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2021
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Brink, Eugene. (2021). Factors affecting individual job performance of software developers in Gauteng, South Africa [Master's dissertation, University of the Witwatersrand, Johannesburg]. WireDSpace.

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Factors affecting individual job performance of software developers in Gauteng, South Africa

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A research article submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Business Administration

Johannesburg, 2021

Protocol number: WBS/BA1295192/694

DECLARATION

I, Eugene Brink, declare that this research article is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the Graduate School of Business Administration, University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.



Signed at Randburg on the 29th day of April 2021

ACKNOWLEDGEMENTS

Neale Penman, for his ongoing supervision, guidance and patience.

My wife and immediate family for their moral support.

SUPPLEMENTARY INFORMATION

Nominated journal:	SA Journal of Human Resource Management
Supervisor / Co-author:	Neale Penman
Word count †:	11 354 Words

Competing interests

The author declares that they have no financial or personal relationship(s) that may have inappropriately influenced them in writing this article.

Author contributions

All sections authored by Eugene Brink.

Funding

The author received no financial support for the research, authorship, and/or publication of this article.

Data availability

Due to the nature of this research, participants of this study did not agree for their data to be shared publicly, so supporting data is not available.

Disclaimer

All views expressed in this article are those of the author and not an official position of the University of the Witwatersrand.

† Including abstract references, etc.

ABSTRACT

Orientation

The orientation of the study lies towards the human resources and managerial fields and focuses on the work performance of individual software developers within the Gauteng area of South Africa. The study attempts to address the question: “Which factors are important in contributing to the individual work performance of a software developer, and how important are each of these factors?”.

Research Purpose

The purpose of the research is to identify and quantify the magnitude and statistical significance of factors that affect the individual job performance of software developers.

Motivation for the study

There is a gap in existing academic literature on individual job performance for software developers. The motivation for the study is to contribute to this gap in knowledge. Results from the study could likely assist in reshaping human resource development and recruitment practises in the software development field.

Research approach/design and method

Software developers were surveyed and scored against a set criterion for performance. Factors that have been noted in literature to influence individual job performance, as well as factors stemming from informal conversation with those in the industry were measured at an individual level. A correlation and a stepwise exploratory regression analysis were used to identify and quantify factors influencing job performance of the individual software developer.

Main findings

Individual Performance was found to be a multilinear and complicated variable to quantify. Instead, the variable was broken up into task performance and contextual performance with total performance some superposition of both variables. Self-Esteem, Achievement Motivation and Work-Life Balance were noted as the most important personal factors in determining task performance. Self-Esteem and Job Satisfaction were considered the most important factors in determining contextual

performance. Notably, quality of education, formal or informal, had no correlation to performance.

Practical/managerial implications

Self-Esteem was a high-quality predictor of both task and contextual performance. For this reason, further study at corporate level is strongly suggested to find ways of improving or fostering this personal attribute to maximise software developer performance. A similar argument can be made for Achievement Motivation and Job Satisfaction.

Overall, the study highlighted and provided empirical evidence supporting fostering and maintaining good emotional health within the workplace. In turn, this will lead to higher individual job performance scores.

The results also challenge the widespread practise of only appointing and recruiting degreed candidates for junior software developer roles, as there is no supporting evidence to suggest higher educated individuals have higher task or contextual performance scores.

Keywords: Software, Programmer, Developer, IT, Technology, Performance, Individual, Task, Contextual

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1. Introduction

1.1 Orientation

The widespread adoption of the personal computer in the early 1980's resulted in a very sudden demand for computer software and an equivalent boom in the software industry. In the years to follow the demand for software grew radically as virtually every market segment become adopters of software driven technology. This gave rise to a multibillion-dollar global software development industry which today employs a vast body of software developers.

Ever since the boom in demand for software, the industry has been characterised by a fast-paced innovation culture based on developing new technologies more rapidly than competitors. The industry has received much academic attention in fields pertaining to group dynamics and management and has delivered many project management frameworks which have been meticulously recorded and documented in academic literature.

As a result, most studies in human resource management in the software development industry have been at either an organisational or business unit level. Very little research on human resource management has been directed at the level of the individual software development professional.

Factors such as formal tertiary academic qualifications and job experience have traditionally been used to rate competencies of individual software developers. Evidence in industry recruitment procedures suggests that these factors alone are insufficient for accurate candidate assessment and emphasise the need for further academic research. For example, it is common industry practise to rely on additional assessments to select candidates, such as psychometric profiling, problem solving skills measurement and technical assessments. There is thus a need to identify additional factors that have thus far been neglected in the recruitment process.

Studies pertaining to the factors affecting individual job performance is useful in various business settings, with the most tangible applications relating to performance management and recruitment practises.

Identifying the respective factors affecting job performance allows for the optimisation of performance management. Once the factors have been weighted by order of

importance training can be directed in a manner to reach optimal performance, and performance gains can be achieved with minimal cost to the organisation. Identification of factors responsible for job performance will also ensure recruitment practises are optimised for candidate selection

1.2 Background and context of the study

Gauteng (particularly Johannesburg and Pretoria) is a business hub densely populated by software development companies and software development business units. These organisations and business units rely heavily on human resources (software developers) for timely delivery of quality products.

Considering how little academic and industry information there is available on the factors influencing individual job performance of software developers there is a need for better assessment of these factors; with the aim of controlling or improving these factors and in so forth providing optimal working conditions for software developers.

The factors may also be employed to screen and classify software developer candidates during the recruitment process.

1.3 Research Problem

There is a dearth of information on the complex factors affecting individual software performance at both an academic and practical level. There is thus both an academic and industry specific need to investigate additional factors that influence software developers job performance, and the magnitude of impact such factors may have. Factors such as individual personality traits, individual education, and organisational factors such as job satisfaction, working environment and work life balance need to be investigated.

1.4 Problem statement

To determine which factors are significant in affecting individual software developer job performance. To determine the potential magnitude that each of these factors may have over the individual job performance of a software developer. To investigate if the factors identified can be used to model the individual job performance of a software developer and if, so to determine the magnitude thereof.

1.5 Research purpose and objectives

The purpose of this study is to identify key factors that influence individual job performance of a software developer.

The objectives of this study are:

1. To identify and review existing academic models of individual job performance.

2. To critically evaluate each of the models and suggest one as a baseline contextual framework on which to base this specific study.

3. To identify factors which have been noted in literature to have a direct impact on employee performance, and to expand this list with industry observed factors especially relevant to software developers.

4. To select factors for further study by critically evaluating the suitability of each of the factors in terms of measurability and applicability to the chosen model.

5. To collect data from individual software developers in Gauteng, South Africa for statistical analysis.

6. To perform a statistical analysis to find evidence suggesting the significance and magnitude of each of the factors identified for study on individual software developer job performance in the Gauteng region of South Africa.

7. To attempt to create holistic mathematical model of factors affecting individual software developer job performance in the Gauteng region of South Africa.

1.6 Delimitations, assumptions and limitations

1.6.1 Delimitations

The study's participants will be limited to software developers, where a software developer is defined as an individual spending half or more of their time at work writing, reviewing or testing code, scripts, or other programmatic logic in their occupation.

The study's participants will be narrowed geographically to individuals working only within the Gauteng region of South Africa.

The study will only include developers working on-site in organisations. Freelancers, contractual remote workers, and digital nomads will not be included in the study.

The study's data collection method will be limited to paper and will not include any form of digital data collection.

The study's data collection method will make use of only close-ended questions, no open-ended questions will be incorporated.

The study's framework, variables, and supporting constructs will be limited to the philosophical contexts described in the literature study, the contextual mathematical model hypothesised, and any underlying concepts of the above.

The study's statistical analyses will be limited to univariate descriptive statistics, correlation analysis, and stepwise linear regression analysis.

The study's final results will be based solely on the results of the statistical analyses and the interpretation thereof.

1.6.2 Assumptions

It is assumed that existing models of individual job performance provide adequate hypothetical mathematical modelling of individual job performance and that it is suitable for these models to be applied to software developers as defined within the scope.

It is assumed that existing models of individual personality traits, determinants and working environment factors are modelled adequately and that it is suitable for these models to be applied to software developers as defined within the scope.

It is assumed that existing peer reviewed data collection instruments and scales pertaining to the beforementioned individual personality traits, determinants and working environment factors are suitable for use in this study. Furthermore, it is assumed that these data collection instruments, where altered slightly for coherence or time constraints, will still provide an adequate representation of the original instrument.

It is assumed that all participants in the study will be providing honest, unbiased and objective answers to the data collection survey.

It is assumed that the statistical methods and mathematical models chosen will provide adequate insight into the variables being observed to the extent that useful results may be extracted.

1.6.3 Limitations

The research domain was found to be highly unexplored and very little academic research could be cited on the area of study. Many of the studies found and referenced were outdated. There is thus a limitation on available existing literature.

The study made thorough use of the knowledge and opinions of industry experts with no academic ties. Thus, anecdotal evidence was introduced into various parts of the study.

The data collection yielded results from 67 respondents and only 58 samples could be used for analysis. A larger sample size would have been better suited, considering the size of the software development community.

The data sampling only targeted software developers which were employed by organisations. There were no samples taken from unemployed, freelancer or digital nomad software developers.

Both the dependent and independent variables of the study were sampled by means of a questionnaire and relied on the honesty of the participants. The data collection could easily be influenced by personal bias.

2. Literature review

2.1 Individual Job Performance

2.1.1 Definition

Campbell & Wiernik (2015) define job performance as a justified measurement of "things that people actually do, actions they take, that contribute to the organisation's goals". They add context to their definition by specifying that the measurement of an individual's job performance is inherently dependent on individuals pursuing relevant, achievable, and measurable goals (Campbell & Wiernik, 2015, p. 48). It is not outside the definition for individuals to identify goals on their own, provided these goal choices are legitimised by the members of the organisation empowered to do so.

Viswesvaran and Ones (2000, p. 645) offer a similar definition to Campbell and Wiernik (2015) by defining work performance as "scalable actions, behaviour and outcomes that employees engage in or bring about that are linked with and contribute to organisational goals".

It is important to distinguish work performance from work productivity as the terms are sometimes used interchangeably in literature. Work productivity is defined as "Input divided by output" (Kemppilä and Lönnqvist, 2002, pp 211) and is therefore a much narrower concept, but may, in part, form part of individual job performance.

From the above definitions the following characteristics of individual job performance can be identified:

Individual job performance is based on actions and behaviours, and not results or the bottom line.

Productivity may form part of an employee's performance but should not be mistaken as the same construct.

Individual job performance is defined by behaviours that contribute to the organisations' goals. Behaviours are open to interpretation by individual workers but must ultimately be aligned with the goals of the organisation.

2.1.2 Models of Individual Job Performance

From the definition it is evident that individual job performance is a broad, abstract and multidimensional concept. This makes measuring of it nearly impossible. Instead,

research seeks to break down the concept into models with various dimensions. These dimensions, in turn, are more likely to have indicators which are measurable.

Despite the significance of individual job performance and its importance to organisations, no comprehensive framework of individual performance exists (Koopmans et al., 2011). Some of the more pertinent models of job performance were reviewed to gain an understanding of the dynamics involved in the concept.

Murphy (1989) developed an early model of individual job performance in a military setting and believes that individual job performance can be modelled by a set of key individual behaviours. Murphy (1989) defined these behaviours as:

1. Task behaviours: Characterised by actions which result in the successful completion of job-related tasks. These behaviours are most strongly influenced by technical ability and willingness to perform operational duties.

2. Destructive behaviours: Any behaviour that risks setbacks to operational goals due to negligence or failure to comply with regulations.

3. Downtime behaviours: Behaviours that directly or indirectly jeopardise an individual's ability to perform task behaviours. Examples of this type of behaviour is absenteeism, lateness, work avoidance and untreated substance abuse disorders.

4. Interpersonal relation behaviours: Any interaction or conflict between individuals that directly or indirectly affect the working environment. Examples include the handling of conflicts between individuals with differing ranks and interpersonal reliability.

Whilst Murphy's (1989) contributions to the pool of knowledge was significant, the model proposed is militaristic in nature and unsuited for general civilian application. Viswesvaran (1993) developed a more generalised model with a different set of dimensions for measuring individual job performance. These dimensions were specified as:

1. Productivity: In the context of individual job performance, is the rate at which an individual produces output, given input. In a workplace setting this is the rate at which goals are accomplished and tasks completed.

2. Quality of work: The quality of the output generated as a result of an individual's productivity.

3. Job knowledge: The knowledge and competencies which an individual possesses to enable them to skilfully complete tasks.

4. Effort: In the contest of individual job performance, is defined as the application of strenuous physical or mental energy towards completing an organisational goal.

5. Leadership Skills: The knowledge and competencies required to successfully lead a group of subordinates towards a set of organisational goals.

6. Communication competence: The ability to communicate successfully with superiors, peers and subordinates via an applicable method.

7. Interpersonal Competence: The competency required to manage interpersonal relations to such an extent as to enable an organisation to reach its goals.

8. Compliance with/acceptance of authority: The personal capacity to comply with and accept authoritative action.

Most recently, Campbell (2015) proposed a revised job performance framework with eight dimensions. Whilst the first four factors are very similar to some of the concepts that the models of Murphy (1989) and Viswesvaran (1993) defined, the latter four dimensions indicate a stronger differentiation into personal leadership qualities than previously proposed. Campbell (2015) identified the following dimensions:

1. Technical Performance: This dimension is a combination of the first three dimensions of Viswesvaran's (1993) model, namely productivity, quality of work, and job knowledge. Technical performance may vary by substantive area, level of complexity or difficulty.

2. Communication: This dimension is similar to Viswesvaran's (1993) definition of communication competence in that they both refer to the proficiency with which information is conveyed clear and well-organised manner.

3. Initiative, Persistence and Effort: This dimension builds on Viswesvaran's (1993) definition of effort but includes the concepts of initiative and persistence. Persistence relates to individual's ability to continue productive behaviour towards a goal despite difficulty or opposition. Initiative encompasses personal elements of leadership and

creativity to take charge of a situation or to find creative solutions to a problem that have yet to be discovered by others.

4. Counterproductive work behaviour: This dimension is a generalised combination of Murphy's (1989) dimensions of destructive and downtime behaviours. These behaviours have a negative effect on the goals of the organization.

5. Supervisory, managerial, executive leadership: This dimension refers to leadership skills, as opposed to management skills, within a hierarchical structure.

6. Hierarchal management performance: The ability to manage resources within an individual's hierarchical reach to best achieve the organisation's goals.

7. Peer/team member leadership performance: This dimension is similar to supervisory, managerial, executive leadership, but specifically addresses leadership actions towards peers.

8. Peer/team member management performance. This dimension is similar to Hierarchal management performance, but specifically addresses management actions towards peers.

Borman and Motowidlo (1993) proposed a very generalised model for individual job performance with two distinct areas, namely core task performance and contextual performance and argued that the performance spectrum could be explained by these two dimensions. Keetman et al. (2011) provided evidence to support the claim of Borman and Motowidlo (1993) after performing a systematic review of frameworks of individual job performance with the objective of identifying frameworks of individual work performance and integrating the results to find a heuristic model. The dimensions most frequently used to define individual work performance could be identified as, or categorised under, the concepts of task performance and contextual performance.

Borman and Motowidlo (1993, pp 73) describe task performance as consisting of "activities that transform raw materials into goods and services that are the organisation's products" and defined it as the "effectiveness with which job incumbents perform activities that contribute to its technical core either by directly implementing a part of its technological process, or by providing it with needed materials or services". Organ and Paine (1999) expanded on this definition by considering task performance

as a “part and parcel of the workflow that transforms inputs of energy, information and materials into outputs in the form of goods and services to the external constituency”.

All models reviewed previously refer to the concept of task performance. In Murphy’s (1989) framework this was labelled “task behaviours”; in Campbell’s (2015) this was “technical performance”; and in Visweran’s (1993) the factors of “productivity”, “quality of work” and “job knowledge” could be considered as task performance.

Borman and Motowidlo (1993) described contextual performance as consisting of “activities that service and maintain the technical core by replenishing its supply of raw materials, distributing its finished products, or providing important planning, supervising, or staff functions that enable it to function effectively and efficiently”, and defined contextual performance as “contributions to the maintenance and enhancement of the social and psychological context that supports task performance”. Borman and Motowidlo (1993) viewed contextual performance as a “set of interpersonal and violation behaviours that support the social and motivational context in which organisational work is accomplished”.

Keetman et al. (2011, pp 63) define contextual performance as “individual behaviours that support the organisational, social, and psychological environment in which the technical core must function” and make reference to this type of performance as pertaining to aspects of non-specific job proficiency, extra role performance and organisational citizenship behaviour. Organ (1988) defines organisational citizenship behaviour as “individual behaviour that is not discretionary, not directly or explicitly recognised by the formal reward system, and that in the aggregate promotes the effective functioning of the organisation”.

All models reviewed previously refer to the concept of contextual performance. In Murphy’s (1989) framework this was labelled “interpersonal behaviours” and “downtime behaviours”; in Campbell’s (2015) this was “initiative, persistence and effort” and “counterproductive work behaviour”, and in Visweran’s (1993) the factors “effort”, “interpersonal competence”, “compliance with/acceptance of authority” could be considered contextual performance.

2.1.3 Factors Affecting individual job performance

2.1.3.1 Relationship between factors and job performance

Neal and Griffin (1999) extended the Borman and Motowidlo (1993) model of performance to include the concepts of determinants and antecedents. According to the Neal & Griffin (1999), each determinant of performance has an impact on both the constructs of task performance and contextual performance. Each determinant, in turn, is composed of some antecedents of individual and organisational factors. Individual job performance is defined as a weighted summation of task and contextual performance (Borman and Motowidlo, 1993). Due to its simplicity and academic merit, this model was chosen as the prototype model for this study. Figure 1 shows the model of performance.

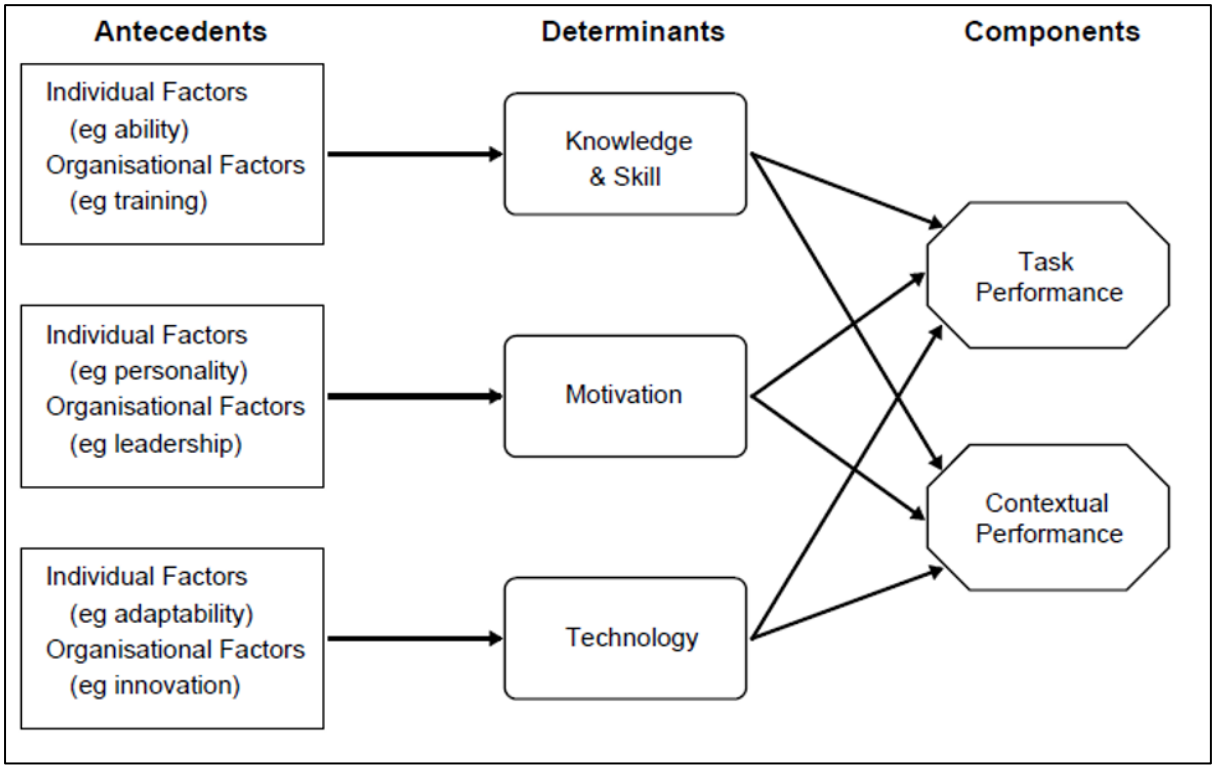


Figure 1: (Neal and Griffin, 1999)

In this study the term ‘factors’ and ‘determinants’ will be used interchangeably to describe the same concept. Campbell (2015) identifies the following types of determinants:

1. Individual trait variables: Including personal abilities, personal motivation and aspects other aspects of personality.

2. State variables: Relevant knowledge and skill, personal attitudes towards an organisation and application of motivation.

3. Situational characteristic variables: Refer to organisation specific variables. This includes reward structures and management/peer leadership.

2.1.3.2 Identification of academic factors

The purpose of the literature reviewed in this section was to identify common factors which have been hypothesised as determinants to individual job performance. This study was first directed at software developers and thereafter studies within the IT industry. Only a few academic studies were found, so the search criteria were expanded to members of any profession requiring specialist knowledge, with the intention of finding factors that appeared common across all industries.

Rasch and Tosi (1992) studied factors specifically affecting the performance of software developers. The factors that had significant correlations to performance were quality of education, intellectual ability, self-esteem, achievement needs and effort.

Akella and Rao (2016) performed an analysis of factors contributing to job performance of employees in the IT industry. Factors identified as significant were appreciation and job satisfaction.

Chong & Teng (2017) investigated employee retention and job performance in private institutions of higher education in the Klang Valley area in Malaysia. The study showed that career development and work-life balance have a significant relationship with employee retention and job performance.

Fort & Voltero (2004) studied the job performance of professional nurses in Armenia. Factors identified for study were job expectations, performance feedback, environment and tools, motivation and incentives, and knowledge and skills. Awases et al. (2013) performed a similar study on factors affecting performance of professional nurses in Namibia. Factors identified as pertinent to the study was knowledge and skill, performance appraisals, remuneration, benefits and reward recognition, development and training, and commitment and satisfaction.

2.1.3.3 Identification of industry factors

The purpose of this section of the literature study was to identify factors known to industry to affect software developer performance but had little academic reference.

One such factor is self-taught technical skills. Discussions with Pretorius (personal communication, 11 January 2019), an industry expert, has confirmed that that having a self-taught technical background or augmenting an existing tertiary background with self-taught skills prove that a candidate is capable of independent learning and possesses the ambition and drive sought after in the industry. Considering the challenges faced by the South African tertiary education system this factor is especially relevant for a study in South African context. Employers report that an increasing number of individuals are already improving their technical skills by means of affordable online resources.

Another factor which presents problems on an individual level in software development professionals is emotional matureness. Pretorius (personal communication, 11 January 2019) has confirmed that a major trend amongst software developers is poor social skills. Whilst this factor does not inherently make for a poor performer, it does complicate engagement with the individual professional.

Pretorius (personal communication, 11 January 2019) believed the final factor for inclusion into study should be achievement motivation and believed that this explained a critical amount of variance in software developer performance.

On review of both academic and industry factors, a selection of factors was made for further study.

2.1.3.4 Quality of Education

Quality of education, within the scope of this project, is defined as the amount of study a person has completed or attempted that is relevant to the software development occupation. Quality of education can be subdivided into the individual components of quality of formal education and quality of informal education.

Research on the relationship between quality of education and performance has produced very mixed results. Schmidt (2016) showed that quality of education is essentially uncorrelated to job performance. Ng & Feldman (2009) showed that educated individuals are more likely to possess procedural knowledge that would lead

to higher task performance ratings. Ng & Feldman (2009) also showed that educated individuals are more likely to engage in organisational citizenship behaviour and less likely to engage in counterproductive work behaviour.

This factor was included as it is has previously shown to be significant to the performance of individuals within the software development industry (Rasch and Tosi, 1992).

It is hypothesised that quality of education is positively correlated to task and contextual performance.

2.1.3.5 Emotional Maturity

Emotional maturity is defined as an individual's ability to observe their own feelings and understand those of others, and in so doing respond to situations with the adequate level of emotional control (Cole, Cole and Dean, 1980).

Although none of the studies reviewed specifically referred to emotional maturity, there is anecdotal evidence to support the claim that emotional intelligence plays a significant role in the individual performance of software developers supported by Pretorius (personal communication, 11 January 2019). There is also anecdotal evidence to suggest that emotional problems arising from low emotional maturity is often observed in poor performers. Dhani and Sharma (2017) performed a study on the effect of emotional intelligence on individual job performance of IT employees. The study showed a highly significant correlation between job performance and emotional intelligence.

It is hypothesised that emotional maturity is positively correlated to task and contextual performance.

2.1.3.6 Self-Esteem

Self-esteem is an individual's feelings of self-worth, confidence and self-respect. There is mixed academic opinion on self-esteem's effects on individual job performance.

Self-esteem has been shown to be useful in many organisational situations. Individuals with higher self-esteem are more likely to have increased success in group settings, show higher levels of resilience in personal failures, and have a lesser chance of developing depression (Baumeister et al., 2003).

Whilst there is a strong known correlation between individual job performance and self-esteem, research shows that increased individual job performance and occupational success may lead to higher self-esteem scores (Baumeister et al., 2003). Care should be taken to avoid sampling the circular relationship between self-esteem and individual job performance.

This factor was included as it is has previously shown to be significant to the performance of individuals within the software development industry (Rasch and Tosi, 1992).

It is hypothesised that self-esteem is positively correlated to task and contextual performance.

2.1.3.7 Achievement Motivation

Achievement motivation is the human need to achieve personal goals and to demonstrate high ability. McClelland (1961) identified the need for achievement, amongst the need for affiliation and the need for power as basic human motivators, and identified the following personality traits of individuals with a high achievement motivation:

1. Individuals regularly set out challenging goals.

2. Individuals engage in calculated risks to achieve goals.

3. Individuals like to receive regular feedback on their progress towards set goals.

4. Individuals have an internal locus of control and prefer working alone.

Little academic evidence was found linking achievement motivation to performance. However, due to strong support by Pretorius (personal communication, 11 January 2019) the factor was included for study.

It is hypothesised that achievement motivation is positively correlated to task and contextual performance.

2.1.3.8 Working environment

Working environment is defined as all the characteristics of a worker's job, including the physical location at which work is performed, activities performed, interaction with co-workers and occupational safety (Raziq & Maulabakhsh, 2015). Working

environment has been found to be positively correlated to individual performance and job satisfaction. (Raziq & Maulabakhsh, 2015).

It is hypothesised that working environment is positively correlated to task and contextual performance.

2.1.3.9 Job Satisfaction

Job satisfaction is the measure of satisfaction or fulfilment an employee derives from their job.

Bakotić (2016) found a statistically significant positive correlation between job satisfaction and organisational performance. Job satisfaction can be job specific, as opposed to industry specific, and is therefore an important factor when considering variance of individual job performance.

It is hypothesised that job satisfaction is positively correlated to task and contextual performance.

2.1.3.10 Work-life Balance

Work-life balance is a term used to describe the healthy balance an individual employee must exert over personal life aspects – such as social life, family responsibilities and leisure time – and employment commitments. In the fast-paced development industry software developers are often required to work extended hours to meet deadlines. Having a poor work life balance can be detrimental to physical and emotional well-being (Haar et al., 2014). Soomro (2018) showed that a healthy work-life balance positively influences individual job performance.

It is hypothesised that work-life balance is positively correlated to task and contextual performance.

3. Research design

3.1 Research approach

The approach of the research is based on two specific research questions:

1. What is statistical significance and magnitude of the correlation between each of the hypothetical influencing factors identified (quality of formal education, quality of informal education, emotional maturity, self-esteem, achievement motivation, working environment, job satisfaction and work-life balance) to the constructs of task and contextual performance in the context of software developers in the Gauteng region of South Africa?

2. Can the hypothetical influencing factors identified be used to construct a basic model of factors affecting task and contextual performance of software developers in the Gauteng region of South Africa?

Figure 2, as adapted from Neal and Griffin (1999) shows the research approach and the specific mathematical model being prototyped for use on the individual software developer.

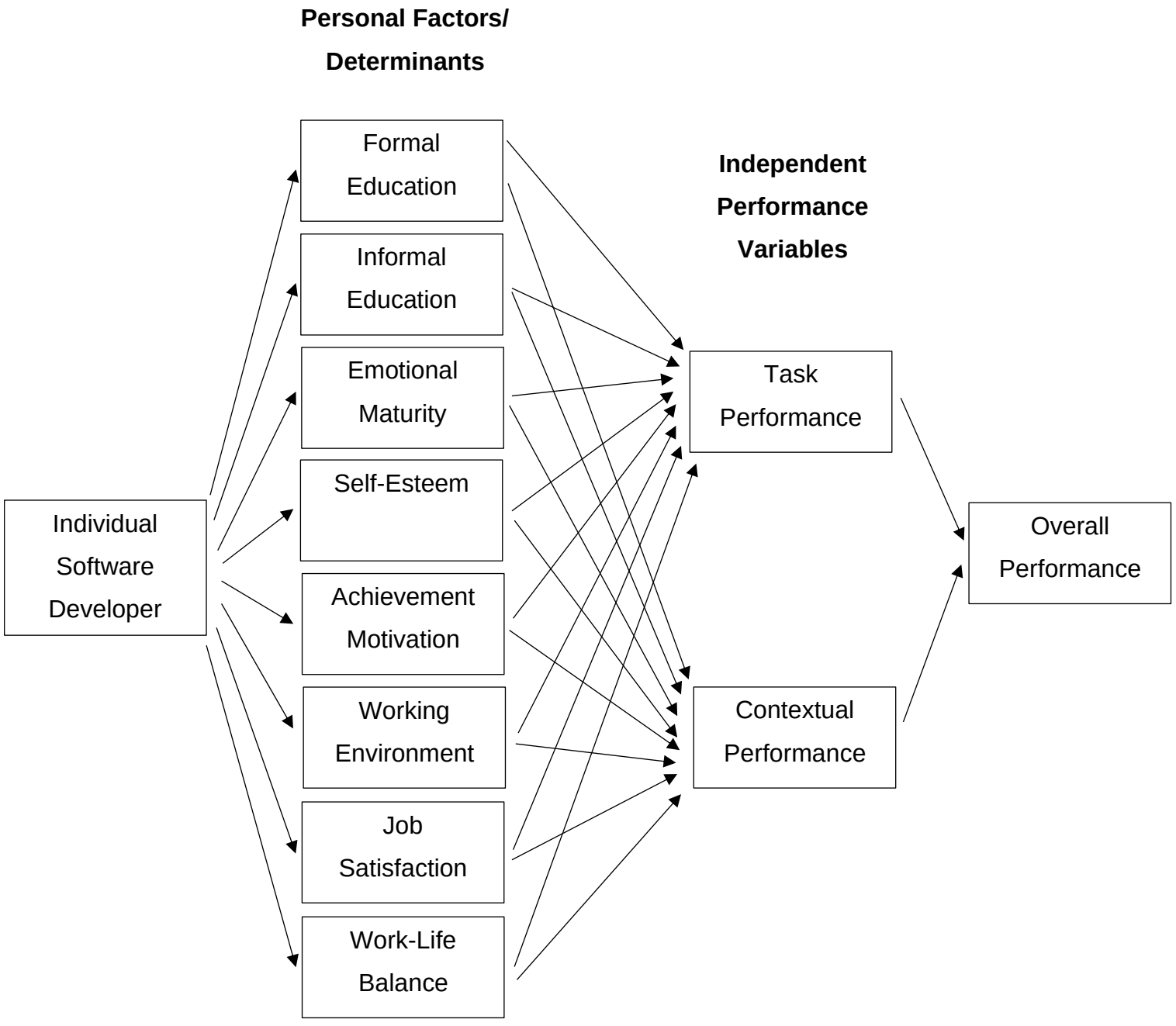


Figure 2: Proposed Model of Individual Software Developer Performance

3.2 Research Method

3.2.1 Research Design

The research is of correlational research design but may also be considered exploratory due to the gap in literature.

3.2.2 Sampling Method

Judgement/Purposive sampling was used to find a representative population of software developers. Key considerations were:

1. The representative sample should include software developers across the seniority spectrum.

2. The representative sample should include software developers working in different subdomains of software development.

3. The representative sample should include software developers working in both the public and private sector.

4. The representative sample should include software developers working in different geographical locations in Gauteng.

3.2.1 Research participants

Data was collected from participating software developers at software development firms in Parktown, Rosebank, Bryanston, Menlyn and Hatfield. Software developers often perform business functions other than developing software (Methvin, personal communication 19 July 2019). Participants were asked to confirm spending at least half of their time at work “writing, reviewing or testing code, scripts, or other programmatic logic” in order to conform to the definition of a software developer within the context of the study. The firms offered services to a multitude of sectors across the public and private sectors.

A total number of 67 responses were received. 7 of these responses were not incomplete and were removed. 3 outliers were also removed and resulted of a dataset with N = 58.

Of the 58 responses, 19 claimed to be intern level developers, 11 junior level developers, 11 Intermediate level developers, 8 senior developers and 3 top-level/executive developers.

3.2.2 Measuring instruments

A paper based self-administered questionnaire was used to collect data. Paper based media as a survey collection instrument was chosen due to anecdotal evidence of the psychographic nature of the population being targeted. Preliminary informal discussions with various software developers indicated that an invitation to an electronic survey immediately presented as spam, and as such would be ignored. Initial discussions also showed that software developers associated paper-based communication with important contractual information, and as such would be taken up with a greater level of respect for quality. For these reasons, a paper-based questionnaire was used.

3.2.2.1 Formal Education

For the purposes of this study, quality of formal education was measured by the attendance or completion of courses registered under the South African National Qualification Framework (NQF) or alternatives abroad. Examples include, but are not limited to: National Senior Certificates, Technical Diplomas, and University Degrees.

Participants to the survey were asked to select the qualifications they had obtained or attempted from a prepopulated list which was ranked from NQF level 4 to NQF level 10. Participants could indicate if they had attempted, completed, or were in progress of completing a certain qualification. The score for formal education was calculated by summing all NQF levels up to the highest NQF level achieved, starting with NQF level 4. Qualifications that were in progress or attempted counted half a score. Scores were normalised by dividing by a theoretical maximum.

A follow up question was posed and asked participants what the highest level of education they had achieved in a field directly relating to software development. The survey suggested examples such in IT as subject in Grade 12, BSc (IT), BCom (IT) and BEng (Computer Engineering). Scoring and normalisation was done as per the first question.

3.2.2.2 Informal/Self-Taught Education

Participants were asked to indicate how often they currently make use of informal education aimed at improving the skills required in their profession. The survey suggested examples such as following online tutorials, completing online courses, watching videos, or reviewing online code repositories of other developers. Four

questions using a 5-point frequency Likert scale was used to measure a participant's involvement in informal education.

Participants were also asked if they had participated in semi-structured education, such as technology specific accreditations. The survey suggested examples such as Amazon Web Services (AWS), Microsoft Learning, or Oracle qualifications. Participants were asked if they had participated in this type of learning, and if so, if they had achieved a beginner, intermediate or specialist level certification. A similar scoring to NQF levels was used to calculate semi-structured education. A score of 1 was assigned to a beginner qualification, 3 was assigned to an intermediate level of education, and 6 was assigned to a specialist level education.

An informal education score was calculated by summing the values of the Likert scale with the semi-structured education and normalised by dividing by a theoretical maximum.

3.2.2.3 Emotional Maturity

The emotional maturity of survey participants was measured using a modified version of the Emotional Maturity Scale (EMS) developed by Singh et al. (1971). The scale was chosen as it provides insight into the emotional maturity subdimensions of emotional instability, emotional regression, social maladjustment, personality disintegration and lack of independence. The scale has shown merit in peer-reviewed research.

The scale was slightly modified to use a 5-point frequency Likert scale to promote homogenises throughout the survey. The scale was also shortened to 5 questions per subdimension of emotional maturity to comply with time constraints. The scale was scored per the original scale's instructions and normalised by dividing by a theoretical maximum score.

3.2.2.4 Self-Esteem

The self-esteem of survey participants was measured using a modified version of the Rosenberg Self-Esteem scale by Rosenberg (1965). The scale measures global self-worth by measuring both positive and negative feelings about the self.

The scale was adapted to 9 questions due to time constraints and used a 5-point frequency Likert scale to promote homogenises throughout the survey. The scale was

scored per the original scale's instructions and normalised by dividing by a theoretical maximum score.

3.2.2.5 Achievement Motivation

Achievement motivation of respondents was measured of using a modified version of the Achievement Motivation Inventory (AMI) developed by Schuler et al. (2004). The original scale contains 170 questions and measures work related achievement motivation across 17 dimensions. The scale was chosen for its thoroughness and merit in in peer-reviewed research.

The scale was adapted to 10 questions due to time constraints and used a 5-point frequency Likert scale to promote homogenises throughout the survey. The scale was scored per the original scale's instructions and normalised by dividing by a theoretical maximum score.

3.2.2.6 Working Environment

The working environment factors of respondents was measured using a modified version of the Working Environment Scale 10 (WES-10) by Røssberg et al. (2004). The scale measures working environment dimensions such as workload, conflict, nervousness and self-realisation. The scale was chosen due its short nature, to comply with time constraints and for its merit in peer-reviewed research.

The scale's wording was modified to be suitable for application to a typical software development work environment and shortened to 7 questions measured using a 5-point frequency Likert scale. The scale was scored per the original scale's instructions and normalised by dividing by a theoretical maximum score.

3.2.2.7 Job Satisfaction

Job satisfaction and job incentivisation of respondents was measured using the Generic Job Satisfaction Scale by Macdonald and MacIntyre (1996). The scale was chosen due its short nature to comply with time constraints and for its merit in peer-reviewed research.

The scale was adapted to 8 questions due to time constraints and used a 5-point frequency Likert scale to promote homogenises throughout the survey. The scale was scored per the original scale's instructions and normalised by dividing by a theoretical maximum score.

3.2.2.8 Work-Life Balance

Work-life balance of survey respondents was measured by a scale developed by Timms et al. (2014). The scale was chosen for its short nature to comply with time constraints.

The scale was adapted to use a 5-point frequency Likert scale to promote homogenises throughout the survey. The scale was scored per the original scale's instructions and normalised by dividing by a theoretical maximum score.

3.2.2.9 Task Performance

Task performance of survey participants was measured by a scale developed from the findings of Goodman and Svyantek (1999) who identified the most important factors of task performance by means of a factor analysis of 221 survey measures. A scale was developed as no applicable scale could be found in existing literature.

The scale consists of 10 questions measured via a 5-point frequency Likert scale. The scale used a combination of positive and negatively scoring questions. The results were summed and normalised by dividing by a theoretical maximum score.

3.2.2.10 Contextual Performance

Contextual performance of survey participants was be measured by a scale developed similarly to that of task performance on the findings of Goodman and Svyantek (1999).

The scale consists of 11 questions measured via a 5-point frequency Likert scale. The scale used a combination of positive and negatively scoring questions. The results were summed and normalised by dividing by a theoretical maximum score.

3.2.3 Research procedure and ethical considerations

Research was conducted on site at organisations that had previously given written approval to do so.

Surveys were administered to staff that agreed to participate in the survey verbally. These members of staff were asked to gather in large rooms / boardrooms and exam like conditions were requested whilst the paper surveys were distributed and completed. All health protocols were implemented and followed as per individual company policy.

Surveys were printed with blank cover pages to ensure proper protection of data during transport. Due care was taken in handling, securing and storage of the data collected. Responses from different organisations were randomised to ensure organisational anonymity.

The following information was communicated to the survey participants verbally and via the measurement instrument:

1. Responding to the survey is completely voluntary.

2. All responses will be kept confidential and only the results of the statistical analysis of the data will be published, in a summarised form.

3. The objective of the study was made clear.

4. Minimal demographic data was collected as it was not pertinent to the study.

All respondents were to provide informed consent via a checkbox and were free to withdraw from the survey at any stage.

3.2.4 Statistical analysis

Data collected towards to each of the hypothetical factors proposed as well as to task and contextual performance self-assessments was analysed using univariate descriptive statistics to gain a deeper understanding of the data the normality thereof.

Correlations between factors identified for research and the constructs of task and contextual performance was investigated using a correlation matrix.

Stepwise exploratory linear regression was used to attempt to formulate mathematical models in response to the second research question.

The mathematical model for task performance proposed followed from the basic linear regression equation:

$$TP = \beta_0 + \beta_{FE}FE + \beta_{IE}IE + \beta_{EM}EM + \beta_{SE}SE + \beta_{AM}AM + \beta_{WE}WE + \beta_{JS}JS + \beta_{WB}WB + \varepsilon$$

Where

$TP = Task\ Performance$

$FE = Formal\ Education$

$IE = Informal\ Education$

$EM = Emotional\ Maturity$

$SE = Self - Esteem$

$AM = Achievemnt\ Motivation$

$WE = Working\ Environment$

$JS = Work - Life\ Balance$

$\beta_0 = Regressional\ Constant$

$\beta_X = Regressional\ Coefficient\ of\ X$

$\varepsilon = Error\ Term$

Similarly, for contextual performance:

$$CP = \beta_0 + \beta_{FE}FE + \beta_{IE}IE + \beta_{EM}EM + \beta_{SE}SE + \beta_{AM}AM + \beta_{WE}WE + \beta_{JS}JS + \beta_{WB}WB + \varepsilon$$

Where

$CP = Contextual\ Performance$

4. Results

4.1 Hypothesised Factors

Table 1 and Table 2 shows the results of the univariate analysis performed on the numerical scores of each of the hypothesised factors. Histograms of the results are available in appendix A. The result of the univariate analysis for each factor is briefly discussed in each of the subsections below.

Table 1

Measure	Formal Education	Informal Education	Emotional Maturity	Self-Esteem
Minimum	0.09	0.05	0.51	0.31
Maximum	0.68	0.85	0.89	0.97
Median	0.38	0.40	0.71	0.68
Mean	0.39	0.40	0.70	0.68
Standard Deviation	0.11	0.18	0.10	0.16
Skewness	0.23	0.30	-0.23	-0.27
Kurtosis	4.00	2.51	2.42	2.32

Table 2

Measure	Achievement Motivation	Working Environment	Job Satisfaction	Work-Life Balance
Minimum	0.43	0.36	0.34	0.13
Maximum	0.90	0.96	1.00	0.81
Median	0.65	0.71	0.63	0.5
Mean	0.65	0.68	0.62	0.52
Standard Deviation	0.11	0.14	0.15	0.11
Skewness	-0.16	-0.57	- 0.24	-0.17
Kurtosis	2.9	2.8	2.37	2.26

4.1.1 Formal Education

Figure A.1 shows the histogram of the normalised formal education score as described in the research method. The histogram depicts a bi-modal distribution of formal education scores with modes at estimated scores of 0.3 and 0.45. The average score is 0.38 and the distribution has moderate positive skewness.

4.1.2 Informal Education

Figure A.2 shows the histogram of the normalised informal education score as described in the research method. The histogram depicts a platykurtic distribution of informal education scores with an average score 0.4 and a moderate positive skewness.

4.1.3 Emotional Maturity

Figure A.3 shows the histogram of the normalised emotional maturity score as described in the research method. The histogram depicts a bi-modal distribution of emotional maturity scores with modes at estimated scores of 0.65 and 0.75. The average score is 0.7 and the distribution has moderate negative skewness.

4.1.4 Self-Esteem

Figure A.4 shows the histogram of the normalised self-esteem score as described in the research method. The histogram depicts a multi-modal distribution of informal education scores with an average score 0.68 and a moderate negative skewness.

4.1.5 Achievement Motivation

Figure A.5 shows the histogram of the normalised achievement motivation score as described in the research method. The histogram depicts a normal distribution with a moderate negative skewness and an average score of 0.65.

4.1.6 Working Environment

Figure A.6 shows the histogram of the normalised working environment score as described in the research method. The histogram depicts a multi-modal distribution of working environment scores with an average score of 0.71 and a large negative skewness.

4.1.7 Job Satisfaction

Figure A.7 shows the histogram of the normalised job satisfaction score as described in the research method. The histogram depicts a multi-modal distribution of job satisfaction scores with an average score of 0.62 and a moderate negative skewness.

4.1.8 Work-Life Balance

Figure A.8 shows the histogram of the normalised work life balance score as described in the research method. The histogram depicts a multi-modal distribution of work life balance scores with an average score of 0.52 and a slight negative skewness.

4.2 Formal Education

Table 3 provides an overview of the results of the formal education information collected. It shows the frequencies of the highest level of NQF accredited education completed; the frequencies of the highest level of NQF accredited education completed in the computer science field; and the frequencies of participants who had indicated that they had attempted or were in the process of obtaining a higher level of education.

Most respondents (n = 29) had completed a NQF level 7 qualification. Roughly 67% of respondents (n = 35) had completed NQF accredited qualifications with some focus on computer science, the most common NQF level being 7 (n = 19). 24% of respondents indicated that they had attempted or were busy completing a higher education. Of this group, roughly half (n = 8) indicated studies had focus on computer science, whilst the other half indicated studies into a different field (n = 6)

Table 3

NQF level	Highest level of accreditation	Highest level of accreditation in computer science	Attempted/Completing accreditation
< 4	0	0	0
4	6	6	0
5	1	0	1
6	1	3	0
7	29	19	3
8	12	6	6
9	3	1	4
10	0	0	0

Table 4 shows the frequencies of participants who had indicated that they had attempted formal, organisation specific education programs. 15% of respondents (n = 8) reported to have completed these programs. Training level was nearly equally distributed amongst beginner, intermediate and advanced programmes.

Table 4

Programme Level	Frequency
Beginner	3
Intermediate	3
Advanced	2

4.3 Individual Performance

Table 5 shows the results of the univariate analysis performed on the numerical scores of task and contextual performance. Histograms of the results are available in appendix A. The result of the univariate analysis is briefly discussed in the subsections below.

Table 5

Measure	Task Performance	Contextual Performance
Minimum	0.35	0.34
Maximum	0.98	0.89
Median	0.64	0.58
Mean	0.64	0.60
Standard Deviation	0.13	0.12
Skewness	-0.27	0.46
Kurtosis	2.64	2.93

4.3.1 Task Performance

Figure A.9 shows the histogram of the normalised task performance score as described in the research method. The histogram depicts a bi-modal distribution of task performance scores with modes at estimated scores of 0.55 and 0.75. The average score is 0.64 and the distribution has moderate negative skewness.

4.3.2 Contextual Performance

Figure A.10 shows the histogram of the normalised contextual performance score as described in the research method. The histogram depicts a normal distribution with a high positive skewness and an average score of 0.58.

4.4 Correlation Analysis

Table 15 shows the result of the correlation analysis performed on the dataset.

Table 15

	Formal Education	Informal Education	Emotional Maturity	Self-Esteem	Achievement Motivation	Working Environment	Job Satisfaction	Work-Life Balance	Task Performance	Contextual Performance
Formal Education	1									-
Informal Education	-0.26	1								
Emotional Maturity	0.10	0.08	1							
Self-Esteem	0.08	-0.06	0.67 ****	1						
Achievement Motivation	0.00	0.45 ***	0.56 ****	0.38 **	1					
Working Environment	-0.06	0.28 *	0.49 ***	0.36 **	0.33 *	1				
Job Satisfaction	0.18	-0.10	0.48 ***	0.62 ****	0.19	0.28 *	1			
Work-Life Balance	0.18	0.08	0.33 *	0.36 **	0.10	0.41 **	0.35 *	1		
Task Performance	0.14	0.08	0.63 ****	0.73 ****	0.56 ****	0.38 **	0.43 ****	0.46 ***	1	
Contextual Performance	-0.06	0.00	0.50 ***	0.63 ****	0.33 *	0.19	0.56 ****	0.25	0.55 ****	1

* p <= 0.05 ** p <= 0.01

*** p <= 0.001 **** p <= 0.0001

4.5 Regression Analysis

4.5.1 Task Performance

Exploratory regression analysis resulted in the follow multiple regression models.

$$TP = \beta_0 + \beta_{AM}AM + \beta_{SE}SE + \beta_{WB}WB$$

Where

$$TP = Task\ Performance$$

$$SE = Self - Esteem$$

$$AM = Achievement\ Motivation$$

$$WB = Work - Life\ Balance$$

$$TP = -0.035 + 0.43AM + 0.43SE + 0.19WB$$

Residual standard error: 0.07732 on 48 degrees of freedom

Multiple R-squared: 0.6823

Adjusted R-squared: 0.6624

p-value: 5.24e-12

4.5.2 Contextual Performance

$$CP = \beta_0 + \beta_{SE}SE + \beta_{JS}JS$$

Where

$$CP = Contextual\ Performance$$

$$SE = Self - Esteem$$

$$JS = Job\ Satisfaction$$

$$CP = 0.23 + 0.35SE + 0.21JS$$

Residual standard error: 0.09043 on 49 degrees of freedom

Multiple R-squared: 0.4462,

Adjusted R-squared: 0.4235

p-value: 5.165e-07

5. Discussion

5.1 Outline of the results

5.1.1 Formal Education

Analysis of the formal education data indicate that most of the respondents had been educated at a tertiary education institute, with more than half (56%) having the equivalent of a NQF 7 bachelor's degree, and 23% having a bachelor's degree with honors or a 4-year bachelor's degree. Two thirds (67%) of the sample had studied towards a degree in the computer science field. This result indicates a preference for software developers with a tertiary education of at least an NQF 7 level, most preferably in a computer science orientated field of study. Contrarily, one third of software developers had no tertiary education, indicating that the profession was not locked to those with higher levels of education.

The univariate analysis had a maximum normalised value of 0.75, indicating that very high levels of education such as NQF level 9 and 10 accreditations were not readily pursued.

The correlation analysis showed no notable correlations between formal education and any other independent variables, nor any dependent variables. Exploratory, stepwise regression analysis also resulted in the removal of formal education variable from the linear models developed for task and contextual performance. This provides further evidence to support that there is no significant correlation between formal education and task and contextual performance. No evidence is presented to support the hypothesis that quality of formal education is correlated to individual software developer performance.

The results are strongly aligned with the findings of Schmidt (2016) and shows that formal education is uncorrelated to job performance. The results do not support the findings of Ng & Feldman (2009) as there is no evidence to show that formal education is correlated to task performance or organisational citizenship behaviour. Interestingly, the results also differ from the very similar study performed on software developers in 1992 (Rasch and Tosi, 1992).

5.1.2 Informal Education

Data indicated that informal education was a personal preference among software developers with the univariate analysis showing high variance (standard deviation = 0.18) in informal education scores.

The correlation analysis showed a moderately strong (0.45), statistically significant ($p < 0.001$) correlation between achievement motivation and informal education. It is hypothesised that the individual characteristics that drives an individual's needs for achievement is likely to motivate an individual to pursue informal education in order to better themselves personally. This result is proposed as a basis for further study.

The correlation analysis showed a weak (0.28), statistically significant ($p < 0.05$) correlation between informal education and working environment. Discussions with Pretorius (personal communication, 11 January 2019) suggested that employers who seek to create better working environments in the IT sector often allow their employees dedicated time and resources to self-improve their technical knowledge. This may be evident within this result.

The correlation analysis showed no correlations between the dependent variables of task and contextual performance. Exploratory stepwise regression analysis also resulted in the removal of informal education score from the linear models developed to predict task and contextual performance. This indicates no correlation between informal education and task and contextual performance.

No evidence is presented to support the hypothesis that quality of informal education is correlated to individual software developer performance.

As with formal education, the results are aligned with those of Schmidt (2016) and do not support the findings of Ng & Feldman (2009) and Rasch and Tosi (1992).

5.1.3 Emotional Maturity

Univariate analysis of the emotional maturity scale indicated that the group of individuals surveyed performed well on the scale, with no scores below 0.5. The Mean (0.7) indicated an emotionally mature audience of respondents.

Emotional Maturity was highly (0.67) and very significantly ($p <= 0.0001$) correlated to Self-Esteem. Similarly, emotional maturity was also moderately correlated to the independent variables of Achievement Motivation (0.56, $p < 0.0001$), Working

Environment (0,49, p <= 0.001), Job Satisfaction (0.62, p <= 0.001) and Work-Life balance (0.33, p <= 0.05). These results indicate a clear underlying relationship between emotional maturity and other personal factors and strongly recommended for further study.

Emotional maturity also correlated significantly and strongly with the dependent variables of Task Performance (0.63, p < 0.0001) and Contextual Performance (0.50, p <= 0.001).

Due to concerns over multicollinearity this variable was excluded from the stepwise exploratory regression analysis. Despite its complex and non-linear relationship to other independent variables, the magnitude and significance of its correlation to task and contextual performance cannot be overlooked. The results support both the study done by Dhani and Sharma (2017) as well as the anecdotal evidence delivered by Pretorius (personal communication, 11 January 2019) that emotional maturity is an important factor in the personal performance of a software developer.

Evidence is presented to support the hypothesis that emotional maturity is correlated to individual software developer performance but is not conclusive.

5.1.4 Self-Esteem

Univariate analysis of the self-esteem survey results yielded a mean score of 0.68 but the data showed fair variance with a standard deviation of 0.16. The audience had various levels of self-esteem with the majority showing positive levels of self-esteem.

Multivariate analysis showed moderate correlation between self-esteem and other independent variables. These included Achievement motivation (0.38, p <= 0.01), Working Environment (0.36, p <= 0.01) and Job Satisfaction (0.62, p <= 0.0001). Correlation with Emotional Maturity has already been discussed. As with emotional maturity, these results indicate a clear underlying relationship between self-esteem and other personal factors and strongly recommended for further study.

Self-Esteem correlated very strongly and significantly with the dependent variables of Task Performance (0.73, p < 0.0001) and Contextual Performance (0.63, p <= 0.0001).

The exploratory regression analysis yielded very strong coefficients for Self-Esteem in predicting both task and contextual performance. In the task performance regression analysis self-esteem shared the highest coefficient of 0.43 with Achievement

Motivation. In the contextual performance regression analysis, it had the highest coefficient of 0.35.

From both the correlation and regression analysis it is evident that self-esteem is an extremely strong factor affecting the performance of the individual software developer. This evidence supports the findings by Rasch and Tosi (1992) and Baumeister et al. (2003).

Evidence is presented to support the hypothesis that self-esteem is correlated to individual software developer performance.

5.1.5 Achievement Motivation

Univariate analysis of the achievement motivation survey results yielded a mean score of 0.65 but the data showed fair variance with a standard deviation of 0.11. Most of the respondents scored between 0.5 and 0.75, indicating a moderately strong set of achievers.

Multivariate analysis showed significant correlations with Informal Education, Emotional Maturity, Self-Esteem each of which has been discussed previously in its respective section. Achievement motivation also showed a weak correlation (0.33, $p <= 0.05$) to working environment. This correlation could be explained by working environments that are conducive in fostering personal growth and skills development.

Achievement motivation showed moderate to strong (0.56, $p <= 0.0001$) correlation to task performance, and weak (0.33, $p <= 0.05$) correlation to contextual performance.

The exploratory regression analysis yielded a very strong coefficient (0.43) for achievement motivation in predicting task performance, making as important a factor as Self-Esteem. Exploratory regression analysis resulted in the removal of the achievement motivation variable for contextual performance.

From both the correlation and regression analysis it is evident that achievement motivation is an extremely strong factor affecting the task performance and weak predictor of contextual performance in the performance of a software developer. This evidence is aligned with the anecdotal evidence provided by Pretorius (personal communication, 11 January 2019). This finding is strongly recommended for further study as little academic evidence could be found showing this correlation.

Evidence is presented to support the hypothesis that achievement motivation is correlated to individual software developer performance.

5.1.6 Working Environment

Univariate analysis of the working environment score showed a normal distribution with a clear tail to the left. Whilst the mean score was 0.68, many respondents scored below 0.5, indicating a poor working environment. This can be explained by the nature of the research design – various companies were surveyed, each with its own set of working conditions. The data suggest that most developers had good working conditions, but that a certain distinct subgroup felt they had much poorer working conditions.

Multivariate analysis showed some level of significant correlation to most other independent variables. This result can be explained by the survey being taken in the workplace setting – most other personal attributes including mood, self-worth etc. can be influenced by one's physical surroundings.

Interestingly, working environment showed only a weak to moderate (0.38, $p <= 0.01$) correlation to task performance and no correlation to contextual performance. The findings are aligned with those of Raziq & Maulabakhsh (2015), however, a poorer correlation was found.

Due to concerns over multicollinearity this variable was excluded from the exploratory regression analysis.

Evidence is presented to support the hypothesis that working environment is correlated to individual software developer performance but is not conclusive.

5.1.7 Job Satisfaction

Univariate analysis of job satisfaction showed a normal distribution with a median of 0.62. However, there was quite a significant amount of variance present and a standard deviation of 0.15 was observed. This result indicates that there was quite mixed opinion on job satisfaction amongst the survey respondents.

Multivariate analysis showed that job satisfaction correlated strongly with all dependent and independent variables, except for formal and informal education. This finding aligns with the findings of Macdonald and MacIntyre (1996) and gives insight

into the non-linear positive correlation between job satisfaction and other personal emotional factors.

Due to concerns over multicollinearity this variable was excluded from the stepwise exploratory regression analysis.

Evidence is presented to support the hypothesis that Job Satisfaction is correlated to individual software developer performance.

5.1.8 Work-life Balance

Univariate analysis of work-life showed a normal distribution with a median of 0.5. However, there was quite a significant amount of variance present and a standard deviation of 0.11 was observed. The univariate statistical analysis suggests that there is no clear trend and mixed results among the survey respondents.

Multivariate analysis of work-life balance showed moderately strong, statistically significant correlations to emotional maturity, self-esteem, working environment and to the dependent variables of Task and Contextual performance. The findings support the findings of Haar et al. (2014) and Soomro (2018).

From both the correlation and regression analysis it is evident that work-life balance is a moderate predictor of contextual performance in the performance of a software developer.

Evidence is presented to support the hypothesis that work-life balance is correlated to individual software developer performance.

5.2 Conclusion

From the results it is evident that factors which influence the individual performance of software developers can be modelled and quantified in terms of magnitude and significance.

Self-Esteem, Achievement Motivation and Work-Life Balance are the most important personal factors in determining individual task performance.

Self-Esteem and Job Satisfaction are considered the most important factors in determining contextual performance.

Quality of education, formal or informal, has no correlation to performance.

5.3 Practical implications

The most notable practical implication of the study is for industry is the result that both formal and informal education do not correlate to individual software developer job performance. Widespread practises of only appointing and recruiting degreed candidates for junior software developer roles need to be reconsidered as no supporting evidence could be found to suggest higher educated individuals have higher task or contextual performance scores. These results are aligned with those of Schmidt (2016) in that level of education is uncorrelated to individual performance.

The study also highlighted and provided empirical evidence supporting fostering and maintaining good emotional health within the workplace. It is recommended that organisations implement programmes to identify and develop Self-Esteem, Achievement Motivation and Work-Life Balance in developers. In turn, this will lead to higher individual job performance scores.

5.4 Limitations

The most notable limitation in the study was the high cross correlation among independent variables. Stepwise, experimental regression was used to circumnavigate the problem, but care should be taken when sampling intangible constructs with difficult to determine cross-referencing correlations.

Furthermore, only a small number (15%) of developers had reported participation in semi-structured training whilst anecdotal evidence suggests this is a popular route of training. A hypothesis for this result was that the courses were normally targeted by specialists working on a consulting basis or “digital nomads” as opposed to developers working in a single organisation. This hypothesis would indicate a sampling error in the population that has been targeted.

5.5 Recommendations

The following recommendations are made for further study.

A moderately strong, statistically significant correlation was found between achievement motivation and informal education. It could be hypothesised that there is some form of causality between these factors, and it is recommended as a basis for further study.

Moderate to strong, statistically significant correlations were found between emotional maturity and the constructs of achievement motivation, working environment, job satisfaction and work-life balance. This finding indicates that many psychological attributes of software developers are influenced by emotional maturity. This is recommended for further study.

The study found unusually high and statistically significant correlations between emotional maturity and both task and contextual performance. Further study is highly recommended as a gap has been identified in literature on the subject and the factor was only included for study after an informal discussion with an industry expert.

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APPENDIX A

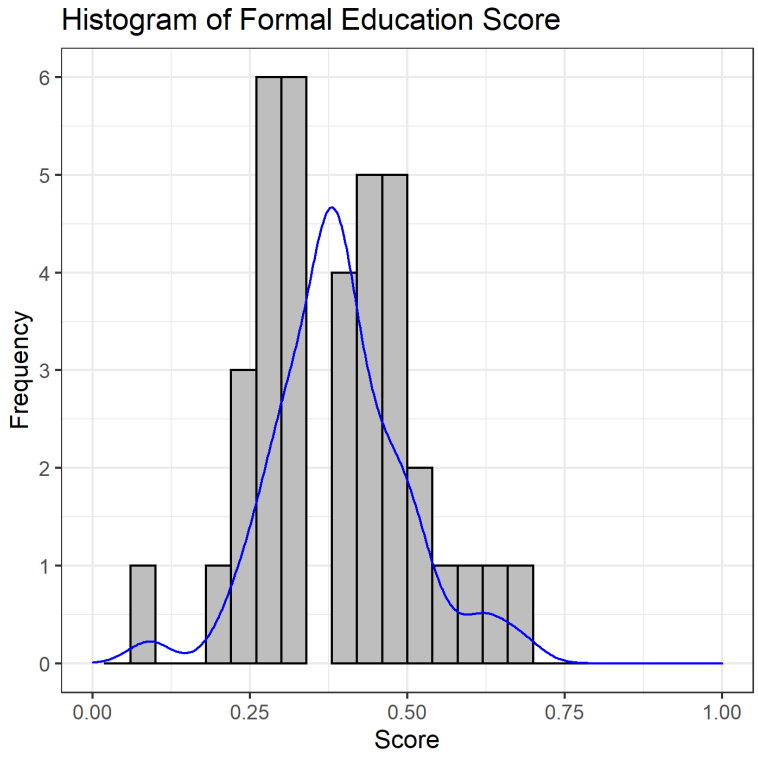


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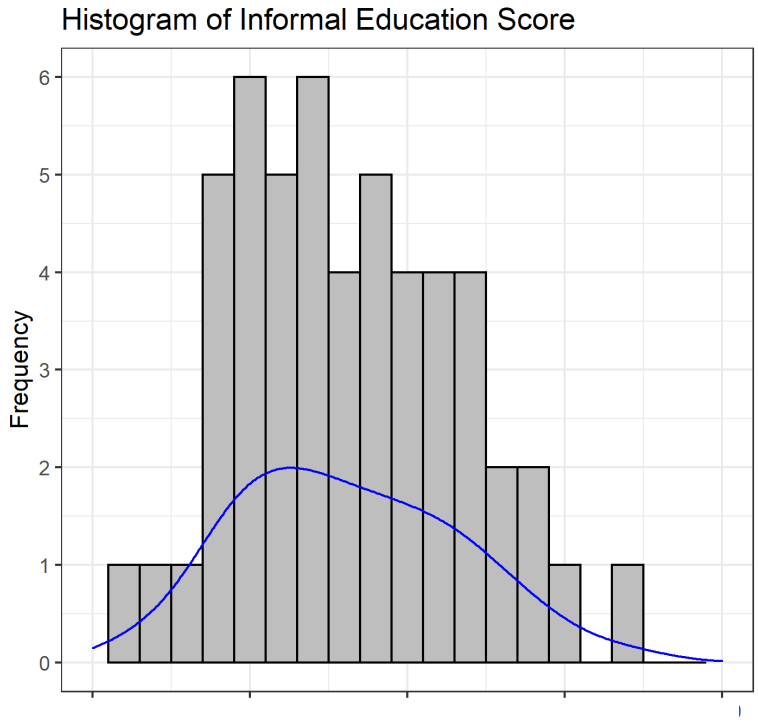


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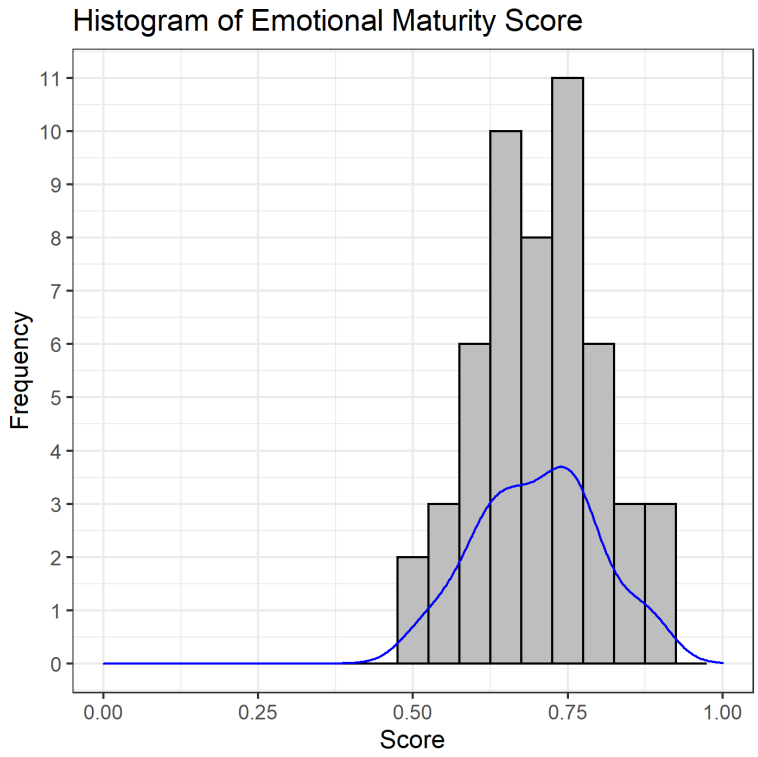


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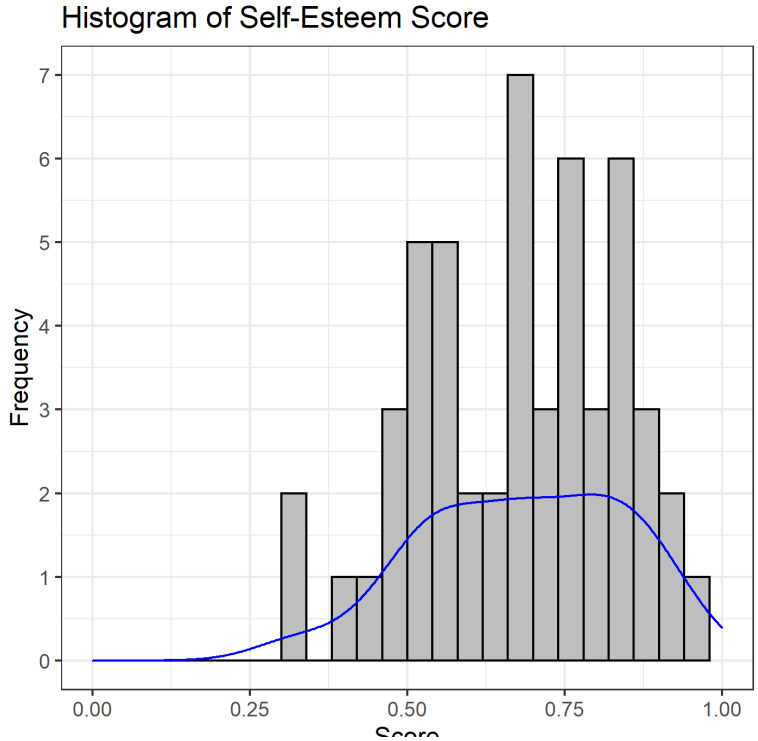


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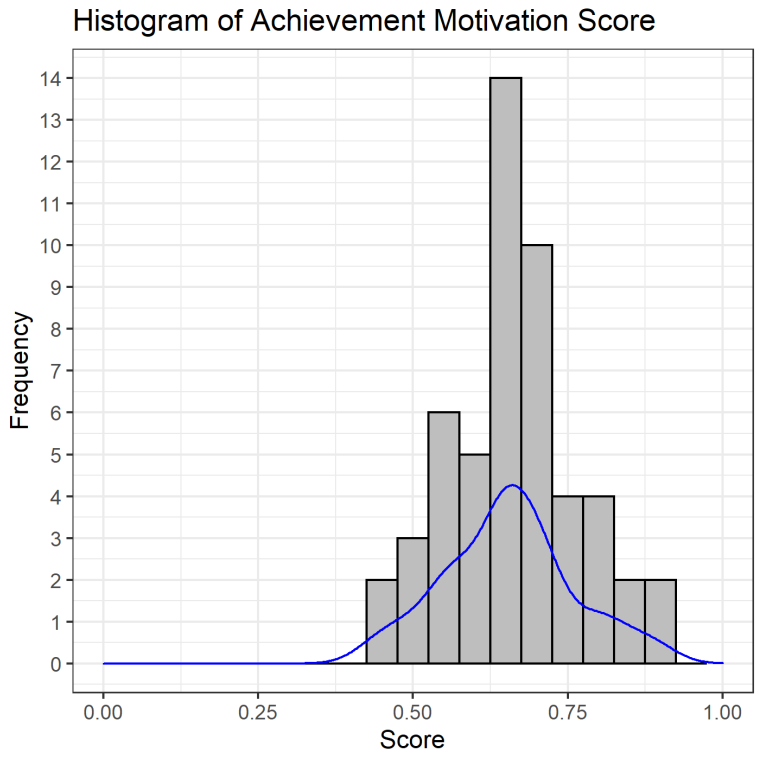


Figure A.5

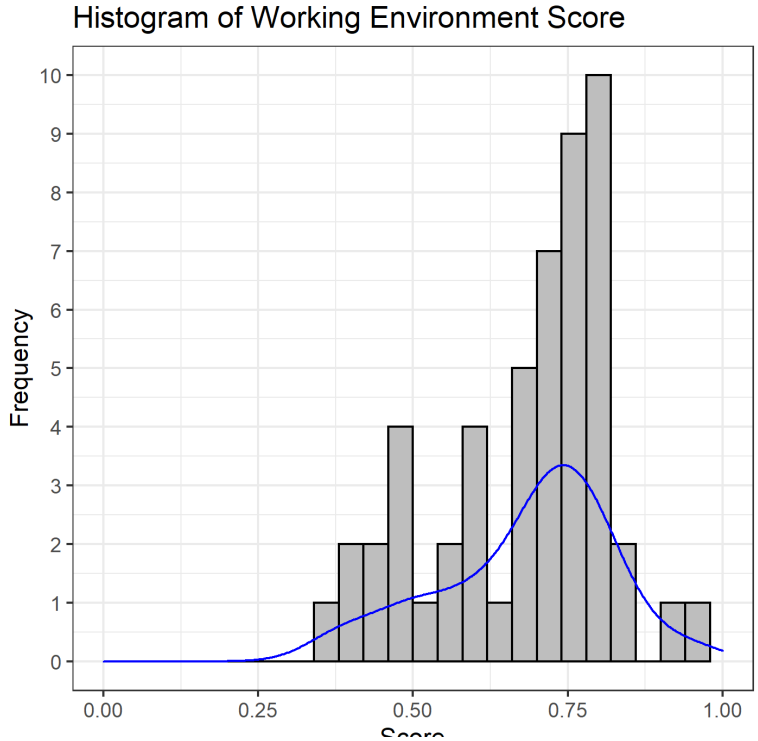


Figure A.6

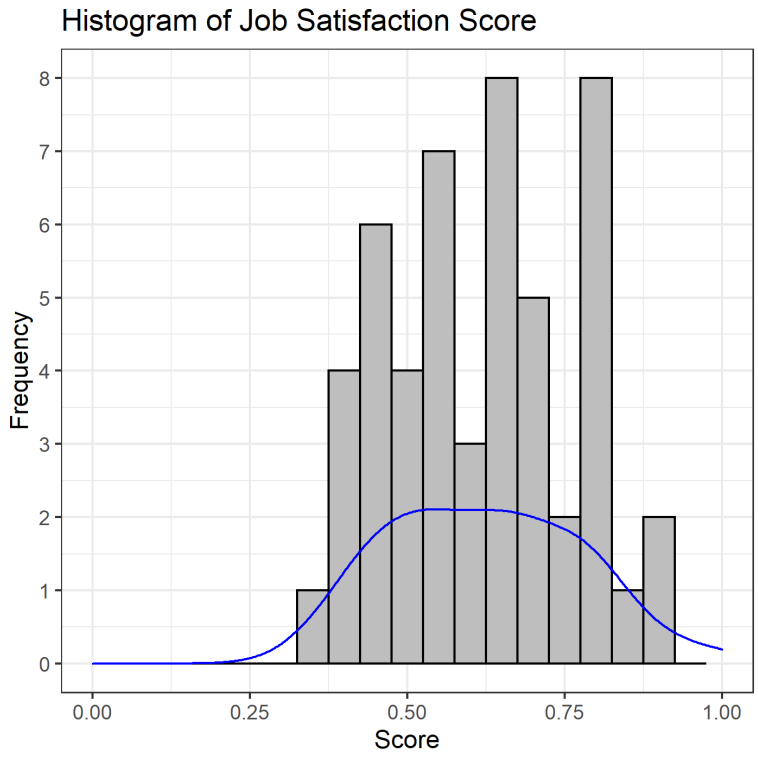


Figure A.7

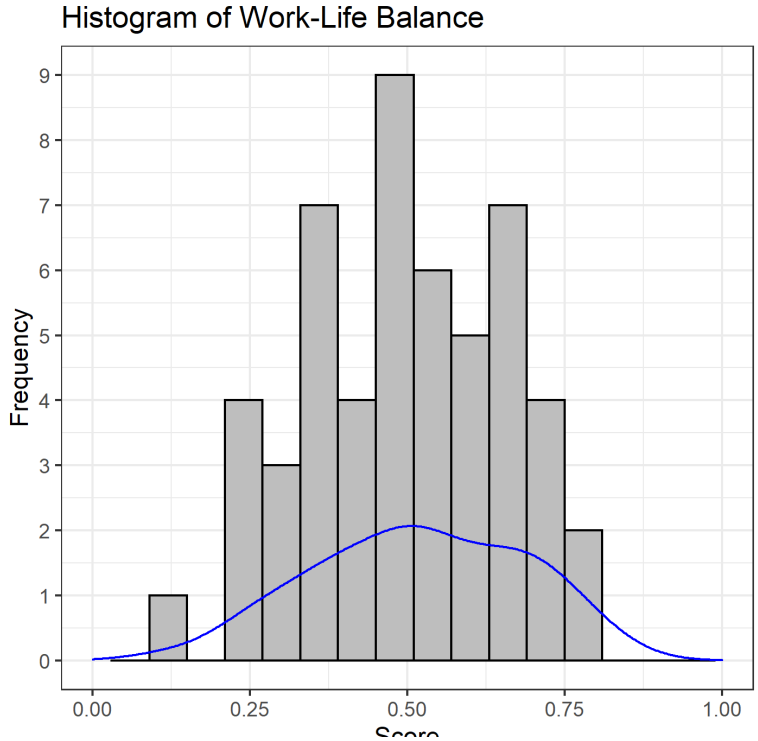


Figure A.8

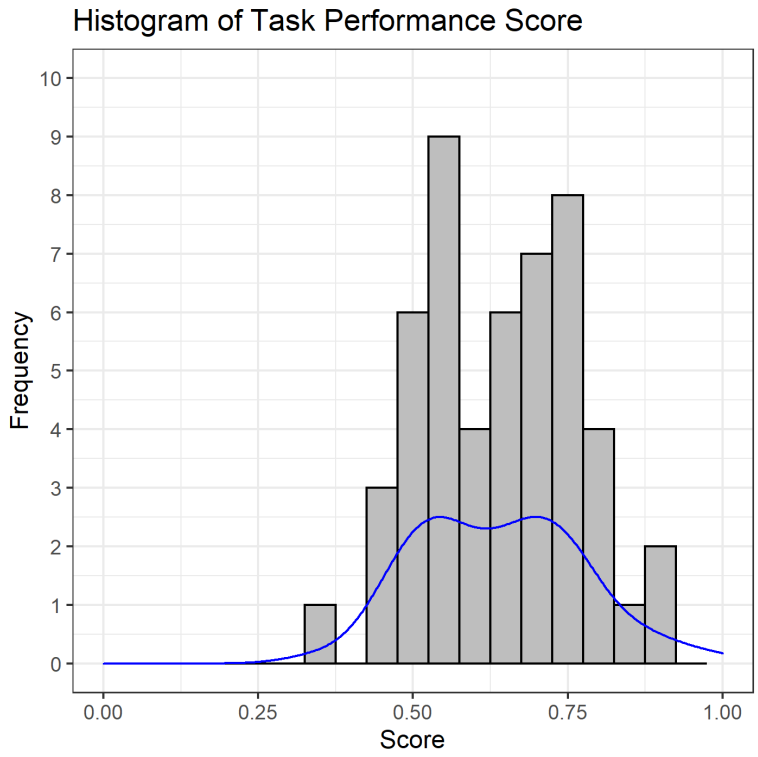


Figure A.9

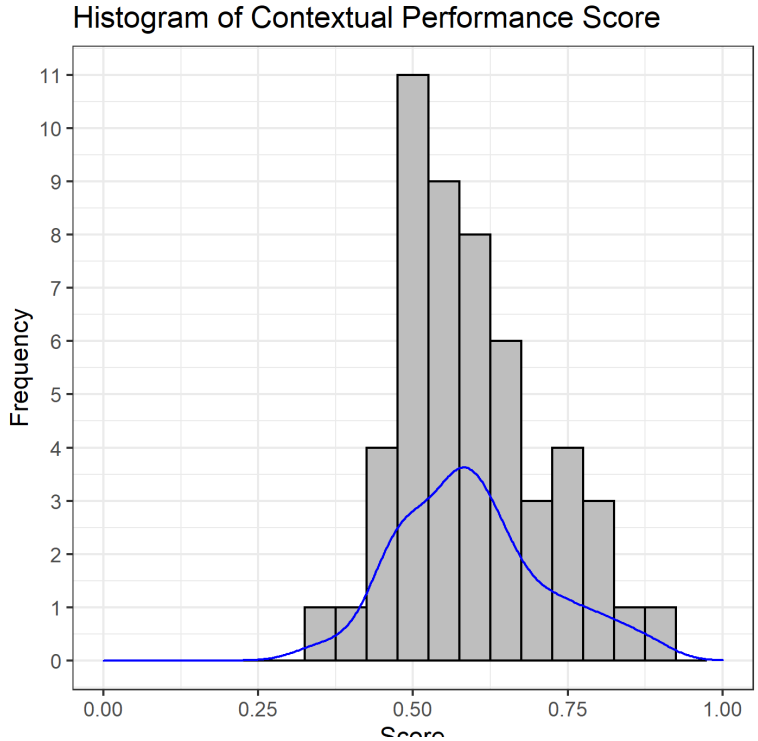


Figure A.10