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TRANSFORMATION OF MANAGERIAL SKILLS OF ENGINEERS

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ABSTRACT

This article argues that there is a difference in leadership styles between experienced and inexperienced engineers in South Africa. It was found that experienced engineers are more transformational and more transactional than inexperienced engineers. To demonstrate this in the study, the researcher uses the Multifactor Leadership Questionnaire (MLQ) of Bass and Avolio (1995) to identify leadership style. The argument is substantiated by the results of a statistical analysis of leadership style administered to 85 experienced and inexperienced engineers in total.

OPSOMMING

Hierdie artikel debateer die verskil in leierskapstyle tussen ervare en onervare ingenieurs in Suid-Afrika. Dit is bevind dat ervare ingenieurs meer transformasioneel en meer transaksioneel is wanneer vergelyk word met onervare ingenieurs. Om hierdie studie te demonstreer, het die navorser gebruik gemaak van die Multifaktor Leierskapvraelys (MLV) van Bass en Avolio (1995) om leierskapstyl te identifiseer Die argument word verder ondersteun deur die resultate van statistiese analise van leierskapstyl wat uitgevoer is op 85 deelnemers, beide van ervare en onervare ingenieurs in totaal.

Due to the acceleration of change, traditional bureaucracy can no longer keep up its pace (Toffler, 1990). As bureaucratic hierarchies decline and horizontally oriented teams and work units evolve, specialized management skills are needed. Babcock (1996) argues that one of the prime responsibilities of the project manager is to build the project team. This involves a whole spectrum of management skills to identify, commit and integrate various project groups from traditional functional organisations into a single programme management system.

Across the board there is a subtle but profound change in the personality traits rewarded by the economic system. This change cannot help but shape the emerging social character of the manager and the engineer.

Babcock (1978) as well as Badawy (1983) state that the engineer who becomes a manager faces a bewildering task as he must:

- re-orient his thinking from things to people,
- learn how to motivate others to get work done rather than do it himself, and
- develop a knack for playing the political game that is so much a part of the management scene.

Seethamraju and Agrawal (1999) indicate in their study that although large numbers of engineers are in management, it is generally believed that they still lack soft skills such as:

- communication,
- business management, and
- interpersonal skills to be successful in management positions.

Kemper (1975) emphasizes that engineers are expected to be experts in certain areas. Their education leads them to be observant of what they see. Engineers are concerned with the creation of devices, systems and structures for human use. Seethamraju and Agrawal (1999) postulate that the engineer is by implication, through his education, trained to be a scientist of things and not a motivator or counsellor of people. Lannes (2001) reports that engineers work mostly with objects and they usually identify with the technical aspects of organizations.

One of the most challenging functions in the engineering industry today is project management, for two reasons. Firstly it requires management skills and abilities that are different from those required in a traditional functional management position. Secondly there is very little training support available to those engineers moving into management positions. Thornberry (1987) states that the project managers are, however, expected to have a very broad perspective, to be able to work mostly with people and primarily to identify with the project rather than their former function areas. Johnston (1987) reports that surveys have shown that the majority of professional engineers are required to assume a degree of management responsibility as they approach mid-career, and for some, the opportunity may come earlier. Badawy (1995) indicates that 63% of the engineers in the USA are employed as managers at the age of 65. This proves the need for generalists in today's business world.

The successful transition of engineers into management is due to three interrelated components, namely knowledge, skills and attitudes. A thorough knowledge of the principles and elements of administration is needed for managerial success. However, such knowledge by itself is not enough to ensure competency. Management theory is seen as a science, while management practice is seen as an art. An effective manager is thus a person who has developed a set of managerial skills. For the purposes of this study, the word or term "engineer" will be used according to the definition of Repic (1990) and Kemper (1975). The engineer is a person who, by reason of his knowledge, use of mathematical, physical, engineering sciences and the principles and methods of engineering analysis and design, which were acquired through engineering education and experience, is qualified to practise engineering.

Tertiary education of engineers in South Africa

The typical duration of the education of an engineer, who is practising as a professional engineer in South Africa, has been four years of undergraduate studies. O'Connor (1994) argues that engineers usually do not need to work with scientists and mathematicians. They have sufficient knowledge to deal with the problems themselves. A sufficient acquaintance with the humanities and social sciences will help an engineering student to understand the large social problems of his time. Babcock (1996) is of the opinion that the "Engineering curriculum should include specific engineering courses that incorporate written,

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oral, graphical and interpersonal communication skills, and these areas should be emphasised in the evaluation of the student performance".

Typical personality profiles of engineers
Lumsdaine, Lumsdaine and Shelnutt (1999) argue that the personality profile of the engineer is to be factual, analytical, mathematical, technical, logical, rational and critical – the typical analyst. Engineers may become fixated on the technical aspects of the job and fail to see interrelationships and the greater whole in the process.

Motivation of engineers
Toffler (1990) states that professional specialists "seemingly derive their rewards from inward standards of excellence, from their professional societies and from the intrinsic satisfaction of their task. In fact, they are committed to the task, not the job; to their standards, not their boss". Haug & Dofny (1997) state in their research that engineers are predominantly 'locals'. Their goals are directed primarily inward, at achieving the goals of the company and advancing within the company.

The career path of the engineer
The engineer does not have a typical career path to prepare him/her for the management role. O'Connor (1994) postulates that only a few engineers receive training in new management principles. The reason why engineers tend to gravitate towards the scientific approach to management is that they are usually rational, numerical and logical. In sharp contrast, engineering work today in general, is based on knowledge, teamwork and the application of certain skills. The manager's role is to concern himself with the people in his team. O'Connor (1994) states that these two roles are linked so closely together that separation will inevitably lead to bad engineering and bad management.

Work experience and interpersonal skills as requirements for engineers to become successful managers
A lack of experience and understanding can cause an engineer to fail in his duty as manager. For the engineer to be successful, he must broaden himself beyond purely technical matters, according to Thornberry (1987). One of the most difficult areas for engineers to improve on is people skills, especially when they move into a project management position. These skills are not as highly valued or as critical in an individual contributor's role as they are in a project manager's job. To gain more experience, McAllister (1984) proposes that the engineer can take on diverse assignments, participate in technical societies and committee work, and cultivate a natural curiosity to understand the overall context of his efforts.

Engineers tend to focus more on things than people, logic than emotion, and facts than feelings. Bircumshaw (1980) confirms that many engineers are not sensitive enough in the field of management. This can be emphasized by the practical, logical thinking engineer being irritated by the irrational, often inconsistent behaviour of those who he manages. It is argued by Sedge (1985) that an engineer, who is used to working with 'things', may never have acquired the necessary interpersonal skills to operate in a 'people-oriented' role. As engineers become involved in larger projects, they require interdisciplinary skills.

Engineers then discover that success will depend not only on technical expertise, but also on other factors such as organizational and people issues. Lannes (2001) states that the knowledge and skills required in the phase of development are primarily things such as project management, interpersonal and communication skills, interdisciplinary skills in finance and marketing, and other organizational skills.

To work well with diverse groups of people is an ability that is sought after by company management when they want to appoint new supervisors. Engineers are usually assigned to teams. To accomplish their work in a way that will result in the achievement of a common goal, team members must work closely with their peers and supervisors. The performance of the entire team depends on the engineer and if he becomes too independent, the whole team suffers. In most job situations today, Koontz, O'Donnell & Weihrich (1984) are of the opinion that poor communication skills can prevent an engineer from moving up. Freston & Lease (1987) state that a new engineer may be average in technical ability, but how people perceive him in meetings and over the telephone is a key to his success.

According to Sedge (1985), it is possible that an engineer, performing a role with a "thing" or "data" orientation, may never have acquired the necessary interpersonal skills to operate in a "people"-oriented role. Most management training fails to meet the needs of those in transition and Bayton and Chapman in Sedge (1985) recommend that improved selection and training procedures are required to smooth the transition process.

The transition from engineer to manager
Sarchet (1969) states that by 2000, more than 50% of corporations would have been headed by men with an engineering background. Managers generally focus on leadership skills, technical skills and administrative skills. Table 1 below depicts the role differences between engineers and managers as indicated by Bennett (1996).

TABLE 1
ROLE DIFFERENCES BETWEEN ENGINEERS AND MANAGERS

Position	Engineer	Manager
Focus	More concerned with things technical/scientific	**More concerned with people**
Decision -making	Makes decisions with much information, under conditions of greater certainty	Often makes decisions with inadequate information, under conditions of greater uncertainty
Involvement	Works on tasks and problem solving personally	**Directs the work of others to goals**
Process outcomes	Work based on facts with quantifiable outcomes	Work based on fewer facts, less measurable outcomes
Effectiveness	Depends on personal technical expertise, attention to detail, mathematical/ technical problem solving, and designing	**Depends on interpersonal skills in communication, conflict management, getting ideas across, negotiating and coaching**
Dependency	Experiences role as autonomous	**Experiences role as interdependent**
Responsibility	Individual accomplishment in one project, task or problem at a time	Many objectives at once, requiring orchestrating a broad range of variables and organisational entities
Creativity	Creative with products, designs, materials	**Creative with people and organisations**
Bottom line	Will it work?	Will it make/save money for the organisation?

Source: Bennett (1996)

Transformational and transactional leadership styles
According to Avolio and Bass (1991), research indicates that transformational leadership can develop in individuals at lower levels in the organization if those individuals have the opportunity to observe the behaviour of successful, appealing, higher level leaders. The aspiring transformational leader must be willing to re-examine his or her strengths and weaknesses as a leader.

Transformational leaders display four distinct characteristics that Avolio and Bass (1991) label the Four Is:

- Individualized consideration
  Transformational leaders pay attention to the individual employee and his needs rather than treating all followers alike and having the same needs. Such leaders listen to and share an individual's concerns while simultaneously helping to build the individual's confidence.

- Intellectual stimulation
  To serve in a transformational leadership role, Avolio & Bass (1991, p. 14) argue that a leader should be concerned with providing ways and reasons for people to change the way they think about technical problems, human relations problems, and even their own personal attitudes and values that have developed over the individual's lifespan. An intellectually stimulating leader helps people to think about 'old' problems in new ways and to use reasoning and evidence to solve problems.

- Inspirational motivation
  Avolio and Bass (1991) postulate that antecedents such as past personal accomplishments, the development of communication skills, and role modelling of other leaders create the potential to inspire others. This potential is realized in part by the interplay with individualized consideration and intellectual stimulation when the person is in a leadership role.

- Idealized influence
  Avolio and Bass (1991) believe that by showing respect for others and by building their confidence and trust in the overall mission, transformational leaders are able to develop much referent power and influence over others.

The transactional leadership style focuses on the interpersonal transactions between managers and employees. Leaders are seen as engaging in behaviours that maintain a quality interaction between themselves and followers (Kreitner and Kinicki, 2001, p. 567). The leader helps the follower identify what must be done to accomplish the desired results: better quality output, more sales or services and reduced cost of production. In helping the follower to identify what must be done, the leader takes into consideration the person's self-concept and esteem needs. The focus is therefore on how leaders influence the follower's expectations.

Gibson, Ivancevich and Donnelly (1997) state that a natural outflow of this style is therefore that the Transactional leader relies on contingent reward and on management by exception. Contingent reward is then defined by Gibson (1997, p. 315) as 'the leader informs followers about what must be done to receive the rewards they prefer' and management by exception is defined as 'the leader permits followers to work on the task and doesn't intervene unless goals aren't being accomplished in a reasonable time and at a reasonable cost'. Bass (1985) states that transactional leadership depends on contingent reinforcement and this could be either positive contingent reward (CR) or the more negative active or passive forms of management-by-exception.

METHOD

This section describes the method that was employed in the study, including a description of the target population and measuring instrument.

Participants/respondents

The respondents consisted of two independent samples. Firstly, all the students currently enrolled for their engineering degrees composed a community of interest. The unit of study (Cooper, 1998, p. 215) was engineering students who are engaging in their degrees at the Rand Afrikaans University in South Africa. The sampling method used is non-probability sampling as defined by Cooper (1998, p. 237). For the purposes of this research, judgement sampling was used as a type of purposive sampling method. The researcher selected sample members to conform to some criteria. The most common attributes of engineering students are their type of education and lack of managerial experience. The sample size (N) is 37.

Secondly, engineering managers at a utility company composed a community of interest. The non-probability sampling method was used. The most common attribute of engineering managers is their managerial experience. The sample variance is therefore greater. The sample size (N) is 48.

Measuring instruments

Leadership style was measured by the Multifactor Leadership Questionnaire (MLQ) developed by Bass & Avolio (1995). The MLQ measures the broad range of leadership from laissez-faire to idealized influence. The MLQ consists of 45 items with four factors that represented the meaning of each construct of the Full Range Model.

Procedure

The research procedure had the following steps:

- The researcher administered the questionnaire in person.
- Respondents were told that confidentiality would be kept.
- Respondents were asked to complete the MLQ leader answer sheet. It was explained to the respondents that the questionnaire consisted of statements about typical leadership behaviour and they were asked to indicate how often they behaved in a certain way. The items required that the respondents should indicate how strongly they identified with the behaviour. Because of the fact that the questionnaire is self-explanatory, respondents did not have to provide their names. This took 20 minutes.
- All the tests were sent to the Statistical Consultation Service at RAU for data analysis.

Statistical analysis

The following statistical methods were used to assess leadership styles of experienced and inexperienced engineers:

a) Cronbach Alpha of the MLQ
b) Frequency distributions of biographical variables of Eskom and RAU respondents
c) Descriptive statistics and independent samples t-test for leadership styles of engineers
d) Comparison of the vectors of means of experienced and inexperienced engineers in respect of the MANOVA measures
e) Analysis of variance to compare means of experienced and inexperienced engineers in terms of the MANOVA measures

RESULTS

Measuring instrument: the Multifactor Leadership Questionnaire

As seen in Table 2, nine items were rejected and the remaining 36 items of the MLQ provided a measurement of leadership style. Three corresponding scales were formed, that represent the transformational leadership style, the transactional leadership style and the non-leadership style for inexperienced engineers and engineering managers. Although some of the reliability coefficients are very low for this research, the measuring instrument has been tested in different research projects and is seen as sufficient for this research.

Table 2
Measuring instrument: the multi leadership questionnaire

	Cronbach Alpha	Number of items
1. Tertiary institution participants		
Transformational leadership	0,8622	20
Transactional leadership	0,4782	12
Non-leadership	0,6983	4
Total		36
2. Utility comapny participants		
Transformational leadership	0,8653	20
Transactional leadership	0,6675	12
Non-leadership	0,3202	4
Total		36

Comparison of data sets in terms of background variables for the utility company & tertiary institution.
Tables 3 and 4 represent the distribution of biographical variables of a utility company and a tertiary institution.

Tabel 3
Distribution of respondents/experienced engineers in a utility company according to biographical variables

Demographic variable	N	%
Formal education		
Commercial	18	38,3
Bachelor's	23	48,9
Master's	4	8,5
Doctoral	0	0,0
Other	2	4,3
Total	47	100
Number of employees reporting directly to participants		
1-5	19	54,3
5-10	11	31,4
10-20	1	2,9
20-50	3	8,6
50 or more	1	2,9
Total	35	100
Number of employees reporting indirectly to participants		
1-5	8	3,8
5-10	1	3,8
10-20	5	19,2
20-50	5	19,2
50 or more	7	26,9
Total	26	100
Number of completed years in the organization		
1-5	11	24,4
5-10	13	28,9
10 or more	21	46,7
Total	45	100
Number of completed years in management		
1-5	23	62,2
5-10	9	24,3
10 or more	51	3,5
Total	37	100

Table 4
Distribution of respondents/inexperienced engineers in a tertiary institution according to biographical variables

Demographic variable	N	%
Formal education		
Commercial	3	8,8
Bachelors	19	55,9
Masters	9	26,5
Doctoral	2	5,9
Other	1	2,9
Total	34	100
Number of employees reporting directly to participants		
1-5	22	91,7
5-10	0	0,0
10-20	0	0,0
20-50	0	0,0
50 or more	2	8,3
Total	24	100
Number of employees reporting indirectly to participants		
1-5	11	64,7
5-10	3	17,6
10-20	1	5,9
20-50	1	5,9
50 or more	1	5,9
Total	17	100
Number of completed years in the organization		
1-5	18	66,7
5-10	8	29,6
10 or more	1	3,7
Total	27	100
Number of completed years in management		
1-5	19	95,0
5-10	1	5,0
10 or more	0	0
Total	20	100

As seen in Tables 3 and 4, more participants in the utility company indicated that they had been exposed to management positions. It is indicated that respondents from the utility company have more work experience in category 10 years or more than the tertiary institution participants. This is in sharp contrast to one tertiary institution respondent who had more than 10 years of work experience. As seen in Tables 3 and 4, the total number of employees reporting to the utility group is more than the total for the tertiary group. More employees report indirectly to the utility group than to the tertiary group. The high count for employees reporting to the tertiary group in the first category (1-5 years) is due to the fact that one employee at the tertiary institution runs a business on a part-time basis in Africa. More employees report directly to the utility company participants compared to the tertiary institution participants. Tables 3 and 4 show the difference in the number of years of formal education between the two independent groups. A total of 47 participants (of the possible 81 participants) of the two independent groups are from the utility company, and they indicated formal education at different levels. It is clear that the group representing the utility group has more years of formal education than the tertiary group.

The 45 items of the MLQ could not be subjected to Chi-square tests in order to establish whether there is a

relationship between the biographical variables from the two independent samples: the tertiary institution sample (which represents young engineers), and the utility comapny engineers (who represent the engineering manager). The number of respondents per cell for the different background variables was too small (20% of the cells have expected frequencies smaller than 5).

Leadership styles

From Table 5, it is clear that significant differences were found in the mean scores of the transformational and transactional leadership styles when the experienced engineers and the inexperienced engineers were compared. The assumption is that the dimensions or scales of the MLQ are correct. From Table 5 it is clear that the tertiary institution engineers are less transformational and transactional than the utility company engineers. On average, the two groups do not differ in terms of the non-leadership style.

The probability value for the transformational leader is 0,00 and is smaller than 0,05, which means that there is a statistically significant relationship between the transformational leadership style and experienced engineers. The assumption is made that the utility company engineers are representatives of experienced engineers. The probability value for transactional leaders is 0,002 and is smaller than 0,05, which means that there is a statistically significant relationship between transformational leadership style and the tertiary institution engineers. The assumption is made that the tertiary institution engineers are representative of inexperienced engineers. This supports the assumption that the two groups differ in terms of leadership style.

As seen in Table 6, a test of equality (Hotelling T^2) of means considered the three dependent variables (transformational leadership style, transactional leadership style and the non-leadership style) for experienced and inexperienced leaders. Since the significance level (0,00) is less than 0,05 for the T^2 test, it is clear that the two groups provide different results with respect to leadership style; 0,246 is statistically significant.

Table 6

MANOVA: comparison of the vectors of means of experienced and inexperienced engineers in respect of the chronometric measures

Effect	Value	F	Hypothesis DF	Error DF	Sig, Of F	Partial Eta squared
Intercept						
Pillai's Trace	0,988	2172,174	3,000	81,000	0,000	0,988
Wilk's Lambada	0,012	2172,174	3,000	81,000	0,000	0,988
Hotelling's Trace	**80,451**	**2172,17**	**3,000**	**81,000**	**0,000**	**0,988**
Roy's Largest Root	80,451	2172,174	3,000	81,000	0,000	0,988
Groups						
Pillai's Trace	0,197	6,636	3,000	81,000	0,000	0,988
Wilk's Lambada	0,803	6,636	3,000	81,000	0,000	0,988
Hotelling's Trace	**0,246**	**6,636**	**3,000**	**81,000**	**0,000**	**0,988**
Roy's Largest Root	0,246	6,636	3,000	81,000	0,000	0,988

P < 0.05

Table 5

Descriptive statistics: Independent samples t-test for leadership styles in respect of experience of engineers

Group		N	Mean	STD Deviation
Transformational Leadership style	Utility company	48	3,1064	0,4110
Transformational Leadership style	Tertiary Institution	37	2,8054	0,4857
Transactional Leadership style	Utility company	48	2,2751	0,4272
Transactional Leadership style	Tertiary Institution	37	1,9865	0,3926
Non-leadershipl Style	Utility company	48	0,5729	0,4464

Levene's test for equality of variance		T-test for equality of means				95% Confidence interval of the Difference	
Independent Samples test above	**F**	**Sig**	**T**	**df**	**Sig**	**Mean Difference**	**Std error Difference**	**Lower**	**Upper**
Transformational Leadership style	0,136	0,714							
Utility company			3,645	83	0,000	0,3550	0,9739	0,1613	0,5487
Equal variances assumed			3,567	70,345	0,001	0,3550	0,0995	0,1565	0,5534
Tertiary institution									
Equal variances assumed									
Transactional Leadership style	0,001	0,973							
Utility company			3,197	83	0,002	0,2886	0,0902	0,1090	0,4681
Equal variances assumed									
Tertiary institution			3,233	80,408	0,002	0,2886	0,0892	0,1109	0,4662
Equal variances assumed									
Non-leadership style	5,852	0,018							
Utility company			-1,696	83	0,094	-0,2221	0,1309	-0,4825	0,0383
Equal variances assumed			-1,593	55,097	0,117	-0,2221	0,1394	-0,5015	0,0573
Tertiary institution									
Equal variances assumed									

Next, an analysis of variance (ANOVA) was performed in order to compare the means of the experienced and inexperienced engineers in respect of each of the chronometric measures.

From Table 7, it is clear that the analysis of variance indicates that there are three dependent variables. The total variance of all scores was broken down into a, between group variance.

TABLE 7
COMPARISONS OF THE MEANS OF EXPERIENCED AND INEXPERIENCED ENGINEERS IN RESPECT OF THE CHRONOMETRIC MEASURES

Source	Dependent variable (Y)	Sum of squares	Df	Mean square	F	p
Group	Transformational leadership style	2,633	1	2,633	13,288	0,00
	Transformational leadership style	1,740	1	1,740	10,223	0,002
	Non-leadership style	1,031	1	1,031	2,877	0,094
	Error	60,318	83	0,726		

P < 0,05 (F0,05 (1,83) = 3,9

From an inspection of Table 7, it is clear that transformational leadership, transactional leadership and non-leadership differ significantly between experienced and inexperienced engineers. This supports the assumption that leadership style differs between experienced and inexperienced engineers.

DISCUSSION

The purpose of the study was to establish whether there is a statistical, significant difference in the leadership styles of inexperienced and experienced engineers. The researcher concludes that there is a statistically significant difference in leadership styles between the independent samples, namely the experienced utility company engineers and the inexperienced tertiary institution engineers.

It is clear from the research results that the inexperienced engineers as well as the experienced engineers have leadership styles and therefore managerial skills. Three leadership styles were identified, namely the transformational leadership style, the transactional leadership style and the non-leadership style for each of the two groups. The two groups provided different results with respect to leadership style. There is a statistically significant relationship between transformational leadership style and inexperienced engineers. There is a statistically significant relationship between the trans-formational leadership style and experienced engineers/ engineering managers. Inexperienced engineers are less transformational and transactional than the utility company engineers. On average, the two groups do not differ in terms of the non-leadership style. It is clear from the research results that the utility group representing the experienced engineers has more years of formal education than the tertiary institution group.

The utility group has also been more exposed to managerial positions than the tertiary institution group. This supports the findings that more people report directly and indirectly to the experienced engineers compared to the inexperienced engineers. The results also indicate that the experienced engineers have more work experience in the category 10 years or more years compared to the inexperienced engineers.

The findings of this research confirm the theory that successful managers tend to grow into their jobs over an extended period of time (Bennett, 1996, Sedge, 1985). The findings also support the arguments of O'Connor (1994) and Badaway (1995) that the engineers have no typical career path to prepare them for the management role. If transformational and transactional leadership styles enable managers to lead and manage people more effectively, then it becomes necessary for engineers to broaden themselves beyond technical matters as argued by Thornberry (1987) and Thamhain (1983).

For the inexperienced engineer to prepare himself for management, he will need to obtain knowledge about management and develop management skills during his formal studies. These managerial skills include the ability to work with and motivate subordinates. The management of business organisations has a key role in initiating and implementing a transition model or programme to ensure that an environment is put in place that will provide the necessary managerial training for the inexperienced engineer to become a successful manager. This can be a difficult process for the engineer, and to ease it and overcome resistance, a well-thought-out and intensive strategy would have to be developed by management. This process starts with the selection of inexperienced engineers and the MLQ can be used as a selection tool in order to identify leadership style.

As leadership style could be identified by the MLQ, this measuring instrument could be used as a test during the selection process of inexperienced engineers. The MLQ could also be used as a measurement of progress of the transformational and transactional leadership styles after training. For the purposes of this investigation, respondents were asked to rate themselves according to the items of the MLQ. It is recommended that if similar research is done in future, at least three subordinates or colleagues could also complete the instrument and rate the person from their perspective. This might provide a clearer picture of the person's leadership style. It is also recommended that the sample size could increase for future research. It would also be worthwhile pursuing means of improving the MLQ as some of the items were rejected and did not contribute to identifying the three leadership styles but focused more on the problem-solving ability of the respondent.

The findings of this research are valuable because of a lack of previous research on the leadership styles and managerial skills of inexperienced and experienced engineers in the South African context.

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