The role of the psychological contract and its influence on engineers' worker engagement

by

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Abstract

The study investigated the concept of the psychological contract and its influence on engineers' worker engagement. The underlying rationale for this study was to address the shortage of engineers and specialised artisans (that is, the shortage of skilled people in two of the professions where such a shortage poses a threat to the economic growth of South Africa) by determining the worker engagement of engineers. The study also attempted to identify the true drivers of engagement for engineers which can then be used as a baseline for further development of business specific strategies. The sample was engineering personnel in the South African project engineering sector, and a combination of two existing questionnaires, the Psychological Contract Inventory (PCI) and the Utrecht Work Engagement Scale (UWES), was used to gather the data.

It was concluded that generally engineers are loyal to the task at hand and not necessarily to the organisation that employs them. They are engaged in their work, but also indicate that they constantly seek to improve their education and experience to make future employment at other companies probable. A somewhat contradictory finding is that they claim to be satisfied with the employment offered to them, as well as the benefits they receive.

To ensure the retention of skilled employees, the study proposes that employers of engineers diversify from time to time, or introduce some variation. Even internal shuffling can be used to continually challenge the engineers. It is further recommended that companies should ensure that there are clear career paths for engineering employees, combining secure employment with stable and realistic benefits.

Key words:

engineers

skills shortage

psychological contract

Psychological Contract Inventory (PCI)

retention strategy

Utrecht Work Engagement Scale (UWES)

worker engagement

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Declaration

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination at any other university or other tertiary institution.

I declare that all sources used in the preparation of this report are duly cited and acknowledged in the text and in the list of references.

I also declare that I have obtained the necessary authorisation and consent to carry out this research.

The language in this research report has been edited by Mrs Idette Noomé (MA English Pret).

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Chapter 1: Introduction

1.1 Research focus

This study examines the psychological contract, its role and influence on engineers' worker engagement in a South African project engineering environment.

1.2 Research aim

The aim of the study is to determine the drivers of worker engagement for engineers and how their psychological contract with the organisation influences their engagement. The study endeavours to ascertain whether there is a correlation between the relational elements of the psychological contract and the level of worker engagement of engineers.

1.3 Research problem and rationale

The skills shortage across the world, but in South Africa in particular, has had a direct effect on the engineering profession. The Department of Labour has admitted that there are severe shortages in the civil and mechanical engineering fields (Dhliwayo, 2008). It has even been reported that the shortage of engineers and specialised artisans poses a threat to the economic growth of South Africa (Khumalo & Mmope, 2007). These are only two of the vital professions where shortages pose a problem.

South Africa is a growing third world country, but to sustain this growth, the government and private sector must train and retain highly skilled individuals.

However, the country is experiencing a severe 'brain drain' that is threatening this economic growth. The South African government is spending billions on infrastructure improvement, but lacks the right people to implement these projects – this poses a daunting challenge. It has been reported that the 'brain drain' cost to South Africa so far has been more than $5 billion, due to the loss of human capital in the period between 1997 and 2008 (Kharwa, 2008).

The ability of the post-apartheid government to supply basic services to the previously disadvantaged section of the population has also been hamstrung by the loss of skilled technical professionals. There has consequently been a drive in some councils, of which the Ethekwini Metro is but one example, to employ retired engineers. The Engineering Council of South Africa (ECSA) has welcomed this re-employment. This was a desperate attempt to ensure that skills were transferred to younger engineers. ECSA also said that the shortage of experienced engineers was due to engineers' accepting positions in Europe and Australia (Dhliwayo, 2008).

This problem is not unique to South Africa: about half of Australia's engineers will retire in the next 15 years and the Australians are therefore in a process of ensuring that skills are transferred to younger engineers. Because the global skills shortage is affecting Australia as well, Australia is making very attractive propositions to young South African engineers (Inggs, 2007). In order to secure the future of the profession in South Africa, local companies must ensure that engineers remain in their positions and are engaged in their jobs. This will ensure that skills are transferred and that the generations of engineers that follow will be on the same level or of an even better quality.

The results of this study should enable companies to guarantee that the employee-organisation relationship with engineers is managed as successfully and effectively as possible. There will be a strategic benefit to employers if they are aware of what the true drivers of engagement for engineers are, even if this information is only used as a baseline for further development of employers' own particular strategies.

1.4 Outline of the study

Chapter 2 presents a literature review of theories relating to the psychological contract and worker engagement.

Chapter 3 contains the specific research questions that address the research problem.

The research methodology is discussed in Chapter 4. The sampling method, data collection, and the questions asked during the data collection process are presented.

Chapter 5 sets out the analysed statistical results. Only the results used in the actual discussion are included. (The remaining results are included in Annexure B).

The results are discussed in Chapter 6, relative to the research questions and propositions.

The conclusion is presented in Chapter 7, with some recommendations to employers, as well as some useful topics for future research.

Chapter 2: Literature review

2.1 Introduction

The global economy expanded significantly between 2002 and the end of 2007. Consequently, business leaders and human resources managers are increasingly concerned about the intensifying international competition for talent. The impact of not having the right people in place to lead and confront business challenges, as well as of employing below-average candidates to fill critical positions, is a source of great concern for business leaders (Wooldridge, 2006). Today, in 2009, with an unprecedented global financial crisis and a widespread economic slow-down, the sourcing of talent still remains a critical item on the agenda of top achieving companies. Despite the downturn, the overwhelming majority of firms still focus on recruiting and retaining top talent (Beechler & Woodward, 2009).

The intellectual capital held by knowledge workers has become a strategic asset to organisations. Hence, the retention of such individuals is a core aspect of the success of a business (Flood, 2001). The employee-organisation relationship refers to the collective relationship between employees and the organisation, but this relationship can be separated into micro- and macro-elements. The 'psychological contract' and perceived organisational support are classified as micro-concepts. Macro-concepts include the employment relationship (Coyle-Shapiro & Shore, 2007).

The field of positive organisational behaviour has developed out of the positive psychology approach. It refers to the study and application of positively oriented human capabilities, talents and strengths (Karatepe & Olugbade, 2009).

This literature review focuses on the drivers of engagement. Closely related to these drivers is the psychological contract between employees and employers.

2.2 Drivers of engagement and worker engagement

Companies have realised that in order to differentiate themselves from their peers, they have to attract and retain key personnel. Clients tend to make use of the services and products of companies that employ certain people who have managed to build a good reputation in the marketplace (Gronring, 2008). Studies indicate that worker engagement correlates positively with customer satisfaction (Salanova, Agut & Peiró, 2005) – this phenomenon is particularly evident in the engineering profession. Employee engagement is critical to talent and leadership management (Gronring, 2008).

The concept of worker engagement has been characterised in two different ways. Engagement refers to energy, involvement and professional efficacy, which are considered to be the direct opposites of burnout dimensions, which are defined as exhaustion, cynicism and a lack of professional efficacy (Maslach & Leiter, 1997). Worker engagement is a motivational, work-related state of fulfilment in employees (Schaufeli & Bakker, 2004). Schaufeli, Salanova, González-Romá and Bakker (2002) define employee or worker engagement as a positive mindset towards one's work, characterised by vigour, dedication and absorption. Rothbard (2001) defines worker

engagement as the conceptualisation of role engagement, with two core dimensions: attention and absorption in a role.

Vigour is characterised by high levels of energy and mental resilience, as well as a willingness to invest effort, tenacity and persistence in difficult circumstances. A person's ability to derive a sense of significance from his/her work, together with feeling proud and enthusiastic, being inspired and challenged by the work at hand, are all elements of dedication.

Thus, an employee who feels great vigour at work tends to be highly motivated by his/her job and is also likely to remain very persistent when the person encounters difficulties or hassles at work. The dimension of vigour is regarded as a motivational concept (Mauno, Kinnunen & Ruokolainen, 2007).

Motivation is the immediate influence on direction, vigour and persistence of action. Vigour and persistence are both characteristics of worker engagement. However, the construct of intrinsic motivation seems to be especially conceptually similar to the dimension of vigour. Intrinsic motivation refers to a person's need to perform a certain activity because this activity gives him/her inherent pleasure and satisfaction. This intrinsically rewarding activity does not need to contain any extrinsic goals, such as a better salary or a bonus (Mauno *et al*., 2007).

Absorption, one of the dimensions of worker engagement, refers to total concentration on and immersion in work. This is characterised by a sense of time passing quickly (Schaufeli & Bakker, 2003) and finding it difficult to detach oneself from one's work (Schaufeli *et al*., 2002). Absorption is tested by six elements that refer to being happily immersed in one's work and having difficulties detaching oneself from it.

Some researchers have taken the view that the experience of absorption is similar to that of flow. Flow has been defined as a mental state in which people are so intensely involved in an activity or task that nothing else seems to matter. The experience itself is so enjoyable that people will do it even at great cost, purely for the feeling of satisfaction that the task or activity brings. Flow tends occur outside the work context, for example, while practising a hobby or playing sport, although flow is also noted in other aspects of life (Mauno *et al*., 2007).

Flow experiences in the work situation are likely to occur when an employee has a good work life balance and his/her personal resources are well developed. The main difference between the concepts of flow and absorption is that absorption is assumed to be a more persistent state of mind which occurs specifically in the work domain, whereas flow rather resembles a short-term peak experience that may occur in any domain of life (Mauno *et al*., 2007).

Job dedication is a concept related to self-disciplined behaviour, such as obeying organisational rules, going the extra mile and taking the initiative at work. Job dedication is a motivational state of job performance that motivates people to act with the intention of promoting the organisation's best interests (Van Scotter & Motowidlo, 1996). Mauno *et al*. (2007) suggest that dedication is characterized by a strong psychological involvement in one's work, with a sense of significance, enthusiasm, inspiration, pride and challenge.

Dedication shares some characteristics with the more traditional concept of job involvement also known as 'commitment'. Commitment has been defined as the degree to which an employee psychologically relates to his/her job. Job involvement is

also considered a function of how far the job can satisfy an employee's present needs (Mauno & Kinnunen, 2000).

Engaged workers are motivated and willing to go the extra mile; they have high levels of energy and are enthusiastic about their work. Often they are fully immersed in their job, so that it seems as though time flies. These workers are also more willing to put the interests of the organisation above their own (Macey & Schneider, 2008; Xanthopoulou, Bakker, Demerouti & Schaufeli, 2009).

As has already been indicated, burnout is often regarded as the opposite of worker engagement. Burnout is defined as exhaustion, cynicism and a reduced or negative professional efficiency (Maslach & Leiter, 1997). There are two schools of thought with regard to the relationship between worker engagement and burnout, and this affects the tests or instruments used to test the two concepts.

Maslach and Leiter's (1997) theory proposes that worker engagement and burnout are negatively correlated. They therefore test for burnout – if a person tests positive for burnout, their negative correlation theory implies that the person is engaged in his/her work (Maslach & Leiter, 1997). They also argue that if a worker is not exhausted, cynical or inefficient, the worker must be energetic, involved and efficient, which, according to them, are the characteristics of an engaged worker. The test they use is called the 'Maslach Burnout Inventory' or MBI (Maslach, Jackson & Leiter, 1996).

The second school of thought argues that there is no positive or negative correlation between worker engagement and burnout. Workers experience burnout as negative and engagement as positive psychological states, but this does not mean that these two states are correlated (Schaufeli & Bakker, 2003). It is possible for a worker to test

low on burnout and low on worker engagement at the same time. Schaufeli and Bakker (2003) also do not test professional inefficiency in their Utrecht Work Engagement Scale (UWES).

Gronring (2008) has developed indexes to measure the correlation between customer loyalty and employee engagement. In developing and implementing similar indexes within companies, he argues that it should be possible to identify what motivates the workers (these motivations are known as drivers of engagement) and what the expectations of the clients are. This will ensure that the workforce is aligned correctly to the needs of clients.

Drivers of engagement are dynamic and must change as the business environment and economy change and evolve over time. A set of engagement predictors have been identified that attempt to monitor employee motivation. These nine drivers include the following (Glen, 2009):

- the organisational process;
- how challenging and motivating job roles are;
- how clear the values of the business are;
- whether workers strike a balance between their work life and personal life;
- the downward sharing of information from management;
- the level of 'stakeholdership' and reward recognition;
- the management of performance;
- the work environment; and
- a passion for the product or service of the business.

Worker engagement is depicted in Figure 1 (next page).

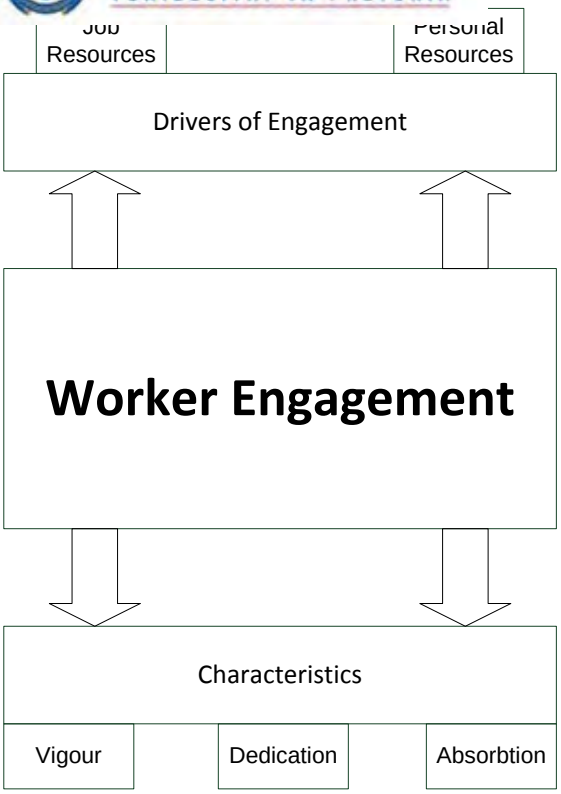

Figure 1: Worker engagement characteristics and drivers

Job resources such as social support, performance feedback and learning opportunities are some of the drivers of worker engagement identified by previous studies (Schaufeli & Bakker, 2003). Engaged workers also perform better because they experience more positive emotions, possess the ability to mobilise resources and cross-pollinate their fellow workers to engage more fully in their work (Bakker & Demerouti, 2008).

Personal resources refer to an individual's sense of his/her ability to have a positive impact on the business's success. This is achieved by means of positive self-evaluation. Personal resources are vital for achieving goals and stimulating personal growth and development. The development of personal resources empowers a worker and improves his/her self-motivation. This in turn has a positive impact on the satisfaction levels of workers and influences worker engagement in a positive manner (Xanthopoulou *et al*., 2007). However, Xanthopoulou *et al*. (2007) found that personal resources did not offset the relationship between job demands and exhaustion.

Instead, personal resources mediated the relationship between job resources and engagement and influenced the perception of job resources.

The conservation of resources theory is a motivational theory which postulates that when motivation is threatened or denied, the result is stress, with a negative effect on motivation (Hobfoll & Shirom, 2001). The main assumption in the conservation of resource theory is that positive experiences or resources are likely to accumulate, creating a positive spiral of resources. It can therefore be deduced that people who have important resources are often able to gain additional resources. The opposite also applies – implying that when a person loses an important resource, that person is likely to suffer the loss of other resources, resulting in a negative spiral of resource loss. Worker engagement, as a positive resource, may result in a positive spiral of resources (Mauno *et al.*, 2007).

2.2.1 Measurement of worker engagement

Research has shown that worker engagement can be reliably measured. It is also possible to distinguish worker engagement from phenomena such as workaholism and financial returns job involvement and organisational commitment (Xanthopoulou *et al*., 2007).

The Utrecht Work Engagement Scale (UWES) is a self-reporting test that determines worker engagement using three aspects: vigour, dedication and absorption (Schaufeli & Bakker, 2003). The UWES presents testees with 17 statements in random order. They rate the statements using a Likert-type scale, with responses marked as follows:

0 = Never,

1 = Almost never (A few times a year or less)

2 = Rarely (Once a month)

3 = Sometimes (A few times a month)

4 = Often (Once a week)

5 = Very often (A few times a week)

6 = Always (Every day)

The UWES assesses vigour with the following six statements:

- At my work, I feel bursting with energy.
- At my job, I feel strong and vigorous.
- When I get up in the morning, I feel like going to work.
- I can continue working for very long periods at a time.
- At my job, I am very resilient, mentally.
- At my work I always persevere, even when things do not go well.

The UWES assesses dedication with the following five statements:

- I find the work that I do full of meaning and purpose.
- I am enthusiastic about my job.
- My job inspires me.
- I am proud of the work that I do.
- To me, my job is challenging.

The UWES uses the following six statements to test absorption:

- Time flies when I'm working.
- When I am working, I forget everything else around me.
- I feel happy when I am working intensely.
- I am immersed in my work.

- I get carried away when I'm working.
- It is difficult to detach myself from my job.

2.3 Psychological contract

Human capital management and the recognition thereof must be an organisational driving force to guarantee that an organisation remains competitive (O'Donohue, Sheeman & Hecker, 2007). One of the aspects of human capital management is the management and maintenance of a healthy psychological contract between the employees and the employer. The unwritten and implied beliefs between an employee and the organisation, and vice versa, form one of the many definitions of the psychological contract (Robbins & Judge, 2007; Rousseau, 1989).

The formal contract between the employee and the organisation is only the basis of the give and take relationship. Indeed, a study by Turnley and Bolino (2002) indicates that a breach of the implied or non-formal contract is a powerful force affecting personnel motivation, morale and turnover.

Psychological contract breach is measured either as a global or a composite breach. A composite breach occurs when there is specific reference to a certain contract or agreement, whereas a general breach is more subjective. A general breach is not qualified in any formal contract or agreement (McInnis, Meyer & Feldman, 2008).

The psychological contract helps to define the contemporary employment relationship. It can also be defined as the obligations of the employer – in short, what an employee believes his/her employer owes him/her (Turnley & Bolino, 2002). This in turn implies that promises and statements made during interviews or later during everyday working conversations can and do affect the psychological contract. The personal

reward, settlement or acknowledgement that the worker feels are due to him/her also affects the psychological contract. Management is often not aware of this crucial factor.

Guest (1998) has raised the question of whether the psychological contract is worth taking seriously. He questioned the content validity and construct validity of the psychological contract, as well as the testability and applicability of the psychological contract. With regard to validity, he argued that it is difficult to specify the precise content of expectations, promises and obligations. He questions the construct validity of the psychological contract concept, because it is unclear who or what constitutes the organisation party to the contract. Guest (1998) has also raised the concern that researchers have not yet established a coherent and conclusive list of dimensions for this construct, and have yet to establish the independence of the dimensions. He also criticised the testability and applicability of the psychological contract as it is currently defined. It is not clear how the presence of a psychological contract is established. Nor is it clear what steps are necessary to alter the contract.

Herriot and Pemberton (1997) recommend that the psychological contract be made explicit, changing the psychological contract from a relational to a transactional contract, leaving aside the practicality of constant renegotiation of the contract.

Despite his caveats, Guest (1998) explains why he thinks the psychological contract is relevant and that it should be taken seriously. The first reason for taking it seriously relates to the analysis of why it has come to the fore in the past decade. In the last few years, the emphasis has shifted from industrial relations to employment relations. The psychological contract provides a construct with which to make sense of and explore this new employment relationship. A second reason for retaining the notion of the

psychological contract is its ability to focus attention on the distribution of power. A third reason for not disregarding the psychological contract is that it has the potential to integrate a number of key organisational concepts. For this to occur, more analytical research is required to determine how far the concept of the psychological contract can usefully embrace and subsume overlapping concepts and theories.

The elements of the psychological contract can be divided into transactional and relational elements (Mcneil, 1985; Rousseau, 1989). Transactional elements refer to a more formal give and take situation. Employees might feel that they have met all their key performance indicators and that they are therefore due to be rewarded with a bonus at the end of the year. Meanwhile, the employer may regard the employees' meeting the required criteria as mandatory and therefore does not see any justification for paying a bonus.

Relational elements are linked to what employees expect from the employer in terms of things that are not related directly to successful task completion. A good example is a scenario in which management decides to start serving free coffee at work. Such an act will have a positive influence on the relational elements of the psychological contract.

Transactional and relational contracts differ from each other in five respects, namely the focus of the contract, the time frame, stability, scope and tangibility (Rousseau & McLean Parks, 1993). Transactional and relational elements also involve remuneration and a supportive employment relationship (Turnley & Bolino, 2002). The elements listed above add to existing theory that cognitive trust and transactional obligations are the basis of the psychological contract. Once these elements are in place, the less measurable relational elements will follow (Atkinson, 2007). However, the power of

the less measurable relational elements should not be underestimated: if these requirements are not adequately met by employers, then the employees' worker engagement will be negatively affected. This might lead to lower levels of productivity, more incidents of absenteeism, and may eventually cause employees to resign from the organisation (Ellis, 2007).

Ellis (2002) has studied promises made within an organisation, focusing on two aspects. The first was the promise of quality communication. The second was the promise of a work-life balance.

Promises of quality communication refer to employees' expectation that they will be kept informed in an open and honest fashion with regard to issues relating to the organisation, as well as to decisions made by management. Quality of communication promise themes include access to supervisors, timely responses, confidential communication, performance feedback and team-oriented communication (Ellis 2007).

Work-life promises refer to the management of workers within their formal work and their personal lives. There are times when workers need time off from work to deal with personal matters. Ellis (2007) has identified work-life promises made by employers such as time off to deal with a death in family, for family reasons, recreation, maternity and paternity leave, medical appointments and child care.

The measurement of the psychological contract is somewhat problematic because of the large number of instruments that are available. The biggest driver of how the contract is measured depends on the questions that the researcher asks. Three forms of measurement were identified: feature-oriented, content-oriented and evaluation-oriented measurements (Rousseau & Tijoriwala, 1998).

Feature-oriented instruments measure the contract against some attribute or dimension. These psychological contracts can be characterised as having a short-term influence or a long-term influence on non-work related activities, and as transactional and flexible arrangements. Content-oriented measurement refers to the specific promises made by the employer and employee. This includes job security, opportunity for training, challenging tasks, flexible working hours and confidentiality. Evaluation-oriented aspects refer to the degree to which the contract is fulfilled (Freese & Schalk, 2007).

McInnis *et al*. (2008) have also looked at three types of measurement, focusing on content, transactional and relational elements. Content elements refer to the specific promises made. Transactional elements refer to monetary benefits such as performance bonuses and merit increases. The softer, less tangible third form of measurement includes relational elements such as social support and development (McInnis *et al*., 2008)

The psychological contract is a dynamic aspect of human resources management. Practices and procedures must be implemented to investigate the satisfaction of employees (Flood, 2001). The true skill lies in identifying and managing the relational elements of the contract.

2.3.1 Measurement of the psychological contract

The Psychological Contract Inventory (PCI) was developed by Rousseau (2000) with two basic objectives: to test the generalised content of the psychological contract in a sound psychological manner and to be used as a self-scoring assessment tool to support executive and professional education. The PCI contains both content and

evaluation measures. Specific terms are tested and then the extent of contract fulfilment between the employer and employee is tested. The PCI was developed to measure the transactional, relational, transitional and balanced dimensions of the psychological contract (Rousseau, 2000).

Rousseau (2000) divided his four dimensions into conceptually homogenous components, as can be seen in Figure 2.

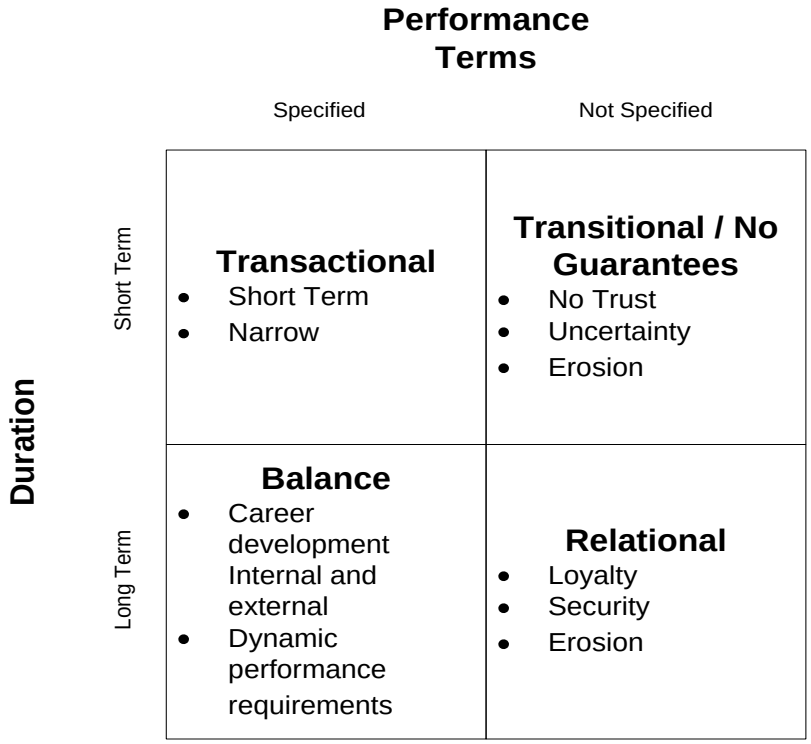

Figure 2: Four dimensions of the PCI (Rousseau, 2000)

These dimensions are explained more fully below (Rousseau, 2000).

- **Relational dimension:** This refers to long-term employment arrangements which are based on mutual trust and loyalty.
    - *Stability:* The employee must stay with the organisation for a long time. The employer must offer long-term employment, together with stable wages.

- *Loyalty:* The employee must commit to meeting the needs of the organisation and support the organisation in achieving its goals. The employer in return must support the well-being of the worker and his/her family.

- **Balance:** This dimension refers to the employment arrangements based on the economic success of the business. The opportunities for workers to develop their careers are also included. The learning relationship between workers and the organisation is evaluated.
  - *External employability:* The development of the internally and externally marketable skills of the employee and the support from the organisation in this matter is evaluated.
  - *Internal advancement:* The ability of and opportunities for workers to develop skills and knowledge that will benefit the organisation is evaluated. The ability and commitment of the employer to make this possible for the worker is also investigated.
  - *Dynamic performance:* In order for an organisation to remain competitive, it must constantly expose its workers to challenging tasks. The commitment of management and workers to establish such a culture is tested.
- **Transitional dimension:** The consequences of organisational change and transitions on the established contracts between the employees and employers are tested.
  - *Mistrust:* This refers to the belief that the business is not consistent in the communication of its intentions to workers. The employer typically withholds information from the employees. The other side of the coin is the possibility that management may not trust the employees.

- *Uncertainty:* Employees are not completely certain about what their personal obligations towards the firm are.
- *Erosion:* There is a negative growth of returns for the contribution of the employee to the business. This can take the form of physical remuneration, as well as a clamping down on and reduction of the work-life of the employee.

- **Transactional dimension:** This refers to the short-term arrangements that focus on the economic performance of the business.
  - *Narrow:* The duties of the employee are limited to fixed or predefined tasks. The employee is therefore required to do what he/she is paid for. No development or involvement is required from the employee.
  - *Short-term:* There is no commitment from the employee to remain with the organisation. Employment is only offered for a limited time.

2.3.2 Structure of the PCI

The PCI is a standard questionnaire developed to test the four dimensions as discussed above. The structure of the questionnaire is set out in Table 1.

Heading	Area tested
Employee obligations	• Short-term • Loyalty • Narrow • Performance support • Development • External marketability • Stability
Employee obligations	• Short-term • Loyalty • Narrow • Performance support • Development • External marketability • Stability
Psychological contract transitions	• No trust • Uncertainty • Erosion
Psychological contract fulfilment	• Employee fulfilment • Employer fulfilment

Table 1: PCI question structure (Rousseau, 2000)

2.4 Concluding remarks

The PCI and the UWES are used in the current study, as explained more fully in Chapter 4, on order to address the research questions and propositions set out in Chapter 3.

Chapter 3: Research questions and propositions

3.1 Research questions

This study investigates the role of the psychological contract and its influence on the worker engagement of engineers.

The following questions were formulated in order to address the research problem:

- Is there a link between the psychological contract and the work engagement of engineers?
- How do employers use the elements affecting the psychological contract to ensure that engineers are engaged in their work?

3.2 Research propositions

The following propositions were tested:

- Proposition 1: There is a positive correlation between the psychological contract of engineers and their engagement in their work.
- Proposition 2: The elements that affect the psychological contract can be influenced in such a manner that engineers become more engaged in their work.
- Proposition 3: The more experience an engineer has accumulated in the industry the more engaged he/she is in his/her work.
- Proposition 4: Engineers become less engaged in their work the longer they are employed at a particular company.
- Proposition 5: The higher management level an engineer occupies in an organisation, the more engaged he/she is in his/her work.

Chapter 4: Research methodology

4.1 Rationale for the method chosen

This study endeavoured to explore the role of the psychological contract on engineers and how their engagement as workers is influenced. The environment within which a person functions directly influences the behaviour of that individual or group of individuals (Hacker, 1997). Quantitative research was conducted making use of existing research questionnaires on the psychological contract and worker engagement.

The benefit of using existing questionnaires is that they were developed over a longer period, compared to the time allowed for a Masters in Business Administration degree. They have already been statistically analysed and tested a number of times to ensure that the questions asked do indeed capture the essence of the constructs and can meet the objectives of the survey. The overall reliability of such questionnaires and of the results is therefore higher.

4.2 Unit of analysis

The data for the quantitative study were collected by means of a structured questionnaire (refer to Annexure A). A correlation analysis was then conducted on the data to determine if there was any correlation between the elements of the psychological contract and the level of worker engagement.

4.3 Population of relevance

The population of relevance was all individuals functioning in the engineering profession. This excluded administrative personnel that are not directly involved in the engineering process.

The unit of analysis was therefore individual engineers. This group was then divided into the levels within which the individuals function. The four organisational levels investigated were junior engineers, senior engineers, middle management and senior management. All of these units were from within the consulting and project-driven engineering environment.

4.4 Sampling method and size

The population was all engineering personnel operating in the consulting or project-driven engineering environment. The sample was a convenience sample of 85 respondents geographically limited to engineering companies in Pretoria (Gauteng, South Africa). Probability sampling was therefore applied, so that every member of the sample had a known probability of being selected. The data presented can therefore not be generalised to all engineers.

4.5 Data collection process

A structured questionnaire was used for data collection. Two existing questionnaires were used. The first was the Utrecht Worker Engagement Scale, better known as the Work & Well-being Survey (UWES), developed by Schaufeli and Bakker (2008). The second was the Psychological Contract Inventory or PCI (Rousseau, 2008). The two

questionnaires were selected to move towards finding conclusive answers for the research questions.

A data collection process must be undertaken in a safe environment that will not infringe on ethical requirements and must be credible, fair and tactical (Srnka & Koeszegi, 2007). The following steps were taken to ensure the ethical protection of the confidentiality of respondents' replies:

- the questionnaires were completed in a printed format;
- the completed questionnaire was placed in an envelope (supplied by the researcher) and sealed by the respondent – this ensures confidentiality and ensures that there is no feedback to the company about individual responses;
- the envelopes were then collected in a random order by third party assistants;
- the respondents were requested not to mark or include their names or any other means of identification on the questionnaire or envelope; this was a direct attempt to keep the respondents anonymous;
- the data was imported into a spreadsheet, but if any identification was visible on any page of the questionnaire or envelope, the data was not considered;
- feedback was provided in aggregate format and not on an individual basis;
- there is a consent statement on the front page of the questionnaire; and
- respondents were assured that the data will be stored in a physical and electronic format in a secure location for ten years. No names or any means of identification were recorded, therefore the stored data is completely anonymous.

4.6 Questionnaire

The questionnaire endeavoured to determine the influence of the relational, co-orientation and transactional factors of the engineers' psychological contract and any consequent influences on worker engagement. The questions also investigated how the psychological contract influences the level of worker engagement. It combined the PCI and the UWES (which are discussed in detail in Chapter 2).

The Psychological Contract Inventory or PCI (Rousseau, 2008) evaluated each respondent's psychological contract in respect of his/her current employer by focusing on employee obligations, employer obligations, psychological contract transactions and psychological contract fulfilment.

The Utrecht Worker Engagement Scale or UWES (Schaufeli & Bakker, 2008) tested each respondent's worker engagement by focusing on the respondent's vigour, dedication and absorption.

The following biographical information was also obtained (without any indication of the person's identity):

- the total number of years experience the engineer has;
- the duration of employment at the current employer; and
- level within the organisation the engineer is functioning in at the moment.

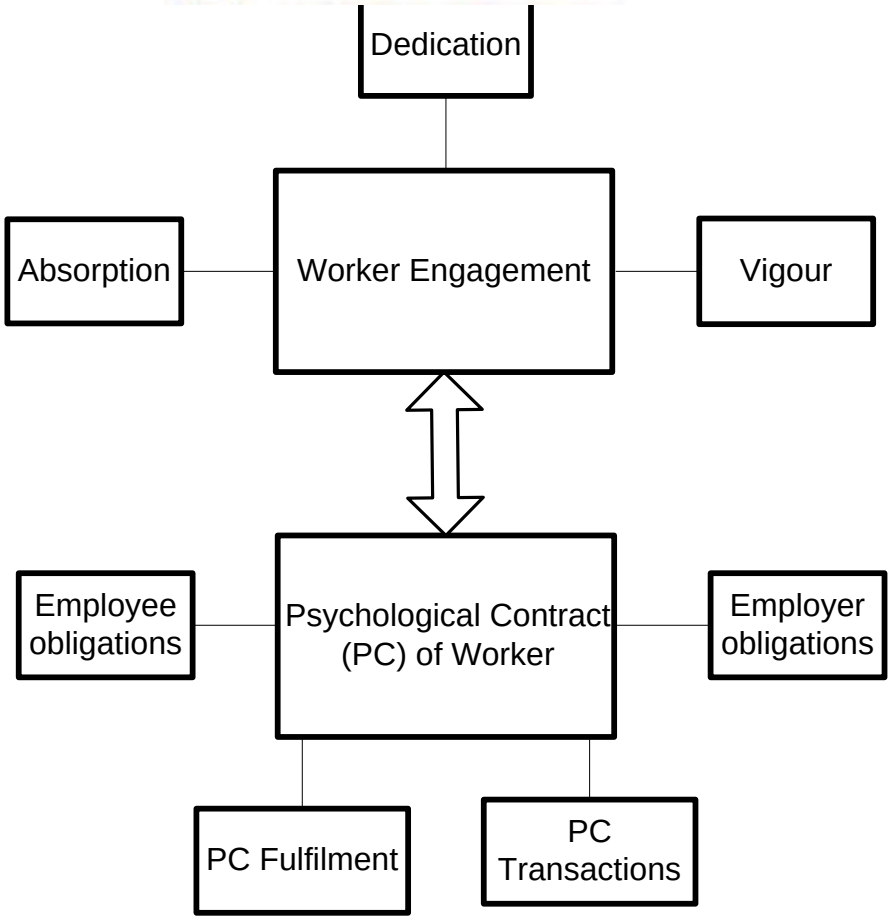

Figure 3: Influences and aspects tested by the questionnaire

4.7 Data analysis approach

The data was analysed to see whether or not there is a correlation between the psychological contract and the worker engagement of engineers. Correlation tests were done between the different elements of the psychological contract and worker engagement. The results indicated which of the constructs of the two theory bases correlated and whether or not there is significant evidence that the psychological contract can be used to assess and influence the worker engagement.

A T-test was used to compare the means of the employee and employer obligations from the perspective of the respondent or employee.

Analysis of variance (ANOVA) was also conducted to test the propositions. The analyses indicated whether or not there was a significant difference in the three groupings of Questions 89, 90, and 91 (Biographical data). These were independent variables. Vigour, dedication and absorption were the dependent variables. If there was a statistically significant difference, Duncan grouping was used to identify which response of the independent variable tested the highest for the dependent variable.

4.8 Potential research limitations

The research might be limited by the fact that the researcher is also an engineer. To overcome this potential source of bias, existing questionnaires were selected to ensure that the research conducted was as neutral as possible and that the preconceived ideas and opinions of the researcher would not influence the results or the questions asked. The research process was supervised by a psychologist to guarantee even more objectivity.

The engineers that were tested came only from the project environment and were geographically limited to Pretoria, Gauteng, for the sake of convenience and to limit costs.

Chapter 5: Results

5.1 Legend

The legend represents the link between the questionnaire and the calculated statistical data.

The letter q is followed by a numerical value, for example, q20 represents Question 20 in the sorted questionnaire. The questionnaire is available in Annexure A.

Worker Engagement
Vigour vi=mean (q1,q4,q8,q12,q15,q17)
Dedication de=mean (q2,q5,q7,q10,q13)
Absorption ab=mean (q3,q6,q9,q11,q14,q16)

Table 2: Worker engagement legend

Psychological Contract

Employee Obligations	
ee1= mean(q18-q21)	Short-term
ee2= mean(q22-q25)	Loyalty
ee3= mean(q26-q29)	Narrow
ee4= mean(q30-q33)	Performance support
ee5= mean(q34-q37)	Development
ee6= mean(q38-q41)	External marketability
ee7= mean(q42-q45)	Stability

Employer Obligations	
er1= mean(q46-q49)	Short-term
er2= mean(q50-q53)	Loyalty
er3= mean(q54-q57)	Narrow
er4= mean(q58-q61)	Performance support
er5= mean(q62-q65)	Development
er6= mean(q66-q69)	External marketability
er7= mean(q70-q73)	Stability

Psychological Contract Transitions	
pt1= mean(q74-q77)	No trust
pt2= mean(q78-q80)	Uncertainty
pt3= mean(q81-q84)	Erosion

Psychological Contract Fulfilment	
pf1= mean(q85-q86)	Employee fulfilment
pf2= mean(q87-q88)	Employer fulfilment

Table 3: Psychological contract legend

5.2 Sample description

A total of 72 usable responses were collected out of a sample of 85 engineers and technicians, a high response rate of 84.7%. The sample consists of engineers and

technicians functioning in a project-driven engineering environment, geographically limited to Pretoria, Gauteng. Of the 72 respondents, 30 were junior engineers, 15 were senior engineers, 8 were from middle management and 19 were senior managers. The experience levels of the group were predominantly 4 to 8 years or more than 16 years experience in the engineering field.

5.3 Basic statistics

The basic statistics section represents the mean, mode, median and standard deviation for each of the constructs tested for worker engagement, psychological contract and the biographical data.

The biographical data reveals information about the sample tested. The three areas about which information was gathered were the engineers' tenure, experience and organisational level. Table 4 illustrates the mean, median and mode of the biographical data.

Basic Statistics: Biographical Data

Variable	N	Mean	Median	Mode	Std Dev
Years experience	72	3.180556	3	5	1.5594
Years at current employer	72	3.625	4	5	1.495886
Level in organisation	72	2.222222	2	1	1.247219

Table 4: Basic statistics – biographical data

The basic statistics for the psychological contract were calculated using the variables set out in Table 3. This data is solely for the tested constructs and no combinations or correlations were done prior to the basic processing of the data.

Table 5 presents a summary of the basic statistics of the results as recorded for the psychological contract.

Basic Statistics: Psychological Contract

Variable	N	Mean	Median	Mode	Std Dev	Sum	Minimum	Maximum
ee1	72	3.10417	3	4	0.49602	223.5	2	4.25
ee2	72	3.69097	4	4	0.75584	265.75	1.75	5
ee3	72	2.91782	3	1	0.65877	210.0833	1	4.5
ee4	72	3.375	4	4	0.80928	243	1	5
ee5	72	2.78472	3	1	0.58488	200.5	1.25	4
ee6	72	3.74653	4	4	0.66673	269.75	2.25	5
ee7	72	2.60417	3	1	0.68014	187.5	1.25	4
er1	72	2.94444	3	3	0.51084	212	1.25	4.25
er2	72	2.81944	3	3	0.74022	203	1	5
er3	72	3.33333	3	4	0.70336	240	2	5
er4	72	3.02778	3	3	0.74062	218	1	4.75
er5	72	2.81597	3	3	0.5676	202.75	1.5	4.25
er6	72	2.76736	3	1	0.58491	199.25	1	4
er7	72	3.14931	3	4	0.86771	226.75	1.5	5
pt1	72	2.125	2	2	0.82436	153	1	4.5
pt2	72	2.04167	2	2	0.82211	147	1	5
pt3	72	2.02778	2	1	0.85225	146	1	5
pf1	72	4.21528	4	4	0.59827	303.5	3	5
pf2	72	4.02778	4	4	0.83872	290	1	5

Table 5: Basic statistics – psychological contract

The basic statistics for worker engagement were calculated using the variables set out in Table 2. This data is solely for the tested constructs and no combinations or correlations were done prior to the basic processing of the data.

Table 6 presents a summary of the basic statistics of the results as recorded for worker engagement.

Basic Statistics: Worker Engagement

Variable	N	Mean	Median	Mode	Std Dev	Sum	Minimum	Maximum
Vi	72	4.31481	5	5	0.8182	310.6667	2.33333	6
De	72	4.54167	5	5	1.04352	327	0.2	6
Ab	72	4.37731	5	5	0.81793	315.1667	2.33333	6

Table 6: Basic statistics – worker engagement

5.3 Correlation testing: Psychological contract and worker engagement

This section looks at the correlation between the constructs of worker engagement and the psychological contract in order to answer the following research questions:

- Is there a link between the psychological contract and the worker engagement of engineers?
- How do employers use the elements affecting the psychological contract to ensure that engineers are engaged in their work?

Correlation tests were performed between all the constructs of the psychological contract and worker engagement. These results are presented in Table 6.

The shaded results are statistically significant at a 5% confidence level.

Correlation between worker engagement and the psychological contract

Pearson Correlation Coefficients, N = 72

Prob > |r| under H0: Rho=0

Alpha = 5% Significance level

		vi	de	ab			vi	de	Ab
ee1	c	0.18123	0.05272	0.15055	er4	c	0.24394	0.24724	0.19171
	sl	0.1276	0.6601	0.2068		sl	0.0389	0.0363	0.1067
ee2	c	0.36071	0.22236	0.31467	er5	c	0.08354	0.04345	-0.0316
	sl	0.0019	0.0605	0.0071		sl	0.4854	0.7171	0.792
ee3	c	0.34554	0.18757	0.25658	er6	c	0.07548	0.02591	-0.1500
	sl	0.003	0.1146	0.0296		sl	0.5286	0.8289	0.2084
ee4	c	-0.2712	-0.1580	-0.2025	er7	c	0.31475	0.27574	0.17997
	sl	0.0212	0.1849	0.0879		sl	0.0071	0.0191	0.1303
ee5	c	-0.2046	-0.0577	-0.1381	pt1	c	-0.4002	-0.4056	-0.3303
	sl	0.0846	0.6297	0.2471		sl	0.0005	0.0004	0.0046
ee6	c	0.48505	0.3813	0.32635	pt2	c	-0.2547	-0.2827	-0.2413
	sl	<.0001	0.001	0.0051		sl	0.0308	0.0161	0.0411
ee7	c	-0.2664	-0.15	-0.2298	pt3	c	-0.3729	-0.3030	-0.3250
	sl	0.0237	0.1822	0.0521		sl	0.0013	0.0097	0.0053
er1	c	0.22777	0.30297	0.03402	pf1	c	0.55254	0.45806	0.58241
	sl	0.0543	0.0097	0.7766		sl	<.0001	<.0001	<.0001
er2	c	-0.0075	0.11016	0.05401	pf2	c	0.52755	0.53293	0.50805
	sl	0.9499	0.3569	0.6523		sl	<.0001	<.0001	<.0001
er3	c	0.3168	0.19669	0.14247	c= Pearson correlation coefficient				
	sl	0.0067	0.0977	0.2325	sl = statistical significance				

Table 7: Correlation between worker engagement and the psychological contract

5.4 T-test: Employee obligations versus employer obligations

A T-test was conducted to investigate the employer obligations of the psychological contract relative to the employee obligations. This was done form the employees' point of view.

Table 8 presents the basic statistical data T-test used to test worker obligations vs. employer obligations

Basic statistics

Legend: ed1=ee1-er1

Variable	N	Lower CL Mean	Mean	Upper CL Mean	Lower CL Std Dev	Std Dev	Upper CL Std Dev	Std Err	Minimum	Maximum
ed1	72	-0.005	0.1597	0.3248	0.6035	0.7025	0.8406	0.0828	-1.25	2.75
ed2	72	0.6274	0.8715	1.1156	0.8925	1.0389	1.243	0.1224	-1.5	2.75
ed3	72	-0.608	-0.416	-0.223	0.7021	0.8172	0.9777	0.0963	-3.25	1.25
ed4	72	0.095	0.3472	0.5995	0.9223	1.0735	1.2845	0.1265	-3.75	3
ed5	72	-0.24	-0.031	0.1777	0.7638	0.889	1.0638	0.1048	-2.5	2.5
ed6	72	0.8068	0.9792	1.1516	0.6303	0.7337	0.8779	0.0865	-0.5	3.25
ed7	72	-0.848	-0.545	-0.242	1.1066	1.288	1.5412	0.1518	-3	2.25

Table 8: Basic statistics – T-test used to test the worker obligations vs employer obligations

The T-test investigated whether the employees or employers are performing better from the viewpoint of the respondents (the employees). The shaded values in Table 9 indicate that the results are statistically significant at a 5% level.

T-Tests

Variable	DF	t Value	Pr > |t|
ed1	71	1.93	0.0577
ed2	71	7.12	<.0001
ed3	71	-4.31	<.0001
ed4	71	2.74	0.0077
ed5	71	-0.3	0.7664
ed6	71	11.32	<.0001
ed7	71	-3.59	0.0006

Table 9: T-test results: Worker obligations vs employer obligations

5.5 ANOVAs

ANOVAs were used to compare the averages of selected constructs (dependent variables) of the psychological contract and worker engagement with the biographical data. Only the results that returned statistically significant results were included. The balance of the results is available in Annexure B.

Tables 10 to 18 (below) contain two sections. The first section is the ANOVA used to investigate whether or not there were any significant differences between the results obtained regarding the dependent variable and the independent variable. The second section contains the Duncan multiple range tests used to investigate which of the responses on the independent variable was the most different from the rest.

Table 10 presents the results of the ANOVA comparing vigour and years of experience.

ANOVA: The generalised linear method

Dependent Variable: vi					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	4.30996773	2.1549839	3.44	0.0377
Error	69	43.2208965	0.6263898		
Corrected Total	71	47.5308642			

R-Square	Coeff Var	Root MSE	vi Mean
0.090677	18.34257	0.791448	4.314815

Source	DF	Type III SS	Mean Square	F Value	Pr > F
q89	2	4.30996773	2.1549839	3.44	0.0377

Duncan's multiple range test for vi

Alpha	Error Degrees of Freedom	Error Mean Square	Harmonic Mean of Cell Sizes
0.05	69	0.62639	21.63934

Number of Means	2	3
Critical Range	0.48	0.505

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	q89
A	4.6597	24	5
B	4.1778	15	3-4
B	4.1263	33	1-2

Table 10: ANOVA and Duncan multiple range test – vigour compared to years of experience

In Table 11, dedication is analysed relative to years of experience.

ANOVA: The generalised linear method

Dependent Variable: de					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	3.76418182	1.882091	1.77	0.1787
Error	69	73.5508182	1.065954		
Corrected Total	71	77.315			

R-Square	Coeff Var	Root MSE	de Mean
0.048686	22.73285	1.03245	4.541667

Source	DF	Type III SS	Mean Square	F Value	Pr > F
q89	2	3.76418182	1.882091	1.77	0.1787

Duncan's multiple range test for de

Alpha	Error Degrees of Freedom	Error Mean Square	Harmonic Mean of Cell Sizes
0.05	69	1.065954	21.63934

Number of Means	2	3
Critical Range	0.6262	0.6588

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	q89
A	4.8417	24	5
A	4.5467	15	3-4
A	4.3212	33	1-2

Table 11: ANOVA and Duncan multiple range test – dedication compared to years of experience

The results of the last test, with years of experience as an independent variable, are presented in Table 12. The dependent variable is absorption.

ANOVA: The generalised linear method

Dependent Variable: ab

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	1.64487935	0.82244	1.24	0.2964
Error	69	45.8547349	0.664561		
Corrected Total	71	47.4996142			

R-Square	Coeff Var	Root MSE	ab Mean
0.034629	18.62343	0.815206	4.377315

Source	DF	Type III SS	Mean Square	F Value	Pr > F
q89	2	1.64487935	0.82244	1.24	0.2964

Duncan's multiple range test for ab

Alpha	Error Degrees of Freedom	Error Mean Square	Harmonic Mean of Cell Sizes
0.05	69	0.664561	21.63934

Number of Means	2	3
Critical Range	0.4944	0.5202

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	q89
A	4.5764	24	5
A	4.3778	15	3-4
A	4.2323	33	1-2

Table 12: ANOVA and Duncan multiple range test – absorption compared to years of experience

ANOVA: The generalised linear method

Dependent Variable: vi

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	4.775651	2.387826	3.85	0.0259
Error	69	42.75521	0.619641		
Corrected Total	71	47.53086			

R-Square	Coeff Var	Root MSE	vi Mean
0.100475	18.24349	0.787173	4.314815

Source	DF	Type III SS	Mean Square	F Value	Pr > F
q90	2	4.775651	2.387826	3.85	0.0259

Duncan's multiple range test for vi

Alpha	Error Degrees of Freedom	Error Mean Square	Harmonic Mean of Cell Sizes
0.05	69	0.619641	22.08247

Number of Means	2	3
Critical Range	0.4726	0.4972

Means with the same letter are not significantly different.

Duncan Grouping		Mean	N	q90
	A	4.5784	34	5
B	A	4.1587	21	1-2
B		3.9804	17	3-4

Table 13: ANOVA and Duncan multiple range test – vigour compared to years employed at current employer

Tables 14 and 15 contain the ANOVA results for dedication and absorption, with Question 90 (years employed with current employer) as the independent variable.

ANOVA: The generalised linear method

Dependent Variable: de

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	6.263964	3.131982	3.04	0.0542
Error	69	71.05104	1.029725		
Corrected Total	71	77.315			

R-Square	Coeff Var	Root MSE	de Mean
0.081019	22.3432	1.014754	4.541667

Source	DF	Type III SS	Mean Square	F Value	Pr > F
q90	2	6.263964	3.131982	3.04	0.0542

Duncan's multiple range test for de

Alpha	Error Degrees of Freedom	Error Mean Square	Harmonic Mean of Cell Sizes
0.05	69	1.029725	22.08247

Number of Means	2	3
Critical Range	0.6093	0.641

Means with the same letter are not significantly different.

Duncan Grouping		Mean	N	q90
	A	4.7588	34	5
B	A	4.6095	21	1-2
B		4.0235	17	3-4

Table 14: ANOVA and Duncan multiple range test – dedication compared to years employed with current employer

ANOVA: The generalised linear method

Dependent Variable: ab

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	3.048906	1.524453	2.37	0.1014
Error	69	44.45071	0.644213		
Corrected Total	71	47.49961			

R-Square	Coeff Var	Root MSE	ab Mean
0.064188	18.3361	0.802629	4.377315

Source	DF	Type III SS	Mean Square	F Value	Pr > F
q90	2	3.048906	1.524453	2.37	0.1014

Duncan's multiple range test for ab

Alpha	Error Degrees of Freedom	Error Mean Square	Harmonic Mean of Cell Sizes
0.05	69	0.644213	22.08247

Number of Means	2	3
Critical Range	0.4819	0.507

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	q90
A	4.5833	34	5
A	4.2941	17	3-4
A	4.1111	21	1-2

Table 15: ANOVA and Duncan multiple range test – absorption compared to years employed with current employer

Tables 16, 17 and 18 (below) present the ANOVA results comparing all three constructs of worker engagement and the level of the respondent in the organisation.

ANOVA: The generalised linear method

Dependent Variable: vi

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	6.52510288	3.262551	5.49	0.0061
Error	69	41.00576132	0.594286		
Corrected Total	71	47.5308642			

R-Square	Coeff Var	Root MSE	ab Mean
0.137281	17.86635	0.7709	4.314815

Source	DF	Type III SS	Mean Square	F Value	Pr > F
qq91	2	6.52510288	3.262551	5.49	0.0061

Duncan's multiple range test for avi

Alpha	Error Degrees of Freedom	Error Mean Square	Harmonic Mean of Cell Sizes
0.05	69	0.5943	21.892

Number of Means	2	3
Critical Range	0.4649	0.4891

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	qq91
A	4.6914	27	3-4
B	4.2222	15	2
B	4.0222	30	1

Table 16: ANOVA and Duncan multiple range test – vigour compared to the current level in the organisation

ANOVA: The generalised linear method

Dependent Variable: de

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	2.77692593	1.388463	1.29	0.2831
Error	69	74.5380741	1.080262		
Corrected Total	71	77.315			

R-Square	Coeff Var	Root MSE	de Mean
0.035917	22.88491	1.039357	4.541667

Source	DF	Type III SS	Mean Square	F Value	Pr > F
q91	2	2.77692593	1.388463	1.29	0.2831

Duncan's multiple range test for de

Alpha	Error Degrees of Freedom	Error Mean Square	Harmonic Mean of Cell Sizes
0.05	69	1.080262	21.89189

Number of Means	2	3
Critical Range	0.6267	0.6594

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	q91
A	4.7852	27	3-4
A	4.4933	15	2
A	4.3467	30	1

Table 17: ANOVA and Duncan multiple range test – dedication compared to the current level in the organisation

ANOVA: The generalised linear method

Dependent Variable: ab

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	3.35588992	1.677945	2.62	0.0798
Error	69	44.14372428	0.639764		
Corrected Total	71	47.4996142			

R-Square	Coeff Var	Root MSE	ab Mean
0.070651	18.27268	0.799853	4.377315

Source	DF	Type III SS	Mean Square	F Value	Pr > F
q91	2	3.35588992	1.677945	2.62	0.0798

Duncan's multiple range test for ab

Alpha	Error Degrees of Freedom	Error Mean Square	Harmonic Mean of Cell Sizes
0.05	69	0.639764	21.89189

Number of Means	2	3
Critical Range	0.4823	0.5074

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	q91
A	4.6358	27	3-4
A	4.3667	15	2
A	4.15	30	1

Table 18: ANOVA and Duncan multiple range test – absorption compared to the current level in the organisation

The results are discussed and interpreted in the next chapter.

Chapter 6: Discussion of results

6.1 Introduction

In this chapter, the results presented in Chapter 5 are discussed relative to the research questions and propositions. The biographical data of the sample are discussed first, followed by a discussion of the correlation test between the constructs of the psychological contract and worker engagement. This is followed by the discussion of the results of the T-tests, which investigated the employee obligations relative to the employer obligations from the employee's perspective. The results received from the ANOVAs are then discussed, along with the Duncan groupings used to identify which of the selections of the biographical data options tested the highest for the constructs of worker engagement.

6.2 Biographical data

A total of 72 usable responses were collected out of a sample of 85 engineers and technicians. This represents a response rate of 84.7%.

The study was also concerned with the total amount of experience in years each respondent had, as well as the total number of years he/she had been employed with the employer at the time of the study.

The data was collected in an organisation and from employees of some of its close alliance partners.

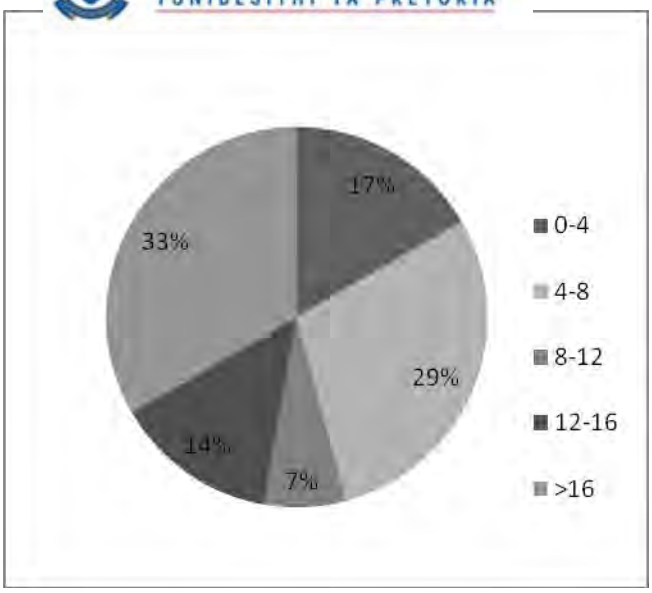

Figure 4: Years of experience

Most of the respondents had four to eight years of experience or more than 16 years of experience. From Figure 4 it is evident that the larger of the two groups is the respondents with 16 years of experience and more; they represent 33% of the surveyed group or 24 of the 72 respondents.

The engineers with between four and eight years of experience represent 29% (21 out of 72) of the group. The fact that 12 of the respondents, 17% of the group, had less than four years experience indicates that there is a strong stream of young talent that will be under the supervision of the more experienced engineers. This can result in good skills transfer.

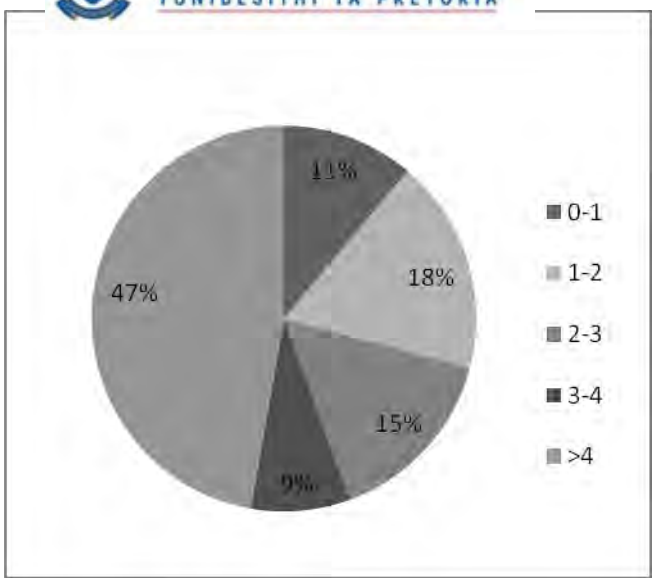

Figure 5: Consecutive years with current employer

Figure 5 indicates the number of years the surveyed engineers have been working for the organisations where they are currently employed. Almost half (47%) of the employees have been employed for more than four years. It must be borne in mind that four years is not a long time. In fact, more than half of the engineers surveyed have been working for their respective organisations for less than four years. The engineering profession is known for its high levels of employee churn or turnover and this general impression was confirmed by this study.

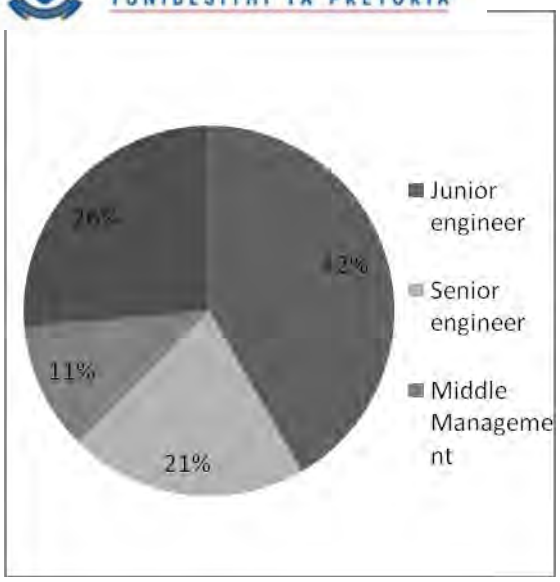

Figure 6: Level in organisation

A total of 30 (42%) of the surveyed engineers were still at a junior engineering level, with 21% at a senior engineer level and 26% in senior management positions. The balance of the respondents was in middle management. The high percentage of respondents in the junior level is not surprising, considering the fact that more than half of the engineers surveyed have been working for their respective organisations for less than four years (see Figure 7).

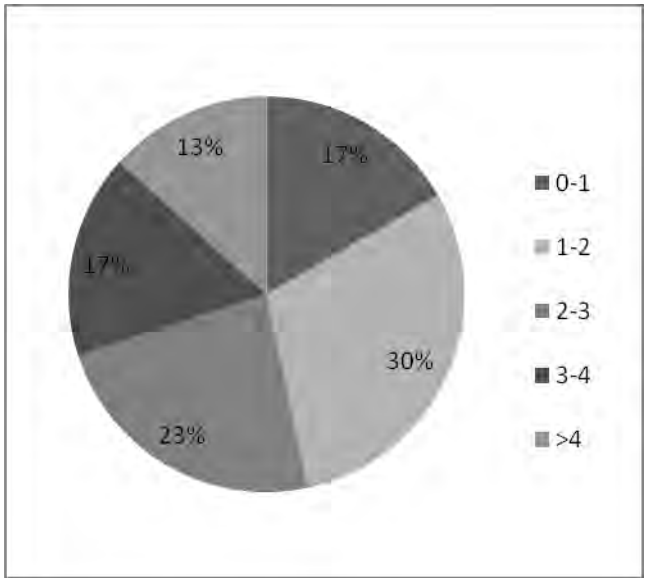

Figure 7: Junior engineers – consecutive years with current employer

The tenure of the junior engineers is spread over the tested year increments with the majority working between one and two years for the organisation. This group of nine represents 30% of the junior engineers.

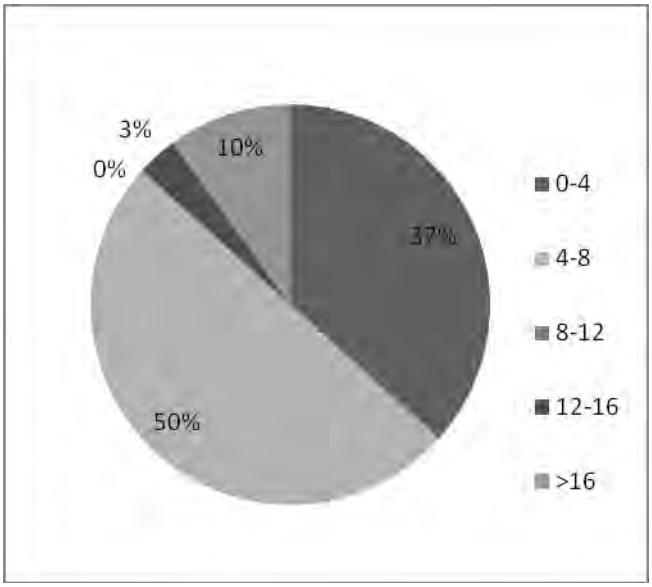

Figure 8: Junior engineers – years of experience

The experience spread of the junior engineers revealed interesting results. A total of 15 (50%) have between four and eight years experience in the engineering profession and 37% are new graduates with up to four years experience.

Another interesting observation is the 10% of individuals occupying junior positions with more than 16 years experience.

6.3 The psychological contract and worker engagement

This section investigates the correlation between the different constructs of the psychological contract and worker engagement. Table 7 (chapter 5) presents these correlation values, as well as the statistical significance of each result.

The results as obtained from the basic statistics of the psychological contract as presented in Table 5 (chapter 5)are then discussed. These data were obtained using the PCI. Next, the results collected using the UWES questionnaire are discussed. These results are presented in Table 6 (chapter 5).

6.3.1 Correlation between the psychological contract and worker engagement

The correlation between the psychological contract and worker engagement for engineers was tested by calculating Pearson correlation coefficients between all the constructs of the two groups. The results are presented in a matrix format in Table 7 (chapter 5). The rows are the constructs of the psychological contract and the columns represent the three constructs of worker engagement.

The subsections that follow investigate these correlations in respect of employee obligation, employer obligation, psychological contract transitions and psychological contract fulfilment.

6.3.1.1 Employee obligations

Vigour displayed the most statistically significant correlations with employee obligations (see Table 7, chapter 5). A total of five out of seven correlations were statistically significant. Absorption had four positive correlations and dedication only one.

Table 19 presents the correlation between employee obligations and worker engagement. The shaded blocks indicate results that are significant at a 5% level.

Correlation between employee obligations and worker engagement

Pearson Correlation Coefficients, N = 72
Prob > |r| under H0: Rho=0 Alpha = 5% Significance level

		vi	de	Ab
Short term (ee1)	C	0.18123	0.05272	0.15055
	sl	0.1276	0.6601	0.2068
Loyalty (ee2)	C	0.36071	0.22236	0.31467
	sl	0.0019	0.0605	0.0071
Narrow (ee3)	C	0.34554	0.18757	0.25658
	sl	0.003	0.1146	0.0296
Performance support (ee4)	C	-0.2712	-0.15802	-0.20258
	sl	0.0212	0.1849	0.0879
Development (ee5)	C	-0.2046	-0.05779	-0.13818
	sl	0.0846	0.6297	0.2471
External marketability (ee6)	C	0.48505	0.3813	0.32635
	sl	<.0001	0.001	0.0051
Stability (ee7)	C	-0.2664	-0.159	-0.22988
	sl	0.0237	0.1822	0.0521

c= Pearson correlation coefficient
sl = statistical significance

Table 19: Correlation between employee obligations and worker engagement

Vigour correlated significantly with loyalty, narrow employee obligations, performance support, external marketability and stability. Vigour is characterised by high levels of energy and a willingness to do more (Schaufeli *et al*., 2002). Dedication only correlated statistically significantly with external marketability.

Vigour and absorption are the two worker engagement constructs that can be influenced by altering the organisational strategy, specifically with narrow employee obligations. It can therefore be concluded that the short-term commitments of the employees, in terms of how long they feel they are obligated to remain with the organisation, cannot be altered to ensure worker engagement.

The Pearson correlation coefficients for stability tested negative. The questions were phrased positively and tested whether the respondents planned to remain employed by the company for a long time. From the results, one has to conclude that even if an engineer is engaged in his/her work, this does not mean that he/she will stay with the company for a long time.

Absorption correlated statistically significantly with loyalty, narrow employee obligations, external marketability and stability. Absorption is the ability of the worker to become immersed in his/her work (Schaufeli & Bakker, 2003) and is closely related to vigour. This means that vigour and absorption can be predicted or influenced by changing loyalty, narrow employee obligations and external marketability.

6.3.1.2 Employer obligations

Employer obligations correlate least with the constructs of worker engagement. In total, there were only six statistically significant correlations out of a possible 21. There were no statistically significant correlations with absorption at all. Vigour had the most correlations, short-term, narrow, performance support and stability. Dedication only correlated at a statistically significant level with two constructs, namely performance support and stability. Table 20 is a summary of all the correlations and their respective statistically significant levels.

Absorption tested positively high in the worker engagement construct. However, according to the correlation results, this was not influenced by any of the constructs of the psychological contract.

Table 20 presents the correlation between employer obligations and worker engagement. The shaded blocks indicate results that are significant at a 5% level.

Correlation between employer obligations and worker engagement

Pearson Correlation Coefficients, N = 72
Prob > |r| under H0: Rho=0 Alpha = 5% Significance level

		vi	de	Ab
Short-term (er1)	C	0.22777	0.30297	0.03402
	sl	0.0543	0.0097	0.7766
Loyalty (er2)	C	-0.0075	0.11016	0.05401
	sl	0.9499	0.3569	0.6523
Narrow (er3)	C	0.3168	0.19669	0.14247
	sl	0.0067	0.0977	0.2325
Performance support (er4)	C	0.24394	0.24724	0.19171
	sl	0.0389	0.0363	0.1067
Development (er5)	C	0.08354	0.04345	-0.0316
	sl	0.4854	0.7171	0.792
External marketability (er6)	C	0.07548	0.02591	-0.1500
	sl	0.5286	0.8289	0.2084
Stability (er7)	C	0.31475	0.27574	0.17997
	sl	0.0071	0.0191	0.1303

c= Pearson correlation coefficient
sl = statistical significance

Table 20: Correlation between employer obligations and worker engagement

6.3.1.3 Psychological contract transitions

All the constructs of worker engagement correlated statistically significantly with the elements of the psychological contract transitions.

Table 21 is a summary of all the correlations and their respective statistically significant levels. The shaded blocks indicate results that are significant at a 5% level.

Correlation between psychological contract transitions and worker engagement

Pearson Correlation Coefficients, N = 72
Prob > |r| under H0: Rho=0 Alpha = 5% Significance level

		vi	de	ab
No trust (pt1)	C	-0.40023	-0.40563	-0.3303
	sl	0.0005	0.0004	0.0046
Uncertainty (pt2)	C	-0.25476	-0.28279	-0.2413
	sl	0.0308	0.0161	0.0411
Erosion (pt3)	C	-0.37292	-0.30301	-0.3250
	sl	0.0013	0.0097	0.0053

c= Pearson correlation coefficient
sl = statistical significance

Table 21: Correlation between psychological contract transitions and worker engagement

All the correlations are significant at a 5% level and negative. The questions (see the questionnaire in Annexure A, Questions 74 to 84) were asked negatively, which means that a negative correlation implies a positive result for the organisation. This indicates that there is a good relationship between worker engagement and the psychological transitions. Psychological contract transitions relate to the experienced levels of mistrust, uncertainty and erosion in a business (Rousseau, 2000). Worker engagement is therefore positively affected when information is shared with the employees, when trust is invested in the workers and when workers are consulted when changes are made.

The workers will also be more engaged in their work when there is a career path for the workers, and when the commitment of the employer is clearly communicated to the employees to avoid uncertainty. Realistic demands and benefits that meet the expectations of the employer also have a positive influence on the engagement levels of the engineers in their work.

6.3.1.4 Psychological contract fulfilment

All the constructs of worker engagement correlated statistically significantly with the elements of the psychological contract transitions. Table 22 is a summary of all the correlations and their respective statistically significant levels.

Correlation between psychological contract fulfilment and worker engagement

Pearson Correlation Coefficients, N = 72
Prob > |r| under H0: Rho=0 Alpha = 5% Significance level

		vi	de	ab
Employee fulfilment (pf1)	C	0.55254	0.45806	0.58241
	Sl	<.0001	<.0001	<.0001
Employer fulfilment (pf2)	C	0.52755	0.53293	0.50805
	Sl	<.0001	<.0001	<.0001

c= Pearson correlation coefficient
sl = statistical significance

Table 22: Correlation between psychological contract fulfilment and worker engagement

From the data, it can be concluded that a positive worker engagement is established when an employee feels that the employer is fulfilling its commitments and meeting

the promises made to the employee. The employee is also fulfilling commitments and living up to the promises he/she made to the employer.

6.3.2 Psychological contract

The results obtained from the basic statistical analysis done for the psychological contract as presented in Table 5 (chapter 5) are discussed under the four main headings of 'Employee obligations', 'Employer obligations', 'Psychological contract transitions' and 'Psychological contract fulfilment'.

6.3.2.1 Employee obligations

Short-term employee obligations (ee1) had a mean of 3.10417 and a mode of four. The standard deviation for this result is 0.49602. It is therefore concluded that the respondents would 'somewhat' to 'moderately' consider quitting whenever they feel that they have no further obligations towards their current employer. They would also consider leaving the organisation at any time and do not feel obligated to remain with the company which currently employs them.

The loyalty (ee2) of the tested engineers is more positive. They are willing to make personal sacrifices, take the organisation's concerns positively and protect the image of the organisation. Loyalty had a mean of 3.69097 with a standard deviation of 0.75584 and a mode of four on a scale of one to five.

Narrow employee obligations (ee3) returned conflicting results. The mean was 2.91782, with a standard deviation of 0.65877 and a mode of 1. Table 23 indicates the frequency of responses selected by the sample for each of the questions (Questions 26 to 29 of the questionnaire).

Frequency Table ee3

	q26	q27	q28	q29
1	14	15	2	42
2	19	9	9	16
3	14	11	12	6
4	17	19	24	4
5	8	18	25	4
Test	72	72	72	72

Table 23: Frequency table for narrow employee obligations (ee3)

The results can therefore be interpreted as implying that the group of engineers were on average indifferent with regard to performing only required tasks, and doing only what they are paid to do. They 'moderately' to 'to a great extent' only fulfil a limited number of responsibilities. They also indicated that they do 'not at all' perform only specific duties as agreed upon during the hiring process.

The performance support (ee4) of the sample returned a mean of 3.375 with a standard deviation of 0.80928. The mode and median are both 4. The respondents are therefore motivated to take on challenging tasks and adjust to the changing performance demands of the organisation. They also accept new and different performance demands.

The option that the respondents selected most frequently for development (ee5) was the first option ('not at all'). This indicates that the respondents do not seek out opportunities to make themselves more valuable to the organisation. The mean was 2.78472, the standard deviation was 0.58488, with a mode of 1.

The external marketability (ee6) from an employee obligation point of view tested high: the mean was 3.74653, with a standard deviation of 0.66673. The mode and median were both 4. The respondents were therefore focused on building their external marketability and contacts to enhance their career potential. They want to be visible to external companies and are seeking out assignments to expose themselves to potential future employers.

Employee stability (ee7) was not so positive, with a mean of 2.60417 and a mode of 1. The respondents reported that they do not plan to remain with the organisation for a long time.

6.3.2.2 Employer obligations

The PCI tested the employer obligations from the employees' or respondents' point of view. They were asked to consider their relationship with their current employer.

On short-term obligations (er1) by the employer, the responses indicated that the employees perceived that the commitment made to secure a job for them in the short term was only average, on a scale of one to five. The mean was 2.94444 and the mode was 3.

The same sentiment was observed for loyalty (er2). The respondents did not feel that their employers were meeting their obligations (they marked 'not at all' or 'to a great extent') showing that they believe that their employers are concerned for their employees' personal lives or making decisions with the employees in mind. The statistical results were a mean of 2.81944, with a standard deviation of 0.74022. The mode was 3.

The results for narrow employer obligations (er3) tested a bit higher; the mean was 3.333333, with a standard deviation of 0.70336. The mode was 4. This indicates that the engineers sampled felt that their organisations were only concerned with developing their skills and abilities with the benefit of the organisation in mind.

The sample also tested neutral with regard to the performance support (er4) and development (er5) from the employer. The mean of 3.02778 with a standard deviation of 0.74062 and a mode of 3 for er4, and the mean of 2.81 with a standard deviation of 0.5676 with a mode of 3 for er5, confirm that the respondents feel 'somewhat' that the organisation is motivating them to achieve higher levels of performance but that there are only average advancement and promotion opportunities within the organisation.

The sample reported that the organisations' commitment to exposing them to external companies for career advancement (er6) is below average. The mean was 2.76736, with a standard deviation of 0.58491 and a mode of 1.

The responses on the organisations' meeting their obligations on work stability provided by the employers to the employees were slightly more positive. The mean of 3.14931, with a standard deviation of 0.86771 and a mode of 4, confirms that the sample felt that there is moderately secure employment, with stable benefits.

6.3.2.3 Psychological contract transitions

The relationship of the employer with its workers was tested in this section. The results for the three constructs of 'no trust', 'uncertainty' and 'erosion' returned low scores. The question was asked in a negative form, so a low score is a positive result for the employer.

The result for no trust (pt 1) was a mean of 2.125, with a standard deviation of 0.8243, and a mode of 2. It confirms that the employees felt that information is shared with them and that they are consulted when changes are made in the organisation.

Uncertainty's (pt2) mean was 2.04167, with a standard deviation of 0.82211 and a mode of 2. The engineers sampled therefore felt that their future at the organisation can be predicted and that there is certainty with regard to the employer's commitments towards its employees.

Erosion (pt3) tested the lowest. This means that the organisation is not demanding more of its workers than they are remunerated for. The mean was 2.02778, with a standard deviation of 0.85225 and a mode of 1.

6.3.2.4 Psychological contract fulfilment

The engineers sampled felt that they fulfilled their obligations (pf1) towards the employer and that the employer fulfilled its commitments (pf2) towards them. The mean for employee fulfilment was 4.21528, with a standard deviation of 0.59827. The mean for employer fulfilment was 4.02778 with a standard deviation of 0.83872. The mode for both these groups was 4.

6.3.3 Worker engagement

Worker engagement was tested using the Utrecht Work Engagement Scale (UWES). This questionnaire tested the engineers' engagement in their work using three constructs; vigour, absorption and dedication.

The results were high (as explained in Table 6). For all three constructs, the modes or most frequently selected option was 5. The means were 4.3148 (standard deviation:

0.8182), 4.54167 (standard deviation: 1.04552), and 4.37731 (standard deviation: 0.81793) for vigour, absorption and dedication respectively.

It is therefore concluded that the sample are bursting with energy at work and that they perceive the work they are doing as meaningful and challenging. They are also immersed in their work and feel that time flies when they are busy.

6.4 Employee versus employer obligations

The means of employee and employer obligations were compared from the viewpoint of the respondents or employees. The results of the T-test in Table 9 revealed that five of the seven tests were statistically significant. Of the five statistically significant results, three of the differences were positive (ed2, ed4, ed6). This indicates that from the employees' perspective, the employers are performing well in terms of loyalty, performance support and external marketability.

T-Test

Variable	t Value	Pr > |t|
ed2	7.12	<.0001
ed3	-4.31	<.0001
ed4	2.74	0.0077
ed6	11.32	<.0001
ed7	-3.59	0.0006

Table 24: T-test – significant results

The negative differences indicate that the employer is performing better in narrow obligations and stability relative to short term obligations, loyalty, performance support, development and external marketability.

6.5 Worker engagement and years of experience

This section looks at the proposition that the more experience an engineer has accumulated in the industry the more engaged he/she is in his/her work. Tables 10, 11 and 12 present the results from the ANOVAs together with the Duncan multiple range tests for vigour, dedication and absorption as the dependent variables and the responses to Question 89 (How many years experience do you have in the industry?) as the independent variable.

Summary of ANOVA and Duncan grouping results

	Independent variable Question 89		
Dependent variable	Option 5	Option 3-4	Option 1-2
vi	4.6597	4.1778	4.1263
de	4.8417	4.5467	4.3212
ab	4.5764	4.3778	4.2323

Table 25: Summary of ANOVA and Duncan grouping results – worker engagement versus experience

The only test that returned statistically significant results (Table 25) at a 5% significance level was vigour (vi). The ANOVA indicated that there is a statistically significant (0.0377) difference between the means of the results to Question 89 relative to vigour. The Duncan grouping indicates that Option 5, or 'more than 16 years experience', tested higher on vigour than the rest of the options. It can therefore be concluded that in terms of vigour engineers with more experience tend to be more engaged in their work.

6.6 Worker engagement and tenure

This section looks at the proposition that engineers are less engaged in their work the longer they are employed at a particular company. Tables 13, 14 and 15 (chapter 5) present the results for the ANOVA together with those for the Duncan multiple range tests for vigour, dedication and absorption as the dependent variables and Question 90 (How many consecutive years have you been appointed by your current employer?) as the independent variable.

Summary of ANOVA and Duncan grouping results

	Independent variable Question 90		
Dependent variable	Option 5	Option 1-2	Option 3-4
vi	4.5784	4.1587	3.9804
de	4.7588	4.6095	4.0235
ab	4.5833	4.2941	4.1111

Table 26: Summary of ANOVA and Duncan grouping results – worker engagement versus tenure

The tests that returned statistically significance results at a 5% significance level were vigour (vi) and dedication (de). The general linear method (GLM) test indicated that there are statistically significant results of 0.0259 and 0.0542 for vigour and dedication respectively. The differences among the means for the results for Question 90 are therefore statistically significant. The Duncan grouping indicates that the combination of Options 1 and 2 (between zero and two years of employment at their current employer) tested higher on both vigour and dedication than the rest of the options. It can therefore be concluded that, in terms of vigour and dedication, engineers working for two years or less at their current employer are more engaged in their work.

6.7 Worker engagement and organisational level

This section examines the proposition that the higher the management level that an engineer occupies in an organisation, the more engaged he/she is in his/her work. Table 27 presents the results of the ANOVA together with the Duncan multiple range tests for vigour, dedication and absorption as the dependent variables and the responses to Question 91 (Your current level in the organisation?) as the independent variable.

Summary of ANOVA and Duncan grouping results

	Independent variable Question 91		
Dependent variables	Option 3-4	Option 2	Option 1
vi	4.6914	4.2222	4.0222
de	4.7852	4.4933	4.3467
ab	4.6358	4.3667	4.15

Table 27: Summary of ANOVA and Duncan grouping results – worker engagement versus organisational level

The only test that returned statistically significant results (Table 26) at a 5% significance level was vigour (vi). The ANOVA indicated that there is a statistically significant (0.0061) difference between the means of the results for Question 91. The Duncan grouping indicates that the combination of Options 3 and 4 (middle and senior management) tested higher on vigour than the other Options (junior and senior engineers). It can therefore be concluded that in terms of vigour, engineers occupying middle and senior management levels are more engaged in their work.

Chapter 7: Conclusion

7.1 Summary and interpretation of results

From the results discussed in Chapter 6, this study concludes that a positive worker engagement was established when the employees in the sample felt that their employers fulfilled their commitments and met the promises made to the employee. The employees indicated that they fulfilled their commitments and lived up to the promises they made to the employer. Furthermore, the respondents reported feeling energetic at work and that the work they were doing was meaningful and challenging to them. These responses were tested by correlating the results of the psychological contract test (the PCI) with those of the worker engagement test (the UWES).

The constructs in the psychological contract that correlated with ones in the worker engagement construct added up to 31 out of a possible 57 combinations. This resulted in a hit rate of 54.38%. Unfortunately, there was not a one-to-one correlation, but a number of significant conclusions could be made with regard to the constructs that did correlate. There is therefore a relationship between the psychological contract and worker engagement if one looks at certain combinations of constructs.

Vigour had the most statistically significant correlation with employee obligations. This means that the engineers surveyed are willing to invest energy, persist under difficult circumstances and are tenacious. All of this had a positive influence on their employee obligations. In terms of the psychological contract, this means that they will make personal sacrifices and take the concerns of the organisation personally. However, there was a negative correlation with performance support and stability. The respondents did test high in terms of performance support, indicating that they are

willing to adapt to the changing requirements of the organisation, but this does not have a positive carry-over into their engagement levels. This would make sense if the organisation is constantly changing performance requirements, because the organisation can expect its engineers to take on the challenge, but such changes would not have a positive influence on worker engagement levels.

In terms of stability, it is concluded that the respondents are engaged in their work and are willing to go the extra mile, but the responses show that they are not committed to remaining with their current employer for a long time. This 'culture' is fuelling the 'brain drain' as discussed in Chapter 1.

There was a full one-to-one correlation between the external marketability of employee obligations and worker engagement. The respondents are therefore concerned with making contact with external companies to explore potential future employment opportunities. They want to be visible to external companies and are seeking out assignments to expose themselves to future employers. This has a positive influence on their worker engagement – if they feel that the company assists them in this matter, they will be more dedicated in their work. This finding runs counter to the normal company culture, as companies usually want to develop company-specific skills as a retention strategy. The respondents confirmed that there is a drive by their employers to train them to obtain company specific skills. This situation is difficult to address, because the study confirmed that the respondents are open to offers from other employers, counteracting the attempts to retain skills in companies and in the country.

The fact that the respondents indicated that they do not plan to remain with a company for a long time ties up with this need to be developed to become more

attractive resources for other employers. They also reported that they would consider leaving the organisation at any time and do not feel obligated to remain with the company. There was no significant correlation with development. This indicates that the group is not seeking out opportunities to make them more valuable to the organisation.

Employer obligations had the least correlation with the constructs of worker engagement. There was no statistically significant correlation with absorption at all. In total, there were only six statistically significant correlations out of a possible 21. Vigour had the most, with a total of four; and dedication only had two statistically significant correlations. Development and external marketability by the employer did not contribute to the positive engagement of the sample.

The organisational commitment to exposing employees to external companies for career advancement was below average, which indicates that the engineers sampled felt that their organisation was only concerned with developing their skills and abilities bearing in mind the benefit to the organisation. This finding is in line with the conclusion drawn earlier that these engineers want to develop a wider range of skills that will make them more marketable in the market outside of the company that they are currently employed in.

There was, however, a positive correlation for both vigour and dedication, relative to employer obligations. This means that the respondents are engaged in their work when the organisation supports them to higher levels of performance, helps them to respond to higher industry standards and to achieve their personal goals.

The sample also reported that they feel that there is moderately secure employment, with stable benefits, indicating that they are not completely dissatisfied with the conditions within which they are employed.

The results revealed that the respondents or employees felt that they were performing better in meeting their obligations than their employers: they felt they performed better in loyalty, performance support and seeking external marketability. The loyal nature of engineers was once again confirmed, together with the need to develop themselves for a wide variety of markets. It is almost as if they want to move towards becoming generalists and avoid specialising in only one particular skill or organisation.

By contrast, employers performed better at meeting narrow obligations and creating stability. The employers are therefore perceived as being focused on limiting the involvement of engineers in the organisation. They are also providing more job-specific training where the respondents indicated that they want to become more marketable to external companies. All this may sound negative, but the fact that the employers are performing moderately well at creating stability indicates that the employers are supplying secure employment with good benefits that can be relied on. However, the engineers are, as discussed above, not motivated to remain with the organisation for a long time, even if the organisation provides such an environment.

Worker engagement is positively affected when information is shared with the employees, when trust is invested in the workers and when workers are consulted when changes are made. The engineers will also be more engaged in their work when there is a career path for them, and when the commitment of the employer is clearly communicated to avoid uncertainty. Realistic demands and benefits that meet the

expectations of the employer will also have a positive influence on the engagement levels of the engineers in their work.

The engagement levels of engineers would then be higher when they feel that the future at the organisation can be predicted and that there is certainty with regard to the employer's commitment towards them.

Engineers with more work experience were more engaged in their work. Experience brings more confidence and this makes it possible for an engineer to act with confidence, assisting him/her to achieve higher levels of engagement. It was also shown that newly graduated engineers (with up to two years of experience) are also more engaged in their work. In terms of management level within the organisation, it was concluded that engineers in middle and senior management were more engaged in their work than junior and senior engineers.

The biographical data revealed some interesting facts. Of the 72 respondents, 30 were junior engineers. The largest part of the cadre of junior engineers was made up, as expected, by individuals that had between zero and eight years of experience. A matter of concern was the 10% of the junior engineers that had more than 16 years experience. It indicates that there is no real career path for those individuals within the organisation they are serving. This is concerning because they are experienced and it is also postulated they will be the next individuals that will leave the organisation, taking the hunger for experience and the lack of commitment to a single company into consideration. Another inference that can be drawn is that the nature of the respondents forces them to start in junior engineering positions each time they move to another company. The ideal structure for a company would be to have newly appointed engineers (in other words, engineers who have worked for the company for

less than four years) with more than eight years experience: this will ensure high levels of worker engagement.

7.2 Recommendations

Figure 9 presents a model that indicates how the elements of the psychological contract can be used to improve worker engagement, and in the process improve worker engagement. This process is an iterative process, starting with the employee obligations and ending with the evaluation of the psychological contract.

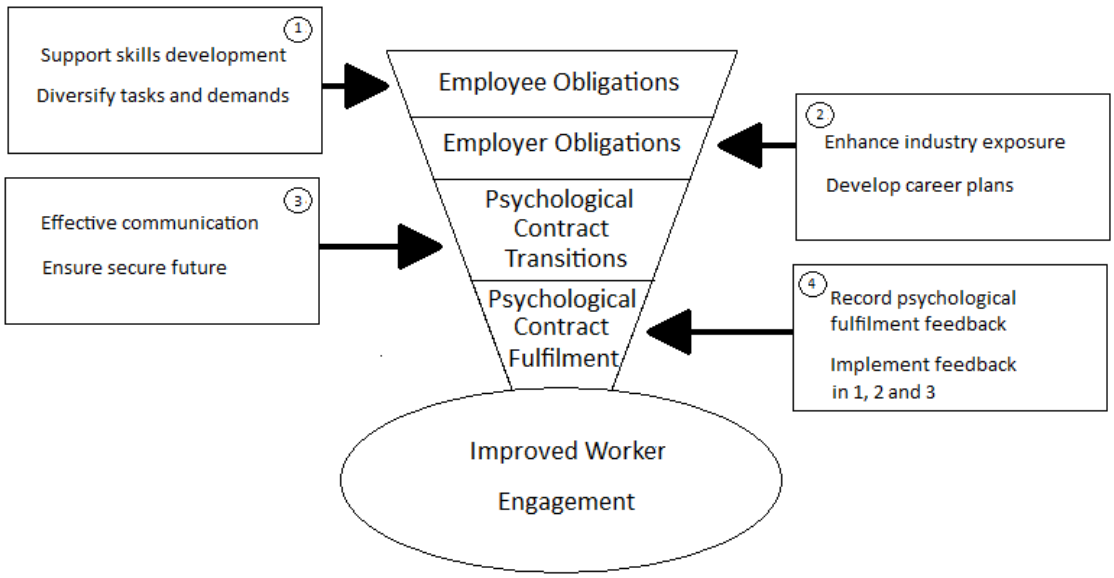

Figure 9 Retention strategy: improved worker engagement model

It is recommended that the industry, especially engineering companies that are functioning in a project-driven environment, should keep the workplace dynamic with new challenges. Diversification by taking on new and challenging projects with a steep learning curve would be one strategy to retain engineering personnel. Rotating engineers between projects and departments could also assist in keeping them engaged and learning. The study also indicates that career paths are important and

that flat structures might not always be the strategy to implement if skills retention is the objective.

Secure employment and stable yet realistic benefits would also contribute greatly to the retention of engineers. Employers must bear in mind that engineering personnel are knowledge workers and that information relating to the health of the business and industry must be communicated to them.

Engineers are loyal and dedicated to the task at hand, but this study has confirmed that they are constantly seeking alternative employment to advance their career paths. A strategy to consider would be to allow them to move on freely to the next challenge. If they are assured that re-employment is always an option in the future, they might return in the future if the recommendations in the previous paragraph have been successfully implemented.

7.3 Suggestions for further research

It is recommended that, in future, similar studies be conducted on other fields of engineering, for instance, maintenance engineers in the manufacturing industry. It would be interesting to see if there is a similar culture of knowledge and experience base expansion to ensure a prosperous career path. Another interesting research topic will be to compare South African engineers to engineers in countries such as Germany and the United States of America.

Another aspect to investigate in more detail is the average tenure of the engineers and the identification of factors that contribute to retention, keeping engineers engaged and focused in their work.

7.4 Concluding remarks

In conclusion, this study set out to find the influence of the psychological contract and its influence on engineers' worker engagement and found that when employers fulfil their commitments and meet the promises made to employees it will result in positive worker engagement. There is therefore a relationship between the psychological contract and worker engagement. Another key finding is that engineers are loyal and dedicated to the task at hand, but they are seeking alternative employment, whether it is to diversify or specialise is another question to be answered. Therefore it is recommended that retention strategies should include the actions recommended in Figure 9. Employers should consider diversifying the workplace, establishing structured career paths for employees, communicating effectively and ensuring exposure of their engineers to the industry. Further education must be motivated and must form part of the career planning within an organisation.

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Appendix A: Questionnaire

Universiteit van Pretoria
University of Pretoria

Dear respondent:

I am conducting research on the psychological contract and its influence on engineers' worker engagement.

You as an engineer are therefore requested to complete the following survey. This will help us better understand the relationship between the psychological contract of engineers and their worker engagement. This survey should not take more than 20 minutes of your time.

Your participation is voluntary and you can withdraw at any time without penalty. The data will be kept confidential. You are requested to refrain from identifying yourself, your company, or division on any page of this document. By completing the survey, you indicate that you voluntarily participate in this research. If you have any concerns, please contact me or my supervisor. Our details are:

Researcher name: Kevin Stasch

Email: stasch.kevin@gmail.com

Phone: 0823726585

Research Supervisor name: Dr Caren Scheepers

E-mail: caren.scheepers@irodo.com

Phone: 0829227072

Once the questionnaire has been completed, please seal it in the envelope supplied.

Thank you

Kevin Stasch

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The following 17 statements are about how you feel at work. Please read each statement carefully and decide if you ever feel this way about your job. If you have never had this feeling, cross '0' (zero) in the space after the statement. If you have had this feeling, indicate how you feel it by crossing the number (from 1 to 6) that best describes how frequently you feel that way.

	Almost never	Rarely	Sometimes	Often	Very often	Always
0	1	2	3	4	5	6
Never	A few times a year or less	Once a month or less	A few times a month	Once a week	A few times a week	Every day

		0	**1**	**2**	**3**	**4**	**5**	**6**
1	At my work, I feel bursting with energy							
2	I find the work that I do full of meaning and purpose							
3	Time flies when I'm working							
4	At my job, I feel strong and vigorous							
5	I am enthusiastic about my job							
6	When I am working, I forget everything else around me							
7	My job inspires me							
8	When I get up in the morning, I feel like going to work							
9	I feel happy when I am working intensely							
10	I am proud of the work that I do							
11	I am immersed in my work							
12	I can continue working for very long periods at a time							
13	To me, my job is challenging							
14	I get carried away when I'm working							
15	At my job, I am very resilient, mentally							
16	It is difficult to detach myself from my job							
17	At my work I always persevere, even when things do not go well							

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Please answer the following questions by marking the appropriate block.

To what extent have you made the following commitments or obligations to your employer:

1	2	3	4	5
Not at all	Slightly	Somewhat	Moderately	To a great extent

		1	2	3	4	5
18	Quit whenever I want					
19	Make personal sacrifices for this organisation					
20	Perform only required tasks					
21	Accept increasingly challenging performance standards					
22	Respond positively to dynamic performance requirements					
23	Seek out developmental opportunities that enhance my value to this employer					
24	Build contracts outside this firm that enhance my career potential					
25	Seek out assignments that enhance my employability elsewhere					
26	Remain with this organisation indefinitely					
27	I have no further obligations to this employer					
28	Take this organisation's concerns personally					
29	Do only what I am paid to do					
30	Adjust to changing performance demands due to business necessity					
31	Accept new and different performance demands					
32	Build skills to increase my value to this organisation					
33	Build skills to increase my future employment opportunities elsewhere					
34	Plan to stay here a long time					
35	Leave at any time I choose					
36	Protect this organisation's image					
37	Fulfil a limited number of responsibilities					
38	Make myself increasingly valuable to my employer					
39	Increase my visibility to potential employers outside this firm					
40	Continue to work here					
41	I am under no obligation to remain with this company					
42	Commit myself personally to this organisation					
43	Only perform specific duties I agreed to when hired					
44	Actively seek internal opportunities for training and development					
45	Make no plans to work anywhere else					

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Consider your relationship with your current employer. To what extent has your employer made the following commitments or obligations to you? Please answer each question using the following scale:

1	2	3	4	5
Not at all	Slightly	Somewhat	Moderately	To a great extent

		1	2	3	4	5
46	A job only as long as this employer needs me					
47	Concern for my personal welfare					
48	Limited involvement in the organisation					
49	Support me to attain the highest possible levels of performance					
50	Opportunity for career development within this firm					
51	Help me develop externally marketable skills					
52	Secure employment					
53	Steady employment					
54	Makes no commitments to retain me in the future					
55	Be responsive to my personal concerns and well-being					
56	Training me only for my current job					
57	Help me to respond to ever greater industry standards					
58	Developmental opportunities with this firm					
59	Job assignments that enhance my external marketability					
60	Wages and benefits I can count on					
61	Stable benefits for employees' families					
62	Short-term employment					
63	Make decisions with my interest in mind					
64	A job limited to specific, well-defined responsibilities					
65	Support me in meeting increasingly higher goals					
66	Advancement within the firm					
67	Potential job opportunities outside the firm					
68	A job for a short time only					
69	Concern for my long-term well-being					
70	Require me to perform only a limited set of duties					
71	Enable me to adjust to new, challenging performance requirements					
72	Opportunities for promotion					
73	Contacts that create employment opportunities elsewhere					

To what extent do the items below describe your employer's relationship to you? Please answer each question using the following scale:

1	2	3	4	5
Not at all	Slightly	Somewhat	Moderately	To a great extent

		1	2	3	4	5
74	Withhold information from its employees					
75	Difficult to predict future direction of its relations with me					
76	Demand more from me while giving me less in return					
77	Act as if it doesn't trust its employees					
78	Uncertainty regarding its commitments to employees					
79	Decreased benefits in the next few years					
80	Introduce changes without involving employees					
81	Uncertainty regarding its commitments to me					
82	Stagnant or reduced wages the longer I work here					
83	Doesn't share important information with its workers					
84	More and more work for less pay					

Please answer each question using the following scale:

1	2	3	4	5
Not at all	Slightly	Somewhat	Moderately	To a great extent

		1	2	3	4	5
85	Overall, how well have you fulfilled your commitment to your employer					
86	Overall, how well does your employer fulfil its commitments to you					
87	In general, how well does your employer live up to its promises					
88	In general, how well do you live up to your employer					

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How many years experience do you have in the engineering profession

1	2	3	4	5
0 to 4 years	4 to 8 years	8 to 12 years	12 to 16 years	More than 16 years

How many consecutive years have you been appointed by your current employer

1	2	3	4	5
0 to 1 years	1 to 2 years	2 to 3 years	3 to 4 years	More than 4 years

Your current level in the organisation

1	2	3	4
Junior engineer	Senior engineer	Middle management	Senior management

Annexure B: Additional statistical results

ANOVA: The generalised linear method

Dependent Variable: **pf1**

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	1.46774	0.73387	2.11	0.1284
Error	69	23.94545	0.347036		
Corrected Total	71	25.41319			

R-Square	Coeff Var	Root MSE	pf1 Mean
0.057755	13.97529	0.589097	4.215278

Source	DF	Type III SS	Mean Square	F Value	Pr > F
q89	2	1.46774	0.73387	2.11	0.1284

Duncan's multiple range test for pf1

Alpha	Error Degrees of Freedom	Error Mean Square	Harmonic Mean of Cell Sizes
0.05	69	0.347036	21.63934

Number of means	2	3
Critical Range	0.3573	0.3759

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	q89
A	4.4167	24	5
A	4.1333	15	3-4
A	4.1061	33	1-2

Table 28: ANOVA and Duncan multiple range test – employee fulfilment compared to years of experience

ANOVA: The generalised linear method

Dependent Variable: **pf2**

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	1.258838	0.629419	0.89	0.4145
Error	69	48.68561	0.705588		
Corrected Total	71	49.94444			

R-Square	Coeff Var	Root MSE	pf2 Mean
0.025205	20.855	0.839993	4.027778

Source	DF	Type III SS	Mean Square	F Value	Pr > F
q89	2	1.258838	0.629419	0.89	0.4145

Duncan's multiple range test for pf2

Alpha	Error Degrees of Freedom	Error Mean Square	Harmonic Mean of Cell Sizes
0.05	69	0.705588	21.63934

Number of Means	2	3
Critical Range	0.5095	0.536

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	q89
A	4.2083	24	5
A	4	15	3-4
A	3.9091	33	1-2

Table 29: ANOVA and Duncan multiple range test – employer fulfilment compared to years of experience

ANOVA: The generalised linear method

Dependent Variable: **pt1**

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	1.668182	0.834091	1.24	0.297
Error	69	46.58182	0.675099		
Corrected Total	71	48.25			

R-Square	Coeff Var	Root MSE	pt1 Mean
0.034574	38.6656	0.821644	2.125

Source	DF	Type III SS	Mean Square	F Value	Pr > F
q89	2	1.668182	0.834091	1.24	0.297

Duncan's multiple range test for pt1

Alpha	Error Degrees of Freedom	Error Mean Square	Harmonic Mean of Cell Sizes
0.05	69	0.675099	21.63934

Number of Means	2	3
Critical Range	0.4983	0.5243

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	q89
A	2.2879	33	1-2
A	2.0333	15	3-4
A	1.9583	24	5

Table 30: ANOVA and Duncan multiple range test – no trust compared to years of experience

ANOVA: The generalised linear method

Dependent Variable: **pt2**

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	0.56717172	0.283586	0.41	0.6635
Error	69	47.4189394	0.687231		
Corrected Total	71	47.9861111			

R-Square	Coeff Var	Root MSE	pt2 Mean
0.011819	40.60379	0.828994	2.041667

Source	DF	Type III SS	Mean Square	F Value	Pr > F
q89	2	0.56717172	0.283586	0.41	0.6635

Duncan's multiple range test for pt2

Alpha	Error Degrees of Freedom	Error Mean Square	Harmonic Mean of Cell Sizes
0.05	69	0.687231	21.63934

Number of Means	2	3
Critical Range	0.5028	0.529

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	q89
A	2.1528	24	5
A	2.0202	33	1-2
A	1.9111	15	3-4

Table 31: ANOVA and Duncan multiple range test – uncertainty compared to years of experience

ANOVA: The generalised linear method

Dependent Variable: **pt3**

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	0.29425505	0.147128	0.2	0.8208
Error	69	51.2751894	0.743119		
Corrected Total	71	51.5694444			

R-Square	Coeff Var	Root MSE	pt3 Mean
0.005706	42.51173	0.862043	2.027778

Source	DF	Type III SS	Mean Square	F Value	Pr > F
q89	2	0.29425505	0.147128	0.2	0.8208

Duncan's multiple range test for pt3

Alpha	Error Degrees of Freedom	Error Mean Square	Harmonic Mean of Cell Sizes
0.05	69	0.743119	21.63934

Number of Means	2	3
Critical Range	0.5228	0.5501

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	q89
A	2.0758	33	1-2
A	2.0667	15	3-4
A	1.9375	24	5

Table 32: ANOVA and Duncan multiple range test – erosion compared to years of experience

ANOVA: The generalised linear method

Dependent Variable: **pf1**

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	2.247578	1.123789	3.35	0.041
Error	69	23.16562	0.335734		
Corrected Total	71	25.41319			

R-Square	Coeff Var	Root MSE	pf1 Mean
0.088441	13.74584	0.579425	4.215278

Source	DF	Type III SS	Mean Square	F Value	Pr > F
q90	2	2.247578	1.123789	3.35	0.041

Duncan's multiple range test for pf1

Alpha	Error Degrees of Freedom	Error Mean Square	Harmonic Mean of Cell Sizes
0.05	69	0.335734	22.08247

Number of Means	2	3
Critical Range	0.3479	0.366

Means with the same letter are not significantly different.

Duncan Grouping		Mean	N	q90
	A	4.3676	34	5
B	A	4.2353	17	3-4
B		3.9524	21	1-2

Table 33: ANOVA and Duncan multiple range test – employee fulfilment compared to years employed at current employer

ANOVA: The generalised linear method

Dependent Variable: **pf2**

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	2.576097	1.288049	1.88	0.1609
Error	69	47.36835	0.686498		
Corrected Total	71	49.94444			

R-Square	Coeff Var	Root MSE	pf2 Mean
0.051579	20.57094	0.828552	4.027778

Source	DF	Type III SS	Mean Square	F Value	Pr > F
q90	2	2.576097	1.288049	1.88	0.1609

Duncan's multiple range test for pf2

Alpha	Error Degrees of Freedom	Error Mean Square	Harmonic Mean of Cell Sizes
0.05	69	0.686498	22.08247

Number of Means	2	3
Critical Range	0.4975	0.5234

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	q90
A	4.2059	34	5
A	4	17	3-4
A	3.7619	21	1-2

Table 34: ANOVA and Duncan multiple range test – employer fulfilment compared to years employed at current employer

ANOVA: The generalised linear method

Dependent Variable: **pt1**

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	0.24614846	0.1230742	0.18	0.8382
Error	69	48.00385154	0.695708		
Corrected Total	71	48.25			

R-Square	Coeff Var	Root MSE	pt1 Mean
0.005102	39.25135	0.834091	2.125

Source	DF	Type III SS	Mean Square	F Value	Pr > F
qq90	2	0.24614846	0.1230742	0.18	0.8382

Duncan's multiple range test for pt2

Alpha	Error Degrees of Freedom	Error Mean Square	Harmonic Mean of Cell Sizes
0.05	69	0.695708	22.08247

Number of Means	2	3
Critical Range	0.5008	0.5269

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	qq90
A	2.2206	17	5
A	2.131	21	3-4
A	2.0735	34	1-2

Table 35: ANOVA and Duncan multiple range test – no trust compared to years employed at current employer

ANOVA: The generalised linear method

Dependent Variable: **pt2**

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	1.03606443	0.5180322	0.76	0.4709
Error	69	46.95004669	0.6804355		
Corrected Total	71	47.98611111			

R-Square	Coeff Var	Root MSE	pt2 Mean
0.021591	40.40254	0.824885	2.041667

Source	DF	Type III SS	Mean Square	F Value	Pr > F
q90	2	1.03606443	0.5180322	0.76	0.4709

Duncan's multiple range test for pt2

Alpha	Error Degrees of Freedom	Error Mean Square	Harmonic Mean of Cell Sizes
0.05	69	0.680435	22.08247

Number of Means	2	3
Critical Range	0.4953	0.521

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	q90
A	2.1667	34	5
A	1.9608	17	3-4
A	1.9048	21	1-2

Table 36: ANOVA and Duncan multiple range test – uncertainty compared to years employed at current employer

ANOVA: The generalised linear method

Dependent Variable: **pt3**

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	0.49206349	0.246032	0.33	0.7184
Error	69	51.077381	0.740252		
Corrected Total	71	51.5694444			

R-Square	Coeff Var	Root MSE	pt3 Mean
0.009542	42.42965	0.860379	2.027778

Source	DF	Type III SS	Mean Square	F Value	Pr > F
q90	2	0.49206349	0.246032	0.33	0.7184

Duncan's multiple range test for pt3

Alpha	Error Degrees of Freedom	Error Mean Square	Harmonic Mean of Cell Sizes
0.05	69	0.740252	22.08247

Number of Means	2	3
Critical Range	0.5166	0.5435

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	q90
A	2.0882	34	5
A	2.0476	21	1-2
A	1.8824	17	3-4

Table 37: ANOVA and Duncan multiple range test – erosion compared to years employed at current employer

ANOVA: The generalised linear method

Dependent Variable: **pf1**

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	1.91967593	0.959838	2.82	0.0666
Error	69	23.4935185	0.340486		
Corrected Total	71	25.4131944			

R-Square	Coeff Var	Root MSE	pf1 Mean
0.075539	13.84278	0.583512	4.215278

Source	DF	Type III SS	Mean Square	F Value	Pr > F
q91	2	1.91967593	0.959838	2.82	0.0666

Duncan's multiple range test for pf1

Alpha	Error Degrees of Freedom	Error Mean Square	Harmonic Mean of Cell Sizes
0.05	69	0.340486	21.89189

Number of Means	2	3
Critical Range	0.3519	0.3702

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	q91
A	4.4259	27	3-4
A	4.1	15	2
A	4.0833	30	1

Table 38: ANOVA and Duncan multiple range test – employee fulfilment compared to the current level in the organisation

ANOVA: The generalised linear method

Dependent Variable: **pf2**

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	3.2148148	1.607407	2.37	0.1007
Error	69	46.72963	0.677241		
Corrected Total	71	49.944444			

R-Square	Coeff Var	Root MSE	pf2 Mean
0.064368	20.43178	0.822947	4.027778

Source	DF	Type III SS	Mean Square	F Value	Pr > F
q91	2	3.2148148	1.607407	2.37	0.1007

Duncan's multiple range test for pf2

Alpha	Error Degrees of Freedom	Error Mean Square	Harmonic Mean of Cell Sizes
0.05	69	0.677241	21.89189

Number of Means	2	3
Critical Range	0.4962	0.5221

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	q91
A	4.2963	27	3-4
A	3.9	30	1
A	3.8	15	2

Table 39: ANOVA and Duncan multiple range test – employer fulfilment compared to the current level in the organisation

ANOVA: The generalised linear method

Dependent Variable: **pt1**

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	3.51203704	1.756019	2.71	0.0737
Error	69	44.737963	0.648376		
Corrected Total	71	48.25			

R-Square	Coeff Var	Root MSE	pt1 Mean
0.072788	37.89262	0.805218	2.125

Source	DF	Type III SS	Mean Square	F Value	Pr > F
q91	2	3.51203704	1.756019	2.71	0.0737

Duncan's multiple range test for pt1

Alpha	Error Degrees of Freedom	Error Mean Square	Harmonic Mean of Cell Sizes
0.05	69	0.648376	21.89189

Number of Means	2	3
Critical Range	0.4856	0.5108

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	q91
A	2.3667	30	1
A	2.1	15	2
A	1.8704	27	39876

Table 40: ANOVA and Duncan multiple range test – no trust compared to the current level in the organisation

ANOVA: The generalised linear method

Dependent Variable: **pt2**

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	0.37788066	0.18894	0.27	0.7613
Error	69	47.6082305	0.689974		
Corrected Total	71	47.9861111			

R-Square	Coeff Var	Root MSE	pt2 Mean
0.007875	40.68475	0.830647	2.041667

Source	DF	Type III SS	Mean Square	F Value	Pr > F
q91	2	0.37788066	0.18894	0.27	0.7613

Duncan's multiple range test for pt2

Alpha	Error Degrees of Freedom	Error Mean Square	Harmonic Mean of Cell Sizes
0.05	69	0.689974	21.89189

Number of Means	2	3
Critical Range	0.5009	0.527

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	q91
A	2.1111	30	1
A	2.0667	15	2
A	1.9506	27	39876

Table 41: ANOVA and Duncan multiple range test – uncertainty compared to the current level in the organisation

ANOVA: The generalised linear method

Dependent Variable: **pt3**

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	3.3037037	1.651852	2.36	0.1019
Error	69	48.2657407	0.699503		
Corrected Total	71	51.5694444			

R-Square	Coeff Var	Root MSE	pt3 Mean
0.064063	41.24531	0.836363	2.027778

Source	DF	Type III SS	Mean Square	F Value	Pr > F
q91	2	3.3037037	1.651852	2.36	0.1019

Duncan's multiple range test for pt3

Alpha	Error Degrees of Freedom	Error Mean Square	Harmonic Mean of Cell Sizes
0.05	69	0.699503	21.89189

Number of Means	2	3
Critical Range	0.5043	0.5306

Means with the same letter are not significantly different.

Duncan Grouping	Mean	N	q91
A	2.25	30	1
A	2.05	15	2
A	1.7685	27	39876

Table 42: ANOVA and Duncan multiple range test – erosion compared to the current level in the organisation