more passive/avoidant compared to the male employees (see Figure 4.2).

It should be noted that, within the study, the differentiation between subordinate-manager, gender combinations were not made. However, the females accounted for 33% of the total sample, indicating that the female segment may be a minority group within this organisation, with management positions filled by males and masculinity may be highly valued.

Paton (2002:539) acknowledged that gender differences do exist and that it may have an impact upon how females manage others or how females should be managed. McColl-Kennedy and Anderson (2005:115) states that care needs to be taken in looking at the gender of subordinates or manager-leaders in isolation. The authors indicated that gender combinations coupled with leadership style can result in different outcomes. For example, a female-male subordinate-manager combination with transformational leadership can result in subordinates' high self-esteem, optimism and commitment. Female-male subordinate-manager relationship in combination with a non-leadership style can lead to high levels of subordinate frustration.

Peterson (2004:106) reported that men value pay, money, and benefits, as well as power, authority, and status significantly more than women. Women valued relationships, recognition, respect, communication, fairness, equity, teams and collaboration, family and home significantly higher than males.

Clearly, the prevalence of biasness within the organisation requires further investigation. It is important that the organisational culture of the organisation and organisational commitment levels of females versus males be assessed and related to the leadership styles. It may give some insights into skills manager-leaders require in managing females. Furthermore, increasing awareness of gender bias within the unit may mitigate stereotypical assumptions and its associated harmful effects.

#### **5.4 LIMITATIONS OF STUDY**

The findings of this study should be viewed with certain limitations in mind. A possible limitation of this study was the sample size.

Another limitation of the current study was that the sample was dominated by subordinates, males and scientists. The generalisability of the present findings should therefore be examined in future studies with more heterogeneous samples.

It should be mentioned that some participants indicated problems with answering certain questions. The diversity, culture, historical background and recent political transformational process may not be reflected by foreign questionnaires. Furthermore, the language usage and expressions used in MLQ may not be clear to South Africans. This may be due to culture differences between Americans and South-Africans or the sample, since creative scientific workers are analytical and logical by nature.

#### **5.5 FUTURE RESEARCH**

The literature addressing the leadership of knowledge workers, within an R&D environment in a South African context is limited. The following further studies are proposed:

##### **A. Investigations emanating from the current study within a petro-chemical organisation.**

- It appears that the manager-leader sample show some self-bias phenomenon where the manager-leaders judge themselves as overly favourable compared to the subordinates. This phenomenon requires further investigation, to establish if the gaps in perception, being manager-leaders versus subordinates, are acceptable

within organisations in general, or with knowledge workers. It is, however, recommended that the organisation attempts to reduce the self-bias phenomenon that the manager-leaders exhibit, which should include regular feedback from subordinates to allow for self-regulation of the manager-leaders' behaviour.

- The mean values for both the experienced and less experienced manager-leaders were in close range of the ideal Full Leadership model. It is, however, important to evaluate how the subordinates of experienced versus less experienced personnel view their manager-leaders. In doing this, mentoring opportunities can be provided by the more successful experienced manager-leaders to the less experienced manager-leaders.
- Within the organisation, different departments are functionally homogeneous. In a project team, for example, scaling-up of a chemical process within a certain time frame, employees from different functionalities may be required to work together. Therefore, it is important to evaluate project teams which can exhibit functional diversity versus the functionally homogenous departments. The advantages / disadvantages and the optimal mix of functional diversity within departments require further investigation; this can assist with group dynamics of project teams which may have time constraints in delivering results.
- Our study found that females viewed their immediate manager-leaders as less transformational and more laissez-faire compared to how some males viewed their manager-leaders. This conclusion requires further investigation. For example, differentiations between the subordinate-manager gender combinations and how this determines the female perception of their manager-leader. It is also important to investigate the culture of the organisation and the employee commitment, and relate this to the leadership styles. This is to establish the training needs of the manager-leaders in managing females. It can assist in retaining valuable high achiever female employees both to the scientific field and to the R&D work-unit.

## **B. Transformational leadership in R&D units**

- Investigate transformational leadership style in the R&D unit of other chemically related companies. This is to establish if certain leadership trends can be observed that is specific to scientific knowledge workers.

- Investigate transformational leadership style in the R&D unit of other non-chemical but technologically orientated companies that vary in the company environments; for example, medium to fast changing environments. This is to establish if certain leadership trends can be observed that is specific for the environmental dilemma that the organisations may experience.
- Investigate transformational leadership style in the R&D unit of an organisation that has centres in multiple international locations. This is to establish how perceptions differ with respect to the centres in different locations.

## **5.6 CONCLUSIONS**

This research investigated the leadership style in a research and development (R&D) work-unit within a petro-chemical company, using the Full Range Leadership Development Theory as assessed as the Multifactor-Leadership-Questionnaire. A literature review was performed discussing leadership in general, transformational leadership, scientific knowledge-workers, technical/scientific leaders and technical leaders showing transformational leadership style. From the literature review, it was concluded that an R&D environment is multi-dimensional and the workforce can be diverse in the field of specialisation and personality characteristics. Subsequently, the literature review also focused on functional diversity and gender differences within technologically and/or scientific environments.

Our research results showed a statistical difference between the leadership style as viewed by manager-leaders and subordinates. Differences in the mean scores of manager-leaders and subordinates found that the manager-leaders over-estimated the frequency ratings of their transformational leadership style and the leadership outcomes, while they underestimated the frequency ratings for transactional and laissez-faire leadership style. This indicates that although the manager-leaders consider themselves as more transformational leaders, the subordinates view their immediate managers as not displaying ideal levels of transformational leadership behaviours.

A self-bias phenomenon may be present where the manager-leaders judge themselves overly favourable. It is recommended that the self-bias phenomenon be addressed within the organisation.

A statistical significant difference was observed in how male and female employees experienced their manager-leaders' leadership style. Some female employees experienced a higher frequency of passive/avoidance behaviour than male employees. Manager-leaders may need different skills to manage females and in general an increasing awareness of gender bias within the work-unit may mitigate stereotypical assumptions.

No statistically significant differences ( $p < 0,05$ ) could be found for the total group between functional areas, that being scientists versus engineers. It should be noted that the departments consist of predominantly scientists, while only one department showed a mixture of scientists and engineers. However, the advantages / disadvantages of functional diversity within departments should be investigated.

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**APPENDIX 1:**  
**Survey Notification**

**Permission was granted at the management meeting dated 20 August 2009**

Dear colleagues

Your assistance is kindly requested in completing a questionnaire for the purpose of research. You have been selected for a survey which will be conducted during September 2009. The questionnaire is part of an investigation into the leadership style within R&D function.

Leadership styles are increasingly important in building and sustaining a high performance organisation that is able to meet the challenges of the current market. Your input will help identify areas of strength as well as professional improvement opportunities.

The questionnaire will be distributed to individuals/groups from 28 August 2009.

Thank you for giving up your valuable time to assist me in the research. Should you have any queries please do not hesitate to contact me.

Yours sincerely  
Genevieve Joorst

**APPENDIX 2:**  
**Covering letter**

August 2009

Dear colleagues

I am writing to request your participation in completing the questionnaire for a research study. The purpose of the study is to examine the leadership style/behaviour within a R&D work unit.

Leadership style/behaviour is becoming increasingly important in building and sustaining a high performance organisation that is able to meet the challenges of the current market.

The questionnaire contains a section asking demographic questions and a Multifactor Leadership Questionnaire (MLQ). The leader version is to be completed by the manager-leader evaluating their leadership style.

Your responses to questionnaire will be kept entirely confidential. Your participation in this research study is completely voluntary. You have a right to withdraw at any point, for any reason. To ensure anonymity please do not write your name anywhere on this documentation. Kindly return the completed questionnaires before or on Friday, 11th September 2009, by placing them in the box provided in your department. Your input will help identify areas of strength as well as professional improvement opportunities.

Thanking you in advance for your assistance in this research.

Yours sincerely

Genevieve Joorst (Researcher)

**APPENDIX 3:**

**Reminder e-mail**

**From:** Joorst, Genevieve (G)

**Sent:** 09 September 2009 04:58 PM

**Subject:** Survey Notification

Dear colleagues

This is just a reminder that the due date for completed questionnaires is Friday 11<sup>th</sup> September.

Thank you all for your participation in this survey.

Yours sincerely,

Genevieve Joorst

## APPENDIX 4:

### Demographic Information

The information will only be used for statistical purposes to ensure that the sample is representative. Please answer the questions by crossing(X) in the relevant box or write down your answer in the space provided.

1. **Gender:** Male  1  Female  2
2. **Age (in complete years):**

3. **Ethnicity:**

|       |   |              |   |
|-------|---|--------------|---|
| Black | 1 | Coloured     | 3 |
| White | 2 | Asian/Indian | 4 |

4. **Formal education:** (Choose highest only)

|           |   |
|-----------|---|
| Technical | 1 |
| Bachelors | 2 |
| Honours   | 3 |
| Masters   | 4 |
| Doctorate | 5 |
| MBA/MBL   | 6 |

Others (specify) \_\_\_\_\_

5. **Organizational level:**

|             |   |
|-------------|---|
| 7 and below | 1 |
| 6           | 2 |
| 5           | 3 |
| 4           | 4 |
| 3 and above | 5 |

6. **Your functional area:**

|             |   |
|-------------|---|
| Scientific  | 1 |
| Engineering | 2 |

Others (specify) \_\_\_\_\_

7. **Background:**

Number of years spent in the **functional area** within R&D:

Number of years in the **current position**:

Number of years with your **current line manager**:

Number of years in **Managerial function**:

**APPENDIX 5:**

**Permission from Mind Garden to use the MQL**

For use by Genevieve Joorst only. Received from Mind Garden, Inc. on August 25, 2009



[www.mindgarden.com](http://www.mindgarden.com)

To whom it may concern,

This letter is to grant permission for the above named person to use the following copyright material:

Instrument: *Multifactor Leadership Questionnaire*

Authors: *Bruce Avolio and Bernard Bass*

Copyright: *1995 by Bruce Avolio and Bernard Bass*

for his/her thesis research.

Five sample items from this instrument may be reproduced for inclusion in a proposal, thesis, or dissertation.

The entire instrument may not be included or reproduced at any time in any other published material.

Sincerely,

A handwritten signature in black ink, appearing to read "Robert Most", with a long horizontal line extending to the right.

Robert Most  
Mind Garden, Inc.  
[www.mindgarden.com](http://www.mindgarden.com)

**APPENDIX 6:**

**Sample items from the leader MQL**

This questionnaire is to describe your leadership style as you perceive it. Please answer all items on this answer sheet. **If an item is irrelevant, or if you are unsure or do not know the answer, leave the answer blank.** Answer all items below by **circling** the appropriate number from the rating scale that best describes your perception. Remember to answer this part of the questionnaire anonymously.

Forty-five descriptive statements are listed on the following pages. Judge how frequently each statement fits the person you are describing.

Use the following rating scale:

| 0          |  | 1               | 2         | 3            | 4                         |   |
|------------|--|-----------------|-----------|--------------|---------------------------|---|
| Not At All |  | Once in a While | Sometimes | Fairly Often | Frequently, if not always |   |
| 1.         | I provide others with assistance in exchange for their efforts                           | 0               | 1         | 2            | 3                         | 4 |
| 2.         | I re-examine critical assumptions to question whether they are appropriate               | 0               | 1         | 2            | 3                         | 4 |
| 3.         | I fail to interfere until problems become serious  | 0               | 1         | 2            | 3                         | 4 |
| 4.         | I focus attention on irregularities, mistakes, exceptions, and deviations from standards | 0               | 1         | 2            | 3                         | 4 |
| 5.         | I avoid getting involved when important issues arise                                     | 0               | 1         | 2            | 3                         | 4 |