

The role of team cohesion in the production performance of a chemicals manufacturing company

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ABSTRACT

In this study team cohesion of various teams in a large chemical manufacturing company is measured by utilising an adapted questionnaire for work teams based on the Group Environment Questionnaire (GEQ) as developed by Carron et al. (1985). The performance of teams is measured by utilising a team's ability to adhere to the company's production schedule over a year period. An exploratory factor analysis is conducted on the questionnaire data and four constructs were extracted. Hierarchical linear modelling is utilised to analyse the correlations that exists within the gathered data and no significant statistical relationships were identified between cohesion, its constructs and team performance, years worked in current team, total work experience and age. The adapted GEQ for work teams utilised in this study was demonstrated to be a valid and reliable measuring instrument for the company.

Key words: Team cohesion, cohesion questionnaire, team performance, adapted group environment questionnaire, Chemical manufacturing.

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LIST OF ABBREVIATIONS

Abbreviation	Meaning
AT	Individual attraction to group
ATG	Attraction to group - Task
ATOP	Adherence to operations planning
ATS	Attraction to group - Social
BU	Business Unit
GEQ	Group Environment Questionnaire
GI	Group Integration
GIS	Group Integration - Social
GIT	Group Integration - Task
KMO	Kaiser-Meyer-Olkin
NWU	North-West University
SAS	Statistical Analysis System

CHAPTER 1: NATURE AND SCOPE OF THE STUDY

1.1. Introduction

People that organise into teams for a common purpose is one of the key fundamentals of executing work in business and almost all other human endeavours (Kozlowski. 2017:205). The daily life of almost all humans are affected by the functioning of teams that conduct work every day, and the understanding of why teams are successful or why they fail is important for this reason (Kozlowski & Ilgen, 2006:78).

Work conducted in large organisations with teams that are differentiated in purpose but work as a collective towards a common goal is a concept that has developed over the latter 19th and 20th centuries. Research that focusses on the effectiveness of teams to perform has increased dramatically over the last fifty years as the functioning of teams has become more important for business and society (Kozlowski & Ilgen, 2006:77).

A team for the purposes of this study is defined by Kozlowski & Ilgen (2006:79) which states the following.

A team is defined as:

- Two or more persons that socially interact that;
- Have one or more shared goals;
- Are placed together to perform tasks that are organisationally relevant;
- With interdependencies with regard to workflow, goals, and outcomes,
- Have different roles and responsibilities;
- Are embedded as a unit in an organisational system with boundaries and connections to a broader system context and task environment.

The increase in complexity and scale in business and all other facets of human existence has necessitated the division of work into manageable jobs executed by teams that are diverse in skills and able to adapt to rapid change (Kozlowski & Ilgen, 2006:78).

As the presence of work teams became a common feature in the business environment, it resulted in the emergence of the importance of understanding the psychological landscape that underpins

the interactions that take place between team members and between different teams (Kozlowski & Ilgen, 2006:78).

The increase in diversity in the workplace has made the psychological aspects of performance even more complex and has made research on team outcomes more challenging (Webber & Donahue, 2001:142).

A conceptual framework for team effectiveness adapted from Kozlowski (2018:207) as illustrated in Figure 1.1-1 below describes the boundaries and elements of how team effectiveness is realised. The framework illustrates the inputs from team members in the form of knowledge, abilities, skills, experience and other unique abilities of individuals as team processes that includes the actions, cognition, behaviour and resource usage by teams to reach goals.

Team processes determine the effectiveness of teams and the interactions and dynamics that are involved in this collaboration is expressed as emergent states (Marks *et al.*, 2001:357). Cohesion forms part of the emergent states that impact the effectiveness of teams and the ability of teams to meet demands and reach goals (Marks *et al.*, 2001:357).

The outputs that result from the combined effort of the team are defined as team performance, team member fulfilment and the overall viability of the team (Kozlowski, 2018:206). The framework includes interventions that can influence the workings of team processes that include elements such as leadership, motivation and other organisational factors that can shape, leverage or align team processes.

The framework illustrates further how environmental dynamics and complexities drive the demands that are required from teams, and how teams reciprocally affect the environmental dynamics and complexities with their output (Kozlowski & Ilgen, 2006:78).

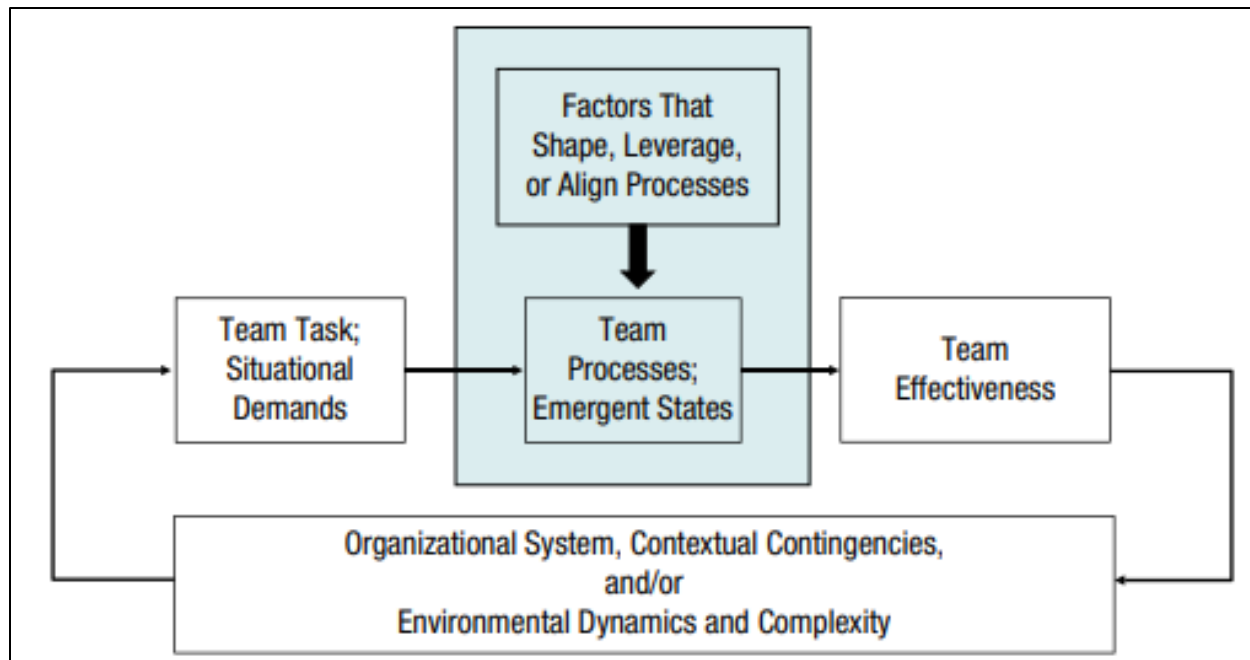


Figure 1.1-1: Team effectiveness conceptual framework

Source: Kozlowski, 2018:207

To improve the understanding of effectively managing teams in the workplace we must understand the factors and processes that play a role in determining how teams perform. The cohesiveness within teams is one of the factors that affect a team's ability to perform. It is therefore important to understand the role that team cohesion plays within teams, to maximise performance by managing the variables that impact cohesiveness.

This study is an endeavour to broaden our knowledge of team cohesion and its impact on performance by assessing the team cohesion that exists within operational teams that work in a large chemical manufacturer in the context of the performance of those teams.

To understand the role of team cohesion and its impact on a team's ability to perform optimally, we need to unpack cohesion as a construct based on the existing body of research to clearly define what factors are involved and how they interact within work teams.

Measuring the factors that influence cohesion within different work teams will enable you to characterise the cohesion that exists within these work teams.

If the work performance of different teams is viewed in the context of the cohesion that exists within these teams, we can begin to understand the possible impacts that the distinct factors of cohesion play in the performance of teams.

The measurement of the performance of teams is therefore an important part of this study because it will form the basis for understanding how the distinct aspects of cohesion impact a team's ability to consistently achieve goals.

The comparison of work team performance in different industries and work environments can be challenging because it is difficult to find a reliable performance metric that considers all the differences that exist within different work situations.

A large chemical manufacturing company with independent work teams that operate different manufacturing units within the same complex and is governed by the same policies and procedures presents an opportunity to compare team performance that is achieved under similar work conditions and performance factors.

The performance differences observed between work teams that work in the same company in similar working conditions, with similar resource availability will most probably be a more reliable comparison if the performance of all the teams is measured using the same method.

If the comparable performance of these work teams is seen within the context of the cohesion that exists within the teams, we can begin to understand what possible role cohesion plays in the observed performance.

The study is an opportunity to establish if an adapted Group Environment Questionnaire (GEQ) is a reliable instrument to measure team cohesion within a chemical manufacturing work environment.

The focus group of the study is the employees of a large chemical manufacturing company that has three main manufacturing Business Units (BU) that operate within a large facility and produce various chemicals that are sold locally and internationally. The three BUs produce different groups of chemical products that are derived from coal feedstock and are part of the same coal value chain.

The target group of this study are composed of the following trades that work as a team to operate the manufacturing plants as provided in Table 1.1-1.

Table 1.1-1: Personnel that are involved in the study

<u>Personnel group</u>	<u>Group function</u>	<u>Personnel role</u>	<u>Personnel function</u>
Production	Production personnel operate the chemical manufacturing plants and ensure that equipment produces the maximum amount of product within the design capacity of the plant	Process artisan	Process artisans physically operate the manufacturing plants and work in 12-hour shifts because the plants are a continuous operation
		Process foreman	Process foremen manage a group of process artisans per shift, and there are four foremen per manufacturing plant that work 12-hour shifts
Maintenance	Maintenance personnel maintain the chemical manufacturing units to ensure that equipment is available and operates to the intended design	Mechanical artisan	Mechanical artisans maintain all mechanical equipment in the manufacturing plants and work only the day shift
		Mechanical foreman	Mechanical foreman manages a group of mechanical artisans and there is one responsible mechanical foreman dedicated per manufacturing unit
		Electrical artisan	Electrical artisans maintain all electrical equipment in the manufacturing plants
		Electrical foreman	The electrical foreman manages a group of Electrical artisans
		Instruments artisan	Instrument artisans maintain all instrumentation equipment in the manufacturing plants
		Instruments foreman	The instrument foreman manages a group of Instrument artisans

Source: Own compilation

The manufacturing departments are operated by operations teams that work shifts as the manufacturing process is a continuous 24-hour-a-day operation. All the manufacturing departments are supported by dedicated maintenance teams that maintain all the manufacturing units with the assistance of outside maintenance contractor companies, who are supervised by permanently employed maintenance staff. The maintenance and operating teams consist of a highly diverse labour force in terms of gender, age, race, culture, experience and education.

The number of persons that work within the three BUs that operate and maintain the manufacturing units is provided in Table 1.1-2.

Table 1.1-2: Operations personnel per business unit

Operating entity	BU1	BU2	BU3	Total
Number of employees	228	165	221	614

Source: Own compilation based on internal company reports

The production personnel run a total of twelve manufacturing plants that span across the three business units that consist of natural working teams with representatives from all personnel roles as provided in Table 1.1-1. The twelve natural work teams are solely responsible for the operation and maintenance of the twelve manufacturing plants that are included in the study and work completely independent from each other. All twelve teams are governed by the same policies, procedures and standards and have access to similar support services and company resources to maintain and operate their manufacturing plants.

1.2. Problem Statement

In any large organisation, there are groups of employees that are assigned to work together in teams to serve a function. The ability of these teams to execute their function is influenced by a range of factors that need to be controlled by management to ensure optimum performance. The cohesiveness that exists within teams is one of the factors that affect the ability of a team to perform tasks (Mullen & Copper, 1994) (Tekleab et al., 2016).

The dynamics that play a role in operational team cohesion are not always well understood by management and are not actively managed. Previous studies demonstrate that team cohesion does play a role in the performance of teams and should be managed to contribute towards extracting the most out of work teams (Lee & Ko, 2019).

Team cohesion is not presently formally managed in the company that is part of the study and is only addressed if problems are reported to management. This is a reactive approach which can be improved if the variables that affect team cohesion are proactively monitored and negative trends addressed before serious negative effects develop.

The main research question for the study is:

- What role does team cohesion play in the production performance of different operational work teams within a large chemical manufacturing business?

Subsidiary questions:

- Is there a statistically significant relationship between the individual constructs of team cohesion and production performance?
- How do the age, experience and years spent in the current work team affect the different elements of team cohesion?
- How can this study help managers to improve the performance of teams?
- How can this study help managers to improve the cohesion of teams?
- Is the adapted GEQ for work teams a valid and reliable measuring tool within a chemical manufacturing work environment?

1.3. Objectives of the study

1.3.1. Primary objective

The main objectives of the study are based on the primary research question in section 1.2 and are listed below.

- Determine if overall team cohesion as measured by the adapted GEQ is a significant factor in the ability of work teams to adhere to the production plan.
- Establish if the adapted GEQ for work teams is a valid and reliable instrument for assessing the cohesion that exists within work teams.

1.3.1.1. Secondary objectives

- Determine if constructs of the cohesion model as proposed by Carron (Carron et al. 1985:248) has a statistically significant impact on the production performance of work teams.
- Assess how cohesion is influenced by work experience, years worked in the current work team and age differences in the work force.

1.4. Scope of the study

The scope of this study is to measure the team cohesion of operational teams that work in a large chemical manufacturing company and to establish how the performance of these teams is influenced by the differences that are observed in the team cohesion that exists within the teams.

The study will be quantitative in nature as the data will be collected in the form of a questionnaire that will be distributed to all operations personnel. A quantitative method has been selected utilising questionnaires as a data collection instrument because the study involves inputs from approximately six hundred employees that are situated in a chemical manufacturing complex. The adapted GEQ distributed via E-mail will be the most effective and practical method to achieve the best response rate.

The GEQ will be utilised to determine the cohesiveness that exists within the various operational teams in the company. The Adherence To Operations Planning (ATOP) measurement will be utilised to determine the operational performance of the various production teams in the company. ATOP is the performance measurement that is used in the company to determine how effectively a manufacturing unit has been operated over a month and is based on a production schedule that is calculated per manufacturing unit.

$$ATOP (\%) = \left[\frac{\text{Volume of product produced in one month by unit}}{\text{Required volume according to production schedule}} \right] \times 100$$

Equation 1: Adherence to operations planning

The study will be cross-sectional in nature as the team cohesion of various operational teams will be quantified at a single point in time and relationships in this data will be examined in the context of the operational performance of the distinct groups.

By comparing the production performance of different operational teams and the measured team cohesion, we will be able to make conclusions regarding the impact of team cohesion on overall production performance.

To effectively run a chemical manufacturing plant requires knowledge, experience, teamwork, communication and coordination that ultimately results in the production of chemical products that can be sold.

For a large company to be competitive, it needs to control an extensive number of variables to ensure that saleable products are produced at the lowest price and highest quality. It will therefore be beneficial for a company to understand what impact team cohesion has on the ability of teams to operate and maintain chemical plants effectively and sustainably.

Three business units that operate within a chemical manufacturing company, situated in the same geographical area will be assessed. The study focuses on production teams who are responsible for operating the plants and maintenance teams who repair and maintain the plants.

The operations personnel that are targeted in this study, are the employees in the organisation that have the most significant and direct impact on the performance of the production units and the company's ability to compete because they directly operate and maintain the equipment.

1.5. Research methodology

1.5.1. Literature/theoretical study

The literature review was conducted for this study to establish a knowledge base for the following aspects.

- To understand how team cohesion is defined in the existing body of literature and what constructs are part of cohesion.
- To understand what studies have been conducted regarding the possible impact of team cohesion on performance.
- How team cohesion as a concept fits into the variables that play a role in the performance of work teams.

In the literature review, team cohesion is defined as a construct based on the existing body of knowledge that exists to enable an understanding of the different components that play a role within

1.5.2. Empirical study

The research methodology applied in this study is structured around the conceptualisation of team cohesion and the application of a measuring instrument that is based on this conceptualisation. A measurement instrument is designed to quantify the cohesion that exists within different teams, based on the conceptual framework of cohesion that has been developed over time.

This study intends to characterise and quantify the cohesion of independent work teams and to determine statistically if any differences between teams can predict performance. In this way, the relationship between cohesion and performance is further investigated in the chemical industry in an environment where independent work teams can be directly compared in terms of production performance and cohesion.

1.5.2.1. Research design

The study was designed using a quantitative approach to enable a statistical evaluation of collected data and to make conclusions based on the statistical results. The cohesion that exists within different work teams at one point in time is quantified using a questionnaire with seventeen close-ended questions regarding the individual's perceptions based on an adapted version of the GEQ for work teams. The questionnaire includes five personal factual questions to collect data regarding the demographics and experience of the participating population.

The validity and reliability of the adapted GEQ is explored statistically to establish if the measuring instrument for team cohesion utilised in the study is adequate.

The quantified cohesion of different teams is statistically explored in the context of the performance of the different teams over a twelve-month period. A performance measurement that represents a team's ability to produce product as planned is used to quantify the effectiveness of the team.

The research design of the study is summarised in Figure 1.5-1 below including all the main steps of the study.

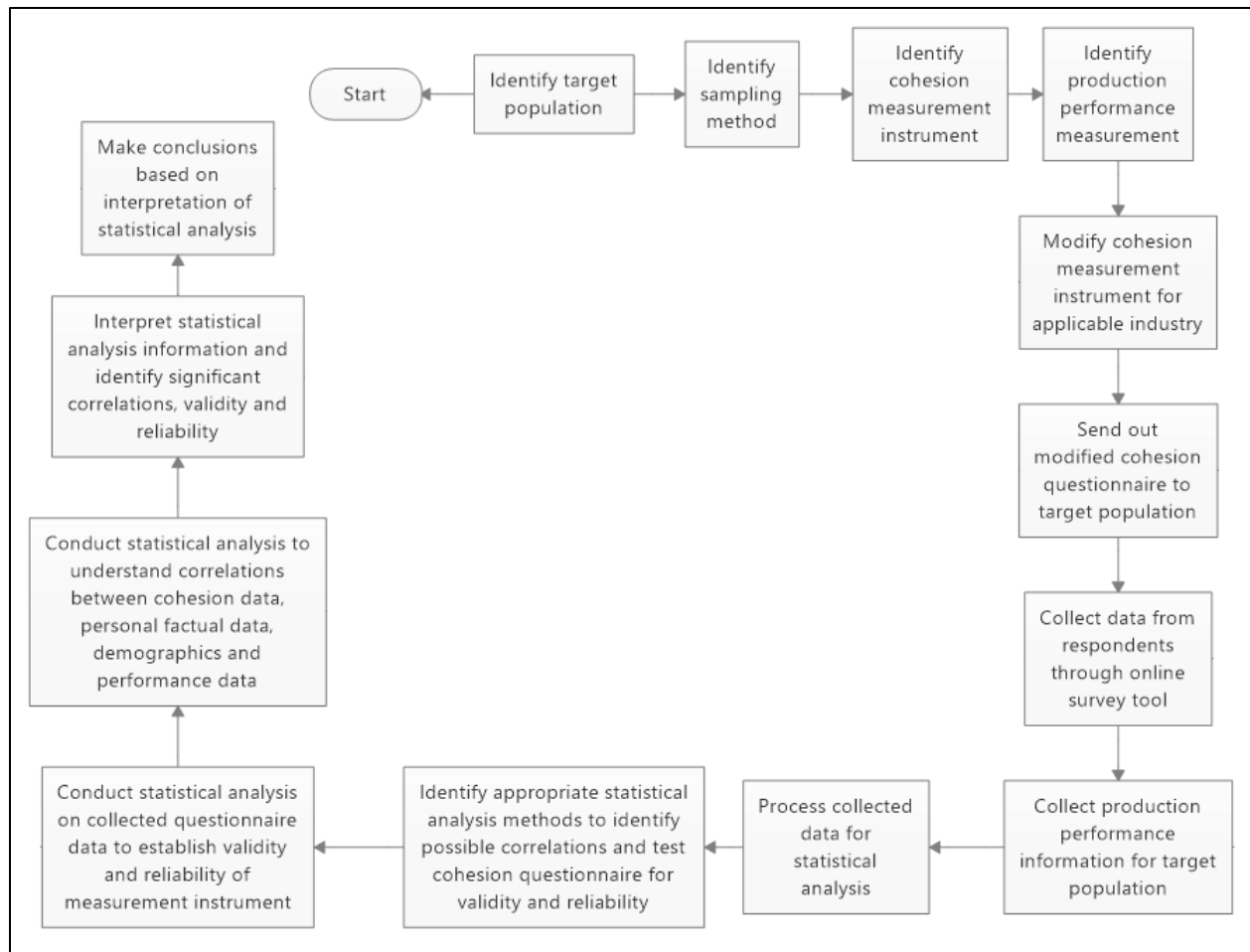


Figure 1.5-1: Research design

Source: Own compilation

1.5.2.2. Target population group

The target population of the study was identified by evaluating what groups of employees have the most significant impact on the production performance of the company. Based on the structure of the company and the nature of the industry it was determined that the personnel that physically operate and maintain the manufacturing units were the most significant employee groups that determine production performance.

The accessibility of the target population was considered to ensure that the collection of data would be practical. The majority of the production and maintenance personnel in the company have access to electronic mail which allowed for easy distribution of the questionnaire and a convenient platform for personnel to respond.

All personnel that was part of the study work for the same division that is part of a greater company that operates a large chemical production complex. All persons in the greater complex report to the same top management structure and the divisions are differentiated at the Vice-President level and BU's are differentiated at the Senior-Management level.

The company structure and the position of the target population within the structure are illustrated in Figure 1.5-2 below. Although the BU's are part of a regional operating entity, they operate mostly independently within the governance structure of the regional entity and share the policies, standards and generic procedures of the same regional operating entity. All BU's share hosted resources with each other in terms of support services, such as human resources and other functional departments.

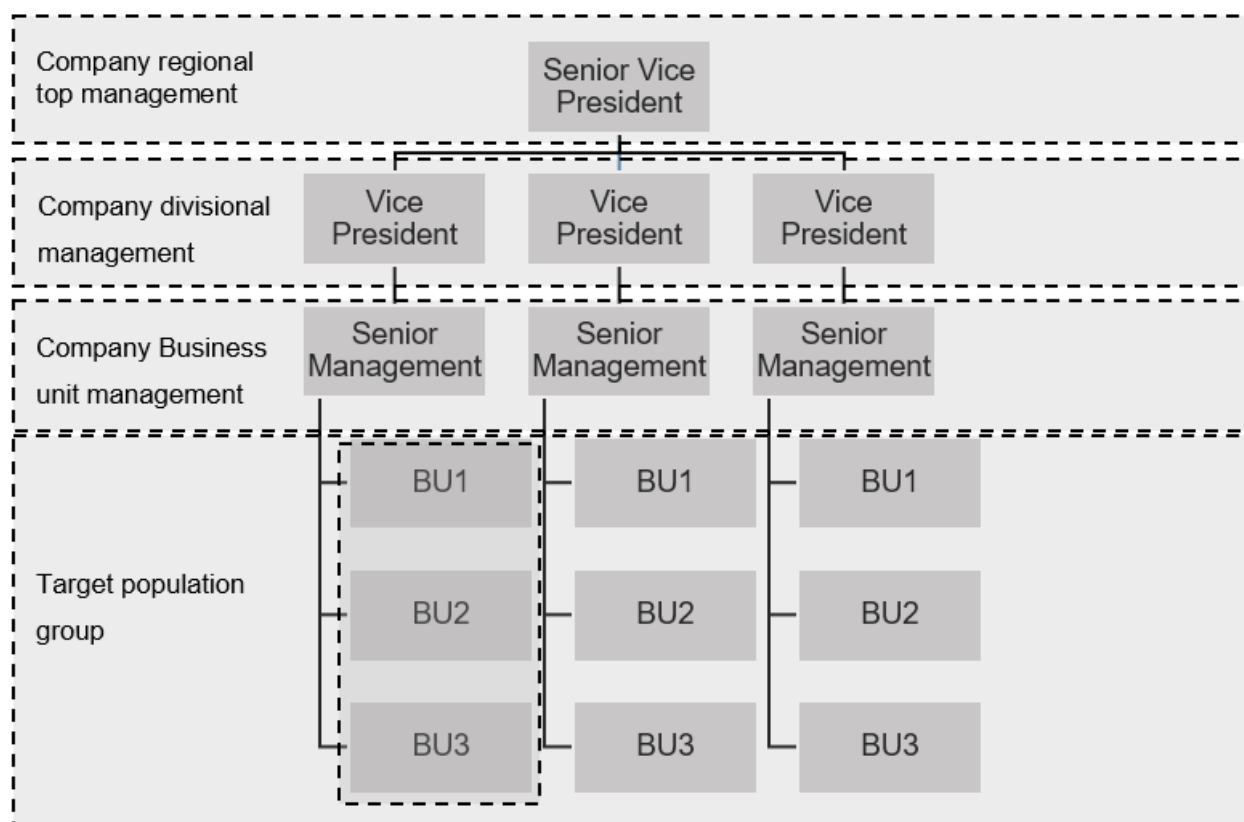


Figure 1.5-2: Company structure

Source: Own compilation

1.5.2.3. Cohesion measurement instrument

A questionnaire was selected as the most adequate measurement instrument for this study because the size of the study population required an instrument that could gather enough information from the population to represent a statistically significant sample. A questionnaire could be distributed to the study population easily and allowed participants to submit data without any significant disruption to their work. By using a questionnaire, information could be gathered in a relatively short amount of time and the format that the data is captured allows for minimal data rework to enable statistical analysis.

The GEQ has been extensively used as a measuring tool for cohesion in teams (Whitton & Fletcher. 2013) and is a reliable instrument and a good fit for this study because the questionnaire prioritises the social and task dimensions of cohesion as recommended in a study by Salas, Grossman *et al.* (2015:372).

The original GEQ questionnaire as provided in Annexure A is structured around the conceptual framework as defined by Carron *et al.* (1985) and the question structure is illustrated in 1.5-1 below. The original GEQ included 18 questions in the form of statements, with a 9-point Likert scale that ranged from Strongly disagree (1) to Strongly agree (9). Questions 1, 2, 3, 4, 6, 7, 8, 11, 13, 14, 17 and 18 are reverse scored in the original GEQ (Carron *et al.*, 1985).

Table 1.5-1: Original GEQ questionnaire structure

Construct	Related questions
Attraction to group - Task (AT-G)	Q2 + Q4 + Q6 + Q8
Attraction to group - Social (AT-S)	Q1 + Q3 + Q5 + Q7 + Q9
Group Integration - Task (GI-T)	Q10 + Q12 + Q14 + Q16 + Q18
Group Integration - Social (GI-S)	Q11 + Q13 + Q15 + Q17

Source: Carron *et al.* (1985)

The original GEQ questionnaire was created to measure cohesion in sports teams and the questions apply to a sports team setting. To make the GEQ relevant to this study it had to be adapted to apply to the workplace setting which was achieved by eliminating questions that had no context in the workplace and certain questions were adapted to apply to the workplace.

The original GEQ was adapted to be applicable to work teams by replacing all references to a team, to work team and by changing questions to similar work-related situations where questions

reversed specifically to sport-related situations. An example of a question that was changed from a sport-specific reference to a work-related reference is the following.

Question 3 from the original GEQ requested the following

- I am not going to miss the members of this team when the season ends (Original GEQ question 3)

Question 3 from the original GEQ was modified to the following question

- I am not going to miss the members of this team when I leave this department (Adapted GEQ for work teams question 2)

Question 2 of the original GEQ was eliminated from the questionnaire because it does not have any purpose in the setting of the chemical manufacturing industry. The question has been deleted as recommended by Carron & Brawley (2000) to make the questionnaire relevant for the specific industry where it is applied.

The adapted GEQ for work teams is provided in Annexure B and the question structure for the adapted GEQ for work teams is provided in Table 1.5-2 below. Questions 1, 2, 3, 5, 6, 7, 10, 12, 13, 16 and 17 are reversed scored in the adapted GEQ.

Table 1.5-2: Adapted GEQ for work team's questionnaire structure

Construct	Related questions
Attraction to group - Task (AT-G)	Q3 + Q5 + Q7
Attraction to group - Social (AT-S)	Q1 + Q2 + Q4 + Q6 + Q8
Group Integration - Task (GI-T)	Q9 + Q11 + Q13 + Q15 + Q17
Group Integration - Social (GI-S)	Q10 + Q12 + Q14 + Q16

Source: Own compilation

1.5.2.4. Production performance measurement

The ATOP data that was utilised for this study forms part of an internal company report that is distributed to all production teams on a monthly basis. The ATOP performance data is expressed as a percentage that indicates the volume of product that was produced by a plant in relation to the amount that was planned to be produced over a month. The performance data for the financial year ending June 2019 was used as an indicator of performance in this study.

The ATOP performance report for each production team is used by management to understand if teams can consistently produce products according to an agreed schedule by controlling the variables that are within their span of control. When performance is below target for the month, losses are analysed to understand what the causes were and improvements are made as a result.

ATOP was identified as an appropriate production performance measure because it is a measure of how effectively a team can deliver saleable product as required by a production schedule.

The production schedule considers the following factors to determine how much product should be produced in a month by each manufacturing unit.

- Market demand
- Seasonal demand
- Supply chain and transport limitations
- Feedstock limitations
- Planned maintenance activities and downtime
- Storage capacity
- Downstream and upstream limitations
- Manufacturing unit design capacity
- Environmental licence and permit requirements

ATOP is a good general indication of a team's performance in terms of maintaining equipment and operating the unit effectively which requires multiple skills, communication, coordination and effective team work.

The ATOP measurement represents a team's ability to effectively execute its goals in a complex and dynamic work environment and is an indication of how a team contributes towards the company's bottom line by predictably producing quality products within set timelines.

ATOP is a very dynamic performance measurement as it is updated on a monthly basis to reflect the volume of product that will be required from each team based on the variables that can be controlled by the teams.

1.5.2.5. Statistical analysis

The statistical analysis for this study was conducted by the Statistical department at the NWU which is situated in Potchefstroom. The statistical analysis for this study was conducted using Statistical Analysis System (SAS) which is software that was developed for data analysis and report writing SAS (2015).

1.5.2.6. Factor analysis

An exploratory factor analysis was conducted to determine if the grouped questions per construct as provided in Table 1.5-2 above, measured distinctive constructs as expected. The exploratory factor analysis was conducted per construct since the internal structure of the questionnaire was expected to be consistent with the existing literature as described in Carron *et al.* (1985) and Whitton and Fletcher (2013).

1.5.2.7. Correlation analysis

The statistical correlation was determined by using hierarchical linear modelling. The dependency with regards to teams was considered by utilizing the hierarchical linear model with PROC in SAS with the use of PROC SURVEYREG. All guideline values that were considered are as proscribed by Field (2009) concerning statistical significance.

Hierarchical linear modelling was preferred as a method of analysis in this study because it applies to grouped data, such as groups of people nested in an organisation (Huta. 2014:13). This approach is therefore fit for identifying significant correlations within data from different teams within the same company which is the purpose of this study.

The statistical significance of the relationships that exist within the data was established between the following variables.

- ATOP and total cohesion
- ATOP and cohesion constructs
- Age and total cohesion
- Age and cohesion constructs
- Work experience and total cohesion
- Work experience and cohesion constructs

- Time spent in current team and total cohesion
- Time spent in current team and cohesion constructs
- Relationship between cohesion constructs
- Relationship between all adapted GEQ for work groups questions

1.5.3. Assumptions of the study

The following assumptions are made in the study and the results and conclusions that are produced in this study must be interpreted in the context of these assumptions.

- It is assumed that all the participants in this study have answered the questionnaire truthfully and that the answers that were provided are a true reflection of their own work experience.
- No participants were influenced in any way to provide answers that were not a reflection of their own opinion.
- All participants in the study work for the same company in the same location and receive similar support from the company to enable them to conduct their work.
- The cohesion that exists within the different work-teams has not changed drastically over the 12 months before when the questionnaire was completed by the participants.
- The company did not go through any large-scale restructuring for 5 years before this study with work teams remaining stable throughout this period. It is therefore assumed that personnel and company structure changes did not significantly affect team cohesion within teams and production performance.

1.5.4. Layout of the study

This report is divided into the following chapters:

Chapter 1 – Nature and scope of the study

- Introduction and overview of the company are documented to put the study into context.

- The problem statement of the study is defined, and the main research questions are provided to enable an understanding of the intent of the study.
- The objectives of the study are determined to guide the study in its desired outcomes.
- The scope of the study is defined to create an understanding of how the study will be approached, what instruments will be involved, and methods used are rationalised.
- The research methodology that was utilised is defined including a description of the literature and limitations of the study

Chapter 2 – Literature review

- The literature review describes cohesion as a concept and the relationship between team cohesion and performance is documented in the view of existing literature.
- The literature on the relationship between leadership and cohesion is documented.
- All relevant references are provided.
- The literature review provides the required context to understand the study in light of the existing research that has been conducted on team cohesion and its relationship with performance.

Chapter 3 – Empirical study

- The methods utilised for the gathering of data is described.
- The target population is described in terms of age, work experience and years worked in current team.
- The team performance is provided in the average ATOP achieved per team.
- The response data from the adapted GEQ is described.
- The questionnaire validity and reliability assessment is provided and discussed
- The correlation analysis is described between the cohesion measurement, population differences and performance measurement.

Chapter 4 – Results and conclusions

- The main and subsidiary research questions are answered.
- Conclusions are made based on statistical results.
- Recommendations are made based on study outcomes.
- Objectives achieved by the study are discussed.

- Recommendations for future studies are proposed.

A summary of the layout of the study is provided in Table 1.5-3 below.

Table 1.5-3: Layout of the study

Chapter	Content
Chapter 1	Nature and scope of the study
Chapter 2	Literature review
Chapter 3	Empirical study
Chapter 4	Conclusions and recommendations

Source: Own compilation

1.5.5. Ethical considerations

The study was relatively low risk regarding the probability to cause harm to any company, individual or group because no sensitive information was used for the study. The ethical principles related to research in business are divided into four categories according to Bryman *et al.* (2017:120) which are listed below.

- Harm to participants
- Lack of informed consent
- Invasion of privacy
- Involvement of deception

The only risk of harm to participants was if the information that was provided by them was made available to other persons in their department or management. This was prevented by ensuring the anonymity and confidentiality of the data and by limiting access to the data. In this way, the privacy of all participants was protected. Participants were reassured in the letter of consent that all data would remain anonymous and confidential.

Participation in the study was entirely voluntary and an informed consent letter was provided to all participants to explain the intention and purpose of the study. Participants were given no incentive to participate in the study and all participation was exclusively voluntary.

No participants were deceived in any way and it was made clear in the letter of consent that the success of the study relied significantly on the honest and accurate participation of all respondents.

Ethical clearance was obtained from the Economics and Management Research Ethical committee of the NWU and the ethical clearance letter with the number NWU-01397-19-A4 is provided in Annexure E of this report.

CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

To improve the understanding of effectively managing teams in the workplace we must understand the factors and processes that play a role in determining how a team performs. The cohesiveness within teams is one of the factors that affect a team's ability to perform. It is therefore important to understand the role that team cohesion plays within a team to maximise performance by managing the variables that impact cohesiveness.

This study is an endeavour to broaden our knowledge of team cohesion and its impact on performance by assessing the team cohesion that exists within operational teams that work in a large chemical manufacturer and the performance of those teams. The study is also an opportunity to establish if the Group Environment Questionnaire (GEQ) is a reliable instrument to measure team cohesion within a chemical manufacturing work environment.

2.2. Literature review

To enable society to function we are required to collaborate with other people to execute certain tasks more effectively and efficiently. During collaboration, there are several factors and processes that affect the ability of a group of individuals to execute a determined task. Typically, people are organised into work teams that serve a specific function within a company with common goals to collectively execute the business strategy and create value. It is therefore beneficial to understand what processes drive the ability of work teams to operate effectively and to achieve goals.

A theoretical framework proposed by Yeatts (2001:83) describes the factors that affect self-managed work team performance as provided in Figure 2.2-1 below. This theoretical framework proposes four main work process factors that directly impact the performance of teams.

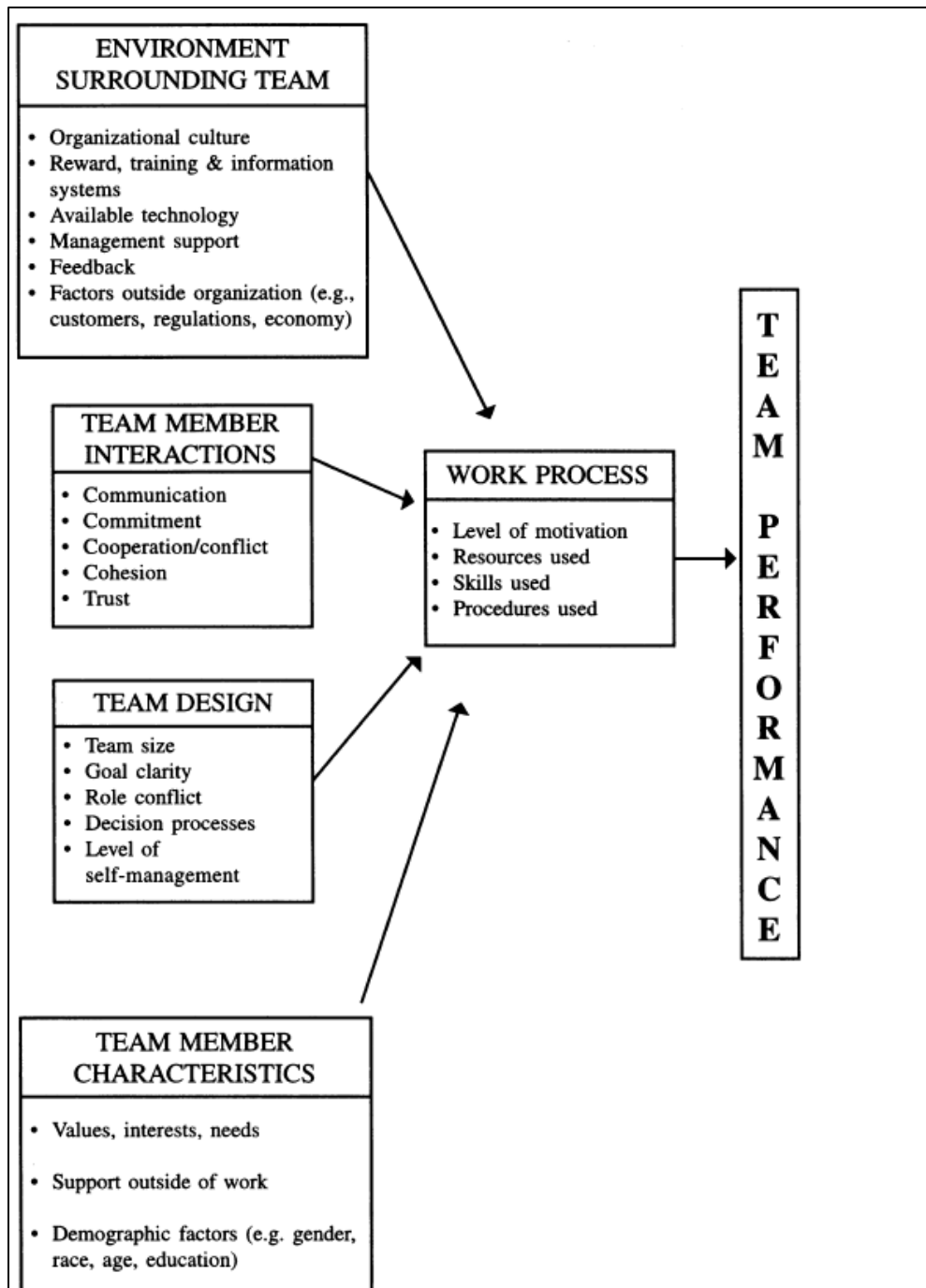


Figure 2.2-1: Factors affecting self-managed Work Team performance
 Source: Yeats et al., 2001:83.

2.2.1. Cohesion defined

One of the team processes that affect a group is team cohesion which was first proposed in 1950 by Festinger (1950:274) and was defined as “the resultant of all the forces acting on the members to remain in the group”.

Team cohesion is described by Beal et al. (1998:989) as the degree to which individuals of a group are prepared to contribute towards its functioning as a unit in pursuit of a goal.

The early definitions of team or group cohesion were unidimensional like the definition from Festinger (1950), however, this early definition was too general and imprecise which made the development of measurement instruments and specific constructs problematic (Craig & Kelly, 1999:243).

A multi-dimensional definition of cohesion has developed over time to describe several factors that motivate teams to remain together to achieve goals (Carron & Brawley, 2000:96). It is important to understand that the multi-dimensional perspective on cohesion implies that there is a multitude of factors that impact the motivation of groups to remain together and to execute tasks and that the prominence of these factors will vary over time and between teams in different situations (Carron & Brawley, 2000:96).

Carron *et al.* (1985:248) constructed a conceptual model of the cohesion process where cohesion is divided into two main categories. The first category is a person's perceptions of the group, which is labelled as group integration (GI), and the second is a person's personal attraction to the group which is labelled individual attraction to the group (ATG). Both categories of perceptions (group integration and individual attraction to the group) can furthermore be focussed on social or task aspects, which presents cohesion as a combination of four distinct constructs as illustrated in Figure 2.2-2.

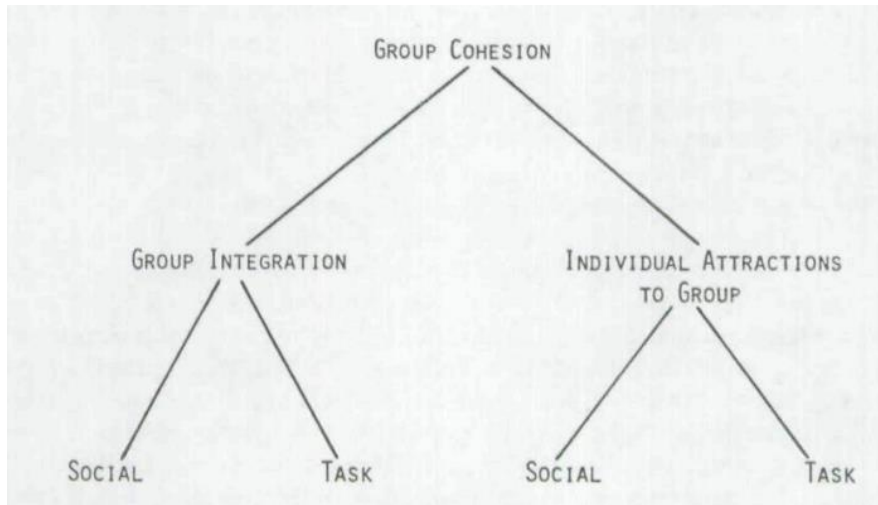


Figure 2.2-2: Cohesion conceptual model

Source: Carron et al., (1985:248)

The constructs as described in the Carron model (Carron *et al.*, 1985:248) can be summarised as follows.

- Group integration (GI) describes the sense of belonging and closeness that exists within the group
- Individual attraction to group (AT) describes the interfaces of the motives that are working on a member to stay in the group
- Group integration - task (GI-T) is the individual member's perception of the group as a whole regarding their commitment to achieving goals
- Group integration - social (GI-S) is the individual members' perception of social interactions that exist in the group
- Attraction to group - task (AT-G) is the motivation of a member to remain in the group as affected by the perception of the group to achieve goals
- Attraction to group - social (AT-S) is the motivation of a member to remain in the group as affected by the sense of belonging that exists in the group and the perception of the social interactions that exist in the group

The conceptual model as developed by Carron (Carron *et al.*, 1985:248) was used as the basis for developing the Group Environment Questionnaire (GEQ), a measuring instrument for team cohesion.

The performance of a team has been correlated to the cohesion that exists within a team in various studies (Mullen and Copper, 1994) (Salas, Grossman *et al.*, 2015:372) and supports the notion that a team where members are committed to being part of a team and relate to the team socially will be more likely to produce more effective outcomes.

In summary, an individual is more likely to perform better in an environment where there is a sense of belonging and an overall sense of collective purpose to conduct tasks.

Cohesion within a team enhances communication and collaboration (Tekleab *et al.*, 2016) and results in an environment where objectives are approached in a collective manner with willing participation and commitment from more individuals.

Several factors affect the cohesion that exists within a team such as diversity in terms of function (Tekleab *et al.*, 2016), leadership and gender which should be considered when assessing the role of cohesion in performance.

The importance of prioritising social and task cohesion when measuring team cohesion was demonstrated in a study by Salas, Grossman *et al.* (2015) which is a valid consideration when constructing or selecting an effective data collection instrument to measure the cohesion that exists within teams.

2.2.2. Team cohesion and its relationship to performance

The positive relationship between team cohesion and performance has been demonstrated in various studies across various industries.

A meta-analysis study of the relationship between team cohesion and performance in sports by (Filho *et al.*, 2014) found that overall cohesion correlated moderately with performance and found a strong relationship between task cohesion and performance. In this study, the reciprocal relationship between team cohesion and performance was demonstrated to be strong.

Overall the relationship between team cohesion and performance has been demonstrated to be strong but has been shown to be a complex relationship that is affected by various factors. Team cohesion is a multidimensional construct that should be studied with a focus on the individual and team level to fully understand its effect on team performance (Salas, Grossman *et al.*, 2015).

In a study conducted for the National Aeronautics and Space Administration on the considerations to compile teams of scientists for long-duration space exploration, team cohesion is identified as one of the critical factors that need to be monitored and managed to ensure optimal performance over the length of a mission (Salas, Tannenbaum *et al.*, 2015:202). The temporal nature of team cohesion and the lack of research on long-term changes in cohesion is highlighted as a concern in this study (Salas, Tannenbaum *et al.*, 2015:202).

The reciprocal relationship between performance and cohesion was explored in a study of 42 newly formed three-person teams of undergraduate students, where teams participated in simulated activities involving interactive resource foraging (Braun *et al.*, 2020:558). Cohesion and performance were demonstrated to have a positive reciprocal relationship where more cohesive teams performed better, and cohesion improved because of good performance (Braun *et al.*, 2020:573).

This study included a temporal component as team performance and cohesion was measured over repetitions of simulations with brief self-assessment periods in between. The cohesion and performance were measured over the repeated simulations and the relationship was investigated as each repetition of simulations influenced the next (Braun *et al.*, 2020:560).

In a study by Mathieu *et al.* (2015) the reciprocal relationship between team cohesion and performance over time was explored by conducting a meta-analysis of relevant literature and experimentally by conducting a longitudinal study on 205 students in 57 teams over a 10-week period.

Student teams took part in complex business simulations where teams were asked to make critical decisions. Performance and cohesion were measured during the 10-week period and the results confirmed the reciprocal relationship between cohesion and performance (Mathieu *et al.*, 2015:727). In this study, it was determined that the positive effect of cohesion on performance was significantly higher than the positive effect of performance on cohesion (Mathieu *et al.*, 2015:727). The relationship between cohesion and performance grew stronger over time but the relationship between performance and cohesion remained consistent over time (Mathieu *et al.*, 2015:727).

Various meta-analysis has confirmed the positive correlation of team cohesion with performance (Mullen and Copper, 1994; Beal *et al.*, 2003; Chiochio and Essiembre, 2009; Evans and Dion,

2012) across various industries, team types and sizes. In the Chiocchio & Essiembre (2009) meta-analysis the cohesion-performance relationship was investigated between project, production and service teams, and the positive effects of cohesion on performance were especially strong with project teams. The study demonstrated that team type and team setting affected the degree to which team cohesion was affecting performance outcomes (Chiocchio and Essiembre, 2009:404).

In a study to investigate the effects of cohesion and disagreement on knowledge sharing it was established that cohesiveness has a positive effect on team members' willingness to share opinions and the sharing of advice (van Woerkom and Sanders, 2010:146). This relationship was found to be a mediating variable in the positive relationship between cohesion and the performance of individual team members (van Woerkom & Sanders, 2010:147).

A meta-analysis conducted by Webber & Donahue (2001) explored the relationship between diversity, cohesion and performance and found that there were no significant effects on cohesion or performance in more diverse work groups.

The positive correlation between cohesion and team performance and the reciprocal nature of this relationship has been robustly established in literature. This established cohesion-performance relationship forms the basis of this study, which will be explored in the chemical manufacturing industry.

2.2.3. Leadership and team cohesion

The effect of leadership on cohesion has been investigated and a significant relationship between leadership style and team cohesion has been demonstrated to exist with transformational leadership particularly identified as being beneficial to team cohesion (Raes *et al.*, 2013).

The nature of the relationships that exist within leadership teams has been demonstrated to influence team cohesion and team performance as a result (Song *et al.*, 2018). Leadership teams with an element of friendship between members are more likely to result in a more cohesive leadership team and improved performance as compared to leadership teams with no friendship ties (Song *et al.*, 2018).

In a study by Imam and Zaheer (2021:8) the effect of shared leadership was investigated as its role in project success in the Information Technology (IT) industry. In this study, shared leadership

was found to contribute to project success through knowledge sharing and an increase in team cohesion through the motivation of team members to achieve common goals (Imam and Zaheer, 2021:8).

Servant leadership has been demonstrated to have a positive effect on team performance by influencing team members' perception of the leader-follower relationship quality (Chiniara *et al.*, 2018:341). Servant leadership benefits performance by creating the perception within teams that there is low differentiation in the way that they are treated as individuals by their leader, which improves team cohesion within teams (Chiniara *et al.*, 2018:341). This study further emphasises the importance of leadership and its influence on a team's ability to perform.

2.2.4. Measuring team cohesion

The measurement of cohesion in teams has evolved as the body of knowledge has developed over time and there are few principles that have remained prominent and consistent during this development.

To enable the effective measurement of cohesion in this study we had to consider the existing measuring instruments that have proven to be successful in other studies over time. A measuring instrument that fit the existing definition and models of cohesion had to be selected to maximise the probability of collecting data that represented a true reflection of the cohesion that existed within the participating teams of the study and which produced usable information that can be utilised to make meaningful conclusions.

The multidimensionality of cohesion should be considered when conceptualising and measuring cohesion with social and task cohesion prioritised (Salas, Grossman *et al.*, 2015:372). When measuring cohesion, a multi-level approach should be utilised where cohesiveness is evaluated on the individual and team level with priority placed on the team level assessment (Salas, Grossman *et al.*, 2015:372). Additionally, the developmental stage of the team should be considered when making measurement decisions (Salas, Grossman *et al.*, 2015:373).

In a study by Bonito *et al.* (2012), it is recommended to conduct research on the group level as opposed to basing analysis on the perceptions of the individuals which supports the recommendation by Salas and Grossman *et al.*(2015) that priority is placed on the team level assessment and not the individual.

2.3. Summary

In the literature review, cohesion has been illustrated how it fits into the greater model that drives team performance by including the model from Yeats *et al.* (2001) in Figure 2.2-1 The definition of cohesion has been unpacked as it developed as a concept over time and the conceptual model for cohesion as a construct as developed by Carron *et al.* (1985) has been explored to create a basis of understanding to measure cohesion of teams.

The beneficial relationship between cohesion and performance has been described and the mechanisms that play a role within this relationship have been unpacked. The importance of leadership has been emphasised as a key factor that influences cohesion and performance. The main considerations have been documented from existing literature when measuring cohesion and what aspects to consider when selecting and applying a cohesion measuring tool.

This literature review lays the theoretical basis for the study and informs the experimental design of the study to ensure that the existing body of knowledge is considered when interpreting results, drawing conclusions and making recommendations.

CHAPTER 3: EMPIRICAL STUDY

3.1. Introduction

This chapter describes how data was collected for the study and the participating population is described in terms of the nominal and ordinal data that was collected. The data collected from the submitted questionnaires is described concerning the statistical analysis that was conducted to determine the reliability and validity of the data. The results of the correlation analysis that was conducted on all data is provided and described.

3.2. Gathering of data

An e-mail with a link to the questionnaire was sent to all 614 employees that formed part of the target population. The questionnaire was completed by participants on a website that specialises in collecting surveys called SurveyMonkey. The informed consent letter and the permission letter from the company were attached to the e-mail to ensure that participants were informed that the study was authorised by the company and that their participation in the study was voluntary.

A cover letter was included in the body of the e-mail that described the intention of the study and consent was given provided by participants by clicking on the link as described in the e-mail that is provided in Annexure F.

134 Employees of the 614 target population completed the questionnaire which is a response rate of 21.83%. This is below the expected range as described by an analysis of 1607 studies by Baruch and Holton (2008) that indicated the average response rate for data collected from individuals is 52.7% with a standard deviation of 20.4%.

The data was downloaded from the SurveyMonkey website and processed to provide it to the Statistical department at the North-West University (NWU) for analysis.

The performance data in the form of ATOP scores per manufacturing unit was sourced from an internal company report that is sent out on a monthly basis which is used to monitor and manage the production performance of the company over time.

3.2.1. Participant population description

The collected responses were distributed across the twelve natural work teams as illustrated in Table 3.2-1 below. The team with the most respondents is team 11 with 18 completed questionnaires which represents 13.4% of all respondents. The team with the least number of respondents is team 1 with 6 completed questionnaires that represent 4.5% of all respondents.

Table 3.2-1: Respondent distribution across natural work teams

Team	Frequency	%	Valid Percent	Cumulative Percent
Team 1	6	4.5	4.5	4.5
Team 2	17	12.7	12.7	17.2
Team 3	12	9.0	9.0	26.1
Team 4	12	9.0	9.0	35.1
Team 5	14	10.4	10.4	45.5
Team 6	9	6.7	6.7	52.2
Team 7	9	6.7	6.7	59.0
Team 8	14	10.4	10.4	69.4
Team 9	11	8.2	8.2	77.6
Team 10	4	3.0	3.0	80.6
Team 11	18	13.4	13.4	94.0
Team 12	8	6.0	6.0	100.0
Total	134	100.0	100.0	

Source: Compiled from received responses

The distribution of years worked in the current team of all respondents is provided in Figure 3.2.1 below with the most represented group working in the same team for 3 to 5 years and the least represented group working in the same team for 21 to 25 years. 72.4% of the population has worked in the same work team for less than 15 years which is expected because retirement will be more prominent with older employees.

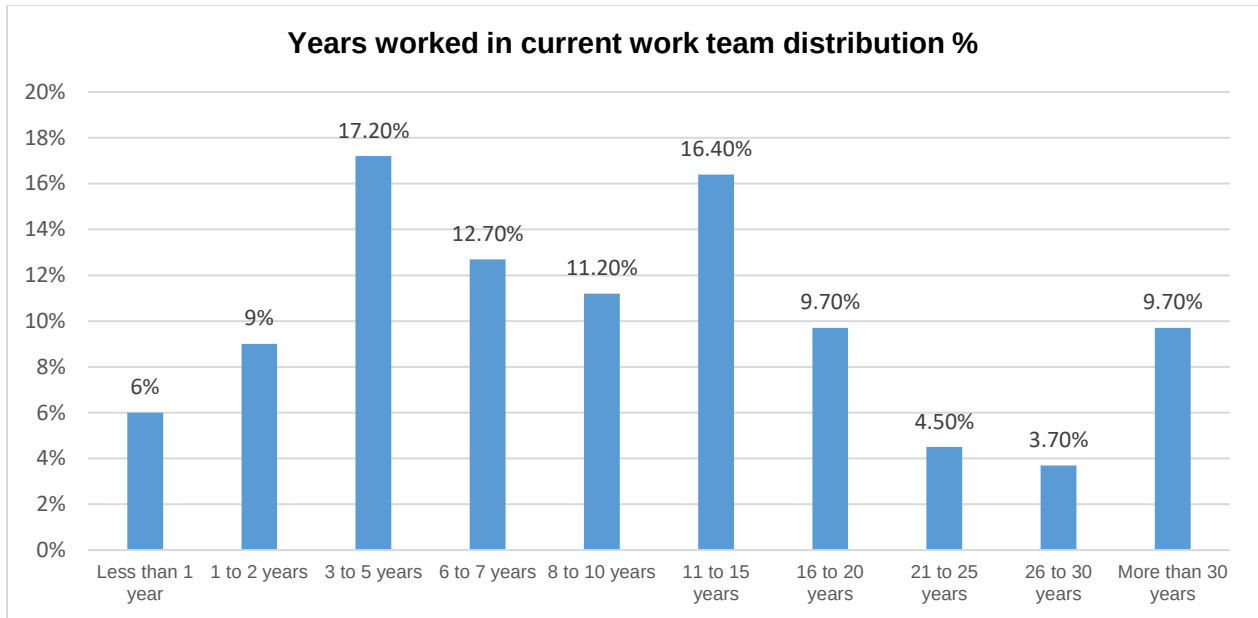


Figure 3.2-1: Years worked in current work team distribution

Source: Own compilation

The distribution of overall work experience of respondents is provided in Figure 5 below, with the most represented group having between 11 and 15 years overall work experience. The distribution is equally distributed with 53% of respondents having less than 15 years of experience and the remaining 47% having more than 15 years of experience.

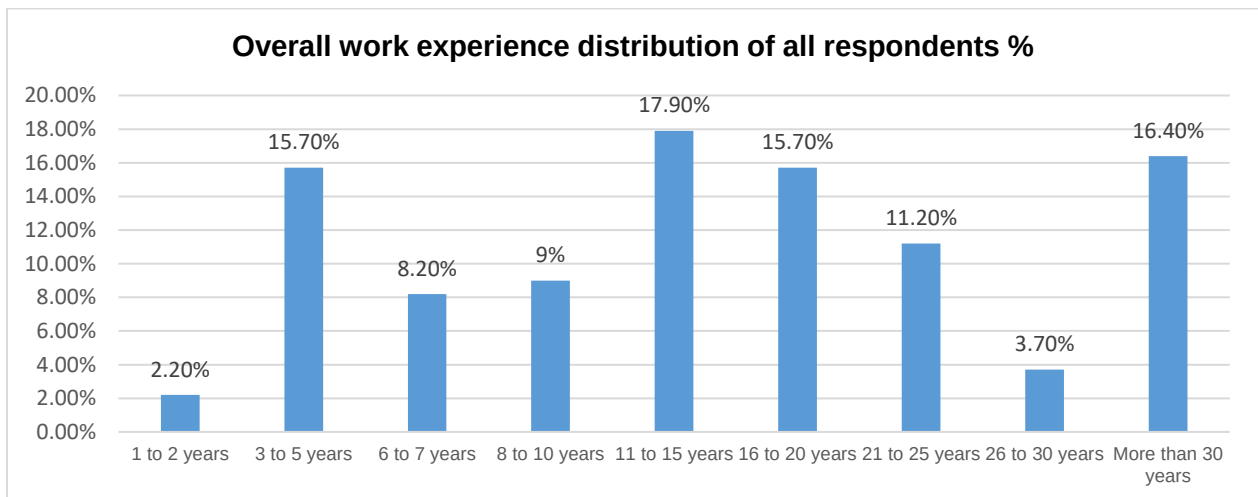


Figure 3.2-2: Overall work experience distribution of all respondents

Source: Own compilation

The age distribution of the respondents is provided in Table 3.2-2 below with the youngest persons being 22 and the oldest 65. 91.8% of all participants are 55 years and younger which is expected with a retirement age of 55 and over. 117 of the participants in the study are male and 17 are female which represents 87.3% and 12.7% of all participants respectively. The predominantly male representation was expected as the chemical manufacturing industry is male-dominated, especially in the production and maintenance trades that are part of this study. The mean age of all participants is 38.73 with a standard deviation of 10.6.

Table 3.2-2: Age distribution of respondents

Age	Frequency	%	Valid Percent	Cumulative Percent
22	3	2.2	2.2	2.2
23	5	3.7	3.7	6.0
24	4	3.0	3.0	9.0
25	3	2.2	2.2	11.2
26	2	1.5	1.5	12.7
27	4	3.0	3.0	15.7
28	5	3.7	3.7	19.4
29	2	1.5	1.5	20.9
30	7	5.2	5.2	26.1
31	2	1.5	1.5	27.6
32	6	4.5	4.5	32.1
33	4	3.0	3.0	35.1
34	9	6.7	6.7	41.8
35	4	3.0	3.0	44.8
36	3	2.2	2.2	47.0
37	5	3.7	3.7	50.7
38	2	1.5	1.5	52.2
39	1	0.7	0.7	53.0
40	5	3.7	3.7	56.7
41	11	8.2	8.2	64.9
42	2	1.5	1.5	66.4
43	3	2.2	2.2	68.7
44	3	2.2	2.2	70.9
45	5	3.7	3.7	74.6
46	4	3.0	3.0	77.6

47	2	1.5	1.5	79.1
48	5	3.7	3.7	82.8
49	2	1.5	1.5	84.3
53	1	0.7	0.7	85.1
54	2	1.5	1.5	86.6
55	7	5.2	5.2	91.8
56	1	0.7	0.7	92.5
57	3	2.2	2.2	94.8
58	3	2.2	2.2	97.0
59	1	0.7	0.7	97.8
60	1	0.7	0.7	98.5
62	1	0.7	0.7	99.3
65	1	0.7	0.7	100.0
Total	134	100.0	100.0	

Source: Compiled from responses

3.2.2. Team ATOP performance and average cohesion scores

The ATOP performance data sourced from an internal company report represents the average production performance per team over a year ending October 2019 as provided in Table 3.2-3 below. Table 3.2-3 includes the cohesion average scores per construct and total average cohesion per team as measured by the adapted GEQ. Team 4 has the highest average score for ATG at 23.42 and Team 1 has the lowest average score for ATG at 16.17. Team 1 has the highest average score for ATS with 30 and Team 7 has the lowest average ATS score with 19.89. Team 2 has the highest average score for GIT with a score of 33.71 and Team 5 has the lowest at 25.43. Team 4 has the highest average score for GIS with a score of 21.67 and Team 1 has the lowest with a score of 14.33. Team 4 scored the highest overall average cohesion score with 108.83 and Team 5 the lowest with 80.

Table 3.2-3: ATOP performance and cohesion average scores per team

	ATOP	ATG	ATS	GIT	GIS	Cohesion
Team 3	82.12%	19.17	21.17	28.08	17.17	85.58
Team 2	85.00%	18.88	26.76	33.71	21.12	100.47
Team 7	87.90%	17	19.89	26.33	20.22	83.44
Team 12	93.30%	18.5	25	32.38	18.88	94.75
Team 8	93.90%	17	21.07	26.29	18.79	83.14
Team 4	94.35%	23.42	29.75	34	21.67	108.83
Team 10	95.80%	19.25	23.25	28.75	15.75	87.00
Team 9	95.80%	18.36	25	26.18	21.55	91.09
Team 11	96.00%	18.06	24.5	30.78	20.11	93.44
Team 5	96.30%	16.36	21.93	25.43	16.29	80.00
Team 6	101.80%	17.33	21.89	27.33	19.44	86.00
Team 1	103.36%	16.17	30	28.17	14.33	88.67

Source: Own compilation

The performance data for Team 1 and 6 is more than 100% of planned production over the 12-month period which indicates that these two teams produced more product than they were required to produce on average over the year. This is an indication of good performance of plant reliability and consistency. Team 1 had the least consistent performance over the 12-month period with 82.12% of planned product produced on time.

3.2.3. Adapted GEQ results

The means and standard deviation per question are provided in Table 3.2-4 below. The highest mean of the answers that were provided by all respondents was Question 9 with 6.14 which is an indication that most of the respondents agreed that their work team is united in trying to reach its goals.

The lowest mean of the answers provided by all respondents is Question 5 with 3.22 which demonstrates that most employees believe that they are given enough opportunities to improve their performance.

Both questions 5 and 9 with the highest and lowest means respectively are positive indications of team cohesion for all respondents with question 5 being reverse scored.

Table 3.2-4: Questionnaire responses answer percentage, means and standard deviations

Question	Percentage of answers per question									Mean	Std. Deviation
	1	2	3	4	5	6	7	8	9		
Q1	23.9	14.2	9.7	9	14.9	7.5	3	9	9	4.10	2.692
Q2	20.9	20.9	13.4	5.2	14.9	2.2	6	4.5	11.9	3.97	2.717
Q3	15.7	14.9	11.2	9.7	11.9	9	9	8.2	11.9	4.54	2.663
Q4	32.1	8.2	17.9	4.5	14.9	7.5	6.7	3.7	4.5	3.57	2.454
Q5	32.8	16.4	17.2	7.5	11.2	3.7	2.2	0	9	3.22	2.432
Q6	1.5	6	10.4	11.2	14.2	9.7	12.7	14.9	19.4	6.01	2.317
Q7	20.9	17.9	14.9	8.2	9.7	6.7	13.4	0	8.2	3.91	2.532
Q8	14.2	15.7	4.5	7.5	20.1	13.4	9.7	8.2	6.7	4.64	2.487
Q9	6	5.2	3.7	11.2	8.2	10.4	22.4	14.2	18.7	6.14	2.385
Q10	9	9	15.7	6	24.6	11.9	9	6	9	4.84	2.321
Q11	13.4	2.2	3	6.7	16.4	8.2	14.9	14.9	20.1	5.90	2.650
Q12	4.5	9.7	12.7	9	21.6	8.2	13.4	8.2	12.7	5.29	2.352
Q13	13.4	10.4	12.7	14.2	24.6	16.4	5.2	1.5	1.5	4.13	1.937
Q14	9.7	14.2	6.7	14.2	23.1	9.7	14.2	3	5.2	4.59	2.208
Q15	10.4	0.7	3	10.4	20.1	15.7	14.9	12.7	11.9	5.71	2.303
Q16	3	10.4	14.2	10.4	19.4	12.7	10.4	2.2	17.2	5.27	2.356
Q17	13.4	10.4	17.2	7.5	20.9	14.9	0	6	9.7	4.45	2.414

Source: Own compilation

3.2.4. Validity and reliability of adapted GEQ for work teams results and discussion

3.2.4.1. Questionnaire validity

The determinant of correlation was calculated for all four constructs to establish if any severe multicollinearity exists within the constructs. All determinant values are higher than the 0.00001 guideline value from Field (2009) as provided in Table 3.2-5 below.

Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was calculated for all four constructs to establish how suitable the data is for factor analysis. The KMO measure of sampling for all constructs was calculated to be above the 0.5 guideline value from Field (2009) as provided in Table 3.2-5 which indicates that sampling adequacy is sufficient for all constructs. AT-G's sampling adequacy was lowest at 0.565 which is still acceptable according to the 0.5 guideline

value. GI-T's sampling adequacy was the highest with 0.737 which indicates good sampling adequacy above 0.7 according to guideline values from Field (2009). The calculated sampling adequacy for all constructs indicates that all data collected is suitable for factor analysis.

Bartlett's test of sphericity was conducted to determine if enough correlation exists between questions per construct, to conduct factor analysis. All values for all four constructs as provided in Table 3.2-5 below were calculated to be below the guideline value of 0.05 from Field (2009) which indicates that there is enough correlation between all items per construct and that the data is suitable for factor analysis.

Table 3.2-5: Statistical analysis per construct (Sample adequacy, sphericity and determinant)

Construct	Related questions	Determinant	KMO Sampling Adequacy	Bartlett's Test of Sphericity
AT-G	Q3 + Q5 + Q7	0.738	0.565	<0.05
AT-S	Q1 + Q2 + Q4 + Q6 + Q8	0.409	0.670	<0.05
GI-T	Q9 + Q11 + Q13 + Q15 + Q17	0.235	0.737	<0.05
GI-S	Q10 + Q12 + Q14 + Q16	0.643	0.672	<0.05

Source: Own compilation

The proportion of variance or communalities was calculated to determine if there is sufficient data per question represented in each construct with a guideline value of equal or greater than 0.3 as from Field (2009). The calculated communalities are provided in Table 3.2-6 below and all values are greater than the guideline value of 0.3 which indicates that there is enough data per question when the four main constructs are extracted.

The total variance explained was calculated for the four constructs which is an indication of the percentage of variance that is contributed if one construct is extracted from the related data per construct as provided in Table 3.2-6 below. The total variance for AT-G and GI-T was calculated as 53.87% and 52.92% respectively which is above the guideline value of 50% as by Field (2009). The total variance for AT-S and GI-S was calculated as 45.12% and 46.8% respectively which is slightly below the guideline value of 50% as by Field (2009).

The exploratory factor analysis indicated that four constructs were extracted from the data as expected which is consistent with the theory discussed in Chapter 2 of this report. This contrasts with a study by Carless and De Paola (2000) where an adapted GEQ for work teams was

demonstrated to have only three valid constructs. The total variance for AT-S and GI-S was calculated slightly below the baseline value of 50%, however, based on the theory and the pattern matrix factor analysis the adapted GEQ for workgroups was applied as a valid measuring instrument with four distinct constructs as provided in Table 3.2-6 below.

Table 3.2-6: Construct validity statistical results per construct

Construct	Question	Communalities	Total variance explained	Factors extracted
AT-G	Q3	0.508	53.87%	1
	Q5	0.422		
	Q7	0.686		
AT-S	Q1	0.340	45.12%	1
	Q2	0.603		
	Q4	0.291		
	Q6	0.420		
	Q8	0.602		
GI-T	Q9	0.682	52.92%	1
	Q11	0.533		
	Q13	0.519		
	Q15	0.508		
	Q17	0.404		
GI-S	Q10	0.386	46.80%	1
	Q12	0.484		
	Q14	0.464		
	Q16	0.538		

Source: Own compilation

3.2.4.2. Adapted GEQ for work teams reliability

To determine the reliability of the adapted GEQ for workgroups, Cronbach's Alpha coefficient was calculated for each construct and for the total questionnaire to establish the internal consistency of each construct. All Cronbach's Alpha values for the four constructs and the full questionnaire as provided in Table 3.2-7 below, are more than the 0.5 guideline value as recommended by Field (2009). This demonstrates that the adapted GEQ for workgroups is a reliable measurement instrument for cohesion in this study. The Cronbach's Alpha for the AT-G was lower than the other constructs which is an indication that the sample size was too small. This can be a result of the question that was removed from the original GEQ questionnaire for AT-G as described in chapter 1 of this report.

The construct with the highest mean is AT-G with a value of 6.11 with a standard deviation of 1.86 which indicates that the target population is mostly motivated to stay in their work team because of a positive perception to achieve goals that exist within the group as provided in Table 3.2-7. The construct with the lowest mean is GI-S with a value of 4.8 with a standard deviation of 1.58 which indicates the individual members' perception of social interactions that exist in the group. The reasonably low number of responses also contributes to these values.

Table 3.2-7: Factor reliability

Construct	Related questions	Cronbach's Alpha	Mean	Std. Deviation
AT-G	Q3 + Q5 + Q7	0.566	6.1119	1.86151
AT-S	Q1 + Q2 + Q4 + Q6 + Q8	0.688	4.8254	1.69323
GI-T	Q9 + Q11 + Q13 + Q15 + Q17	0.771	5.8358	1.69792
GI-S	Q10 + Q12 + Q14 + Q16	0.620	4.7985	1.57860
GEQ	All questions	0.875	5.3433	1.40399

Source: Own compilation

3.2.5. Correlation analysis results and discussion

The correlation between variables was determined by utilising hierarchical linear modelling to establish if any statistically significant relationships exist within the dataset. The p-values are reported for completeness' sake but will not be interpreted because a convenience sample was used and not a random sample. The guideline values as provided in Field (2009) are used to determine if any practical significant relationships exist between variables with values higher than 0.1 and smaller than 0.3 indicating a small non-practical relationship. Correlation values equal to 0.3 and lower than 0.5 indicate a medium and practical visible relationship between variables. Correlation values of 0.5 and higher indicate a large practical significant relationship between variables according to Field (2009).

The statistical analysis indicated that there was no significant correlation between any cohesion constructs and ATOP with all values below 0.1 as provided in Table 3.2-8 below. Since all the p-values are above 0.05, there is no statistically significant correlation between the total GEQ scores of the sample group and ATOP with a correlation score of -0.05 as provided in Table 3.2-8 below.

This result indicates that cohesion and its constructs do not play a significant role in the ability of teams to produce quality product when required.

Table 3.2-8: Cohesion construct correlation with ATOP

ATG	Correlation	-0.08
	p-value	0.34
ATS	Correlation	0.06
	p-value	0.52
GIT	Correlation	-0.10
	p-value	0.23
GIS	Correlation	-0.07
	p-value	0.46
GEQ	Correlation	-0.05
	p-value	0.55

Source: Own compilation

The most statistically significant relationship between constructs within the data is between AT-G and GI-T with a correlation value of 0.686 as provided in Table 3.2-9 below. This indicates that a team member is more motivated to remain in a group if their perception is that their group is committed to achieving goals. This demonstrates that team members are motivated more by their perception of a group's commitment to achieving goals than the perception of the social interactions that exist within their work group. The constructs with the least statistically significant relationship within the data were between GI-S and AT-S with a correlation value of 0.481 as provided in Table 3.2-9. This further supports the more prominent role of commitment to the task of a group regarding team members' motivation to stay in a group. All probability values among the constructs are below 0.05.

Table 3.2-9: Correlation among constructs

		AT-G	AT-S	GI-T	GI-S
ATG	Correlation	1	0.618628	0.687459	0.557584
	p-value		<.0001	<.0001	<.0001
ATS	Correlation	0.618628	1	0.530943	0.480729
	p-value	<.0001		<.0001	<.0001
GIT	Correlation	0.687459	0.530943	1	0.598247
	p-value	<.0001	<.0001		<.0001
GIS	Correlation	0.557584	0.480729	0.598247	1
	p-value	<.0001	<.0001	<.0001	

Source: Own compilation

There is no statistically significant relationship between any cohesion construct and the number of years that a person worked in their current team with all values below 0.1 as provided in Table 3.2-10. No statistically significant relationship exist between the total GEQ scores of the teams, and the number of years worked in their current team with a correlation value of 0.02 which is below the guideline values.

Table 3.2-10: Cohesion correlation with years worked in current team

ATG	Correlation	0.04
	p-value	0.60
ATS	Correlation	0.04
	p-value	0.60
GIT	Correlation	-0.02
	p-value	0.84
GIS	Correlation	0.02
	p-value	0.83
GEQ	Correlation	0.02
	p-value	0.78

Source: Own compilation

Similarly, there is no statistically significant relationship indicated between total work experience and any cohesion construct or total GEQ scores of the teams as illustrated in Table 3.2-11 with all correlation scores below the guideline values of Field (2009).

Table 3.2-11: Cohesion correlation with total work experience

ATG	Correlation	-0.05
	p-value	0.58
ATS	Correlation	0.02
	p-value	0.81
GIT	Correlation	-0.10
	p-value	0.24
GIS	Correlation	-0.05
	p-value	0.55
GEQ	Correlation	-0.05
	p-value	0.53

Source: Own compilation

The only indication of a small to medium relationship that is indicated in the data is between age and ATS with a correlation value of 0.27 which is the closest to the guideline value of 0.3 (Field, 2009) as illustrated in Table 3.2-12. However, there are no other statistically significant correlation of the other constructs (ATG, GIT, GIS) and age. There is no statistically significant correlation between overall measured GEQ in the teams and age.

Table 3.2-12: Cohesion correlation with age

ATG	Correlation	0.18
	p-value	0.02
ATS	Correlation	0.27
	p-value	0.00
GIT	Correlation	0.15
	p-value	0.08
GIS	Correlation	0.10
	p-value	0.16
GEQ	Correlation	0.22
	p-value	0.01

Source: Own compilation based on statistical analysis

Below follows a description of the statistically significant relationships (p-values <0.05) between questions of the adapted GEQ that was identified with correlation values above the guideline value of 0.5 in Table 3.2-13.

- A significant positive relationship was identified between if team members approved of the work methods of their team and if they believed that the whole team took responsibility for the performance of the team (Q7 and Q11)
- A significant positive relationship was identified between the probability of team members missing their team if they left and the approval of the work methods of their team (Q7 and Q2).
- A significant positive relationship was identified between the probability of team members missing their team and their perception of their team as one of the most important social groups (Q2 and Q8).
- A significant positive relationship was identified between team members' approval of their team's work methods and their perception that their team was united in trying to reach goals (Q7 and Q9).

- A significant positive relationship was identified between the approval of their team's work methods and if members have conflicting aspirations for the team's performance (Q7 and Q13).
- A significant positive relationship was identified between a team member's perception of their team being unified in trying to reach goals and if members have conflicting aspirations for the team's performance (Q 9 and Q13).
- A significant positive relationship was identified between a team member's perception of the whole team taking responsibility for loss or poor performance and if team members have conflicting aspirations for the team's performance (Q11 and Q13).
- A significant positive relationship was identified between team members who are perceived to be united in trying to reach goals and if everyone wants to help team members who have problems (Q9 and Q15).
- A significant positive relationship was identified between if members are happy with their team's desire to achieve goals and if team members communicate freely about each other's responsibilities during work (Q3 and Q17).
- A significant positive relationship was identified between if members stick together outside of work and if team members communicate freely about each other's responsibilities during work (Q16 and Q17).

Table 3.2-13: Correlation between questions in adapted GEQ responses

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17
Q1	1.00	0.41	0.37	0.23	0.40	0.18	0.17	0.22	0.22	0.27	-0.08	0.17	-0.05	0.04	0.44	0.29	0.30
Q2	0.41	1.00	0.28	0.17	0.37	0.39	0.56	0.50	0.37	0.19	0.33	0.36	0.37	0.10	0.33	0.35	0.19
Q3	0.37	0.28	1.00	0.34	0.16	0.30	0.40	0.15	0.49	0.35	0.29	0.23	0.29	0.21	0.44	0.38	0.54
Q4	0.23	0.17	0.34	1.00	-0.03	0.19	0.31	0.37	0.33	0.25	0.18	0.23	0.13	0.36	0.35	0.24	0.22
Q5	0.40	0.37	0.16	-0.03	1.00	0.25	0.34	0.20	0.22	0.14	-0.01	0.37	0.23	-0.09	0.13	0.35	0.29
Q6	0.18	0.39	0.30	0.19	0.25	1.00	0.41	0.40	0.36	0.42	0.26	0.34	0.34	0.01	0.16	0.18	0.32
Q7	0.17	0.56	0.40	0.31	0.34	0.41	1.00	0.42	0.59	0.42	0.69	0.44	0.61	0.20	0.29	0.30	0.35
Q8	0.22	0.50	0.15	0.37	0.20	0.40	0.42	1.00	0.41	0.15	0.24	0.16	0.25	0.12	0.36	0.15	0.15
Q9	0.22	0.37	0.49	0.33	0.22	0.36	0.59	0.41	1.00	0.43	0.49	0.33	0.52	0.39	0.54	0.35	0.38
Q10	0.27	0.19	0.35	0.25	0.14	0.42	0.42	0.15	0.43	1.00	0.33	0.24	0.44	0.31	0.22	0.23	0.29
Q11	-0.08	0.33	0.29	0.18	-0.01	0.26	0.69	0.24	0.49	0.33	1.00	0.30	0.56	0.35	0.32	0.11	0.26
Q12	0.17	0.36	0.23	0.23	0.37	0.34	0.44	0.16	0.33	0.24	0.30	1.00	0.33	0.24	0.11	0.40	0.24
Q13	-0.05	0.37	0.29	0.13	0.23	0.34	0.61	0.25	0.52	0.44	0.56	0.33	1.00	0.31	0.25	0.19	0.27
Q14	0.04	0.10	0.21	0.36	-0.09	0.01	0.20	0.12	0.39	0.31	0.35	0.24	0.31	1.00	0.29	0.32	0.08
Q15	0.44	0.33	0.44	0.35	0.13	0.16	0.29	0.36	0.54	0.22	0.32	0.11	0.25	0.29	1.00	0.35	0.49
Q16	0.29	0.35	0.38	0.24	0.35	0.18	0.30	0.15	0.35	0.23	0.11	0.40	0.19	0.32	0.35	1.00	0.52
Q17	0.30	0.19	0.54	0.22	0.29	0.32	0.35	0.15	0.38	0.29	0.26	0.24	0.27	0.08	0.49	0.52	1.00

Source: Own compilation based on statistical analysis

CHAPTER 4: CONCLUSIONS AND RECOMMENDATIONS

4.1. Answering the main research question

The main research question as formulated in the first chapter of this report is as follows:

- What role does team cohesion play in the production performance of different operational work teams within a large chemical manufacturing business?

The relationship between performance and cohesion is well established in the existing literature as described in Chapter 2 of this report. The null hypothesis is therefore that there will be a statistically significant relationship between the cohesion that exists within the different teams and the production performance that is achieved by these teams.

The results of this study indicate that there is no statistically significant relationship between the ability of teams to produce saleable product on schedule, and the cohesion that exists within teams as measured by the adapted GEQ in this study. The fact that correlation analysis yielded no statistically significant relationships between the variables resulted in regression analysis also not giving significant results. Hence the results of regression analysis are not reported in this study.

The company that was part of the study is a large and complex organisation with multiple variables that play a role in the production performance and many other moderating factors could determine the production performance and could have a bearing on team cohesion. Team cohesion does not directly predict production performance as demonstrated by this study. It is however probable that other important performance measures are related to team cohesion and the company should not ignore team cohesion completely because of this result.

4.2. Answering the sub-research questions

- Is there a statistically significant relationship between the individual constructs of team cohesion and production performance?

There was *no* statistically significant relationship between any individual construct and ATOP identified in this study as demonstrated by the values in Table 3.2-8.

- How do the age, experience and years spent in the current work team affect the different elements of team cohesion?

No statistically significant relationship was identified between total work experience or years worked in the current team and the individual constructs of team cohesion. There was a weak indication of a small to medium correlation between ATS and age as demonstrated in Table 3.2-12.

- How can this study help managers to improve the performance of teams?

The adapted GEQ for work teams can be utilised to measure team cohesion of teams, and this information can be used to trigger interventions where cohesion has been reported to be a limiting factor to performance. The ability to measure cohesion will enable management to limit the possible negative effects that team cohesion can have on a team where it is lacking.

- How can this study help managers to improve the cohesion of teams?

By measuring the different elements of team cohesion through the adapted GEQ for work teams, managers can understand the dynamics of the cohesion that exists within their teams. Although the results of this study do not suggest that this will predict better performance, this could contribute to enabling them to have focussed interventions to maximise cohesion over time. This is based on the results of the literature study.

- Is the adapted GEQ for work teams a valid and reliable measuring tool for a chemical manufacturing company?

This study has demonstrated that the adapted GEQ for work teams is a valid and reliable measuring tool for a chemical manufacturing company.

4.3. Conclusions

4.3.1. The role of cohesion in performance

This study identified *no* statistically significant relationship between team cohesion as measured by the adapted GEQ and a team's ability to produce quality product on schedule. This is contrary to the outcome that was predicted during the literature study, that there would be a significant

relationship between the performance measure of teams, and the team cohesion that exists within a team as discussed in chapter 2.

Additionally, there was *no* statistically significant relationship demonstrated between any of the individual constructs of team cohesion and the production performance of teams.

We can conclude that team cohesion as measured by the adapted GEQ does not play a significant role in the overall production performance as measured by ATOP.

4.3.2. Age, work experience and years spent in the current work team impact team cohesion

No statistically significant relationship was determined to exist between age, years of work experience or time spent in the current work team and any element within team cohesion.

Based on the statistical results we can conclude that age, work experience or time spent in the current work team does not significantly affect any elements of cohesion or the overall cohesion that exists in the groups. The company can therefore accept that the differences in work teams related to age, work experience and years spent in the current team do not significantly affect team cohesion.

4.3.3. Validity and reliability of adapted GEQ for work teams

The adapted GEQ for work teams was statistically demonstrated to be a valid and reliable measuring tool when applied in a chemical manufacturing company. This was an expected result because the original GEQ has been demonstrated to be a valid and reliable measuring tool for various industries and environments.

The adapted GEQ for work teams considers the multidimensionality of cohesion with social and task cohesion prioritised as recommended by Salas, Grossman et al. (2015:373). Cohesiveness is measured on the individual and team level by the adapted GEQ as recommended in the study by Salas and Grossman et al. (2015:373).

The statistical evaluation of the adapted GEQ in Chapter 3 of this report and the conceptual framework that is supported in the existing body of literature demonstrates that it is a valid and reliable measuring instrument for cohesion in the chemical manufacturing industry.

4.4. Recommendations

Team cohesion is not currently directly measured or managed within the company and its overall role in performance is not well understood. It would be beneficial for the company to measure cohesion as part of the existing human resource monitoring programme to understand if there are any significant relationships with other critical performance measures. If any significant relationships are identified which is very probable based on the current literature the company can identify problem areas and intervene.

This study did not identify a significant relationship with overall production performance, and this could be because of the general nature of the ATOP performance measurement which represents a summary of a team's performance. There may be other existing performance measurements in the company that is more specific to teams that can be utilised to differentiate performance differences between teams more distinctively. This information can be utilised in the context of the measured cohesion within teams to understand what drives performance within work teams.

The company should make leaders and the workforce aware of team cohesion and the conceptual model that it is based on. This will allow leaders to understand what drives cohesion in their teams and how they need to intervene to create a cohesive team. Currently, the concept of team cohesion is not well understood in the company by leaders or the workforce which makes it challenging to manage effectively. A workforce that understands team cohesion and its conceptual model may be more likely to focus on the deficiencies in their own teams and intervene than a team that is not informed.

4.4.1. Limitations of the study

The limitations of this study are as follows.

- The study only includes employees of one company in one industry which could make the results less likely to be a general reflection of the role of team cohesion in performance in other industries, companies and scenarios. The external validity of the study is limited because a convenience sample is used as the target population (Andrade, 2021:88).
- The GEQ questionnaire was utilised as a measuring instrument in this study and team cohesion is only measured using this instrument. The GEQ may not be reliable and valid

in all industries and team scenarios which could make the results of this study less applicable to other industries.

- The performance measurement used in this study is a general measurement of a team's ability to produce product that is within customer specifications as per schedule. Although this is a useful performance indicator and does reflect a team's overall productivity it does not include other more specific performance indicators that are also important for overall company performance.
- The study only included production and maintenance employees in the study because they have the most direct impact on the production performance of the operating units. The study did not consider the impact of the supporting departments (Human resources and supply chain departments etc.). All the employees that were included in the study are supported by the same support departments and there should not be a significant difference in support.
- The validity of the questionnaire data collected in this study relied on the honesty and credibility of the employees that voluntarily participated in the study. Great care was taken to ensure that questions were understandable and clear and completed noticeably incorrect questionnaires were removed from the study. Completed questionnaires with all questions answered with the same value were removed from the study as an example.
- In this study, the cohesion of different work teams is measured at a single point in time and therefore the inherently temporal nature of cohesion is not considered. The change of cohesion that exists within teams over time and the possible impact of this change over time on performance is not considered.
- The ATOP performance measurement is a general measurement of a teams ability to produce saleable product when required and does not include all performance variables that are significant for the company.

4.5. Achievement of the objectives of the study

This study did achieve the objective of investigating if team cohesion had a significant role in the production performance of a chemical manufacturing company by statistically evaluating if there was a significant correlation between a team's ability to produce saleable products in time and the cohesiveness that exists within teams. The consideration of more comprehensive team-specific performance measures would have been beneficial to this study because it would have resulted in a more comprehensive assessment of the role cohesion plays in performance. The use of a general production performance measure such as ATOP is useful to explore how significant the role of team cohesion is in performance, which is a starting point to further investigate its overall role and to understand how to manage cohesion in the context of performance.

The objective of establishing the significance of the different constructs of cohesion concerning production performance was achieved by statistically analysing if there were any significant relationships between production performance and the differences that were measured between teams in terms of cohesion constructs. The consideration of more performance measures would have expanded the scope of the study and increased the probability of a more comprehensive description of the role of each construct of cohesion in performance.

The adapted GEQ for work teams utilised in this study to measure cohesion within teams was demonstrated to be valid and reliable, which supports the statement that the objectives were achieved as stated above.

This study further demonstrates that the GEQ questionnaire is a valid tool that can be utilised in various scenarios and industries to measure cohesion. It supports the current literature concerning the reliability and validity of the GEQ and its versatility when adapted to different industries.

The objective to determine how cohesion is influenced by work experience, years worked in the current team and age differences in teams was achieved by statistically examining if there were any significant relationships between overall cohesion, its different constructs and the variables between teams.

Overall the objectives of the study were achieved within the limitation of the study scope.

4.6. Recommendations for future research

- Determining causal relationships between the variables was beyond the scope of this research. Multiple regression analysis or structural equation modelling is suggested in follow-up studies to establish whether such causal relationships exist.
- The relationship between team cohesion and other performance measurements should be explored to understand if there are any useful relationships that can be used to optimise performance. A multivariate factor analysis including all team performance variables, team diversity factors and cohesion constructs will provide a more comprehensive understanding of the role of cohesion in performance.
- The study of changes in cohesion over time and the impact on team performance will explore the temporal nature of cohesion and how the reciprocal mechanisms of cohesion and performance function.
- The validity and reliability of the adapted GEQ for work teams should be further explored with a larger sample population within the chemical manufacturing industry and other industries to improve the adequacy of the measuring instrument and the understanding of the conceptual model of cohesion.
- The relationship between cohesion as measured by the adapted GEQ and its relationship with performance should be investigated on a larger scale in various industries to improve our understanding of what role cohesion plays in performance. If significant relationships are identified they can be used to optimise performance by managing cohesion within work teams.
- Future studies should include the impact of leadership on team cohesion to understand how performance, leadership and cohesion are interconnected in the chemical manufacturing industry. The relationship between leadership and cohesion is described in the existing literature and it could be beneficial to understand how the existing literature applies to the chemical manufacturing industry.

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ANNEXURE A – GROUP ENVIRONMENT QUESTIONNAIRE (GEQ)
(CARRON *ET AL.*, 1985)

GROUP ENVIRONMENT QUESTIONNAIRE

ALBERT V. CARRON*
LAWRENCE R. BRAWLEY**
W. NEIL WIDMEYER**

*THE UNIVERSITY OF WESTERN ONTARIO (London, Canada)
**UNIVERSITY OF WATERLOO (Waterloo, Canada)

This questionnaire is designed to assess your perceptions of your athletic team. There are no right or wrong answers so please give your immediate reaction. Some of the questions may seem repetitive but please answer All questions. Your candid responses are very important to us.

Your responses will be kept in strictest confidence (Neither your coach nor anyone other than the researchers will see your responses). You have been asked to indicate your name only in the event that we need to match two pieces of information on each player.

NAME (print) _____ AGE _____ SEX M ☐ F ☐

GROUP (NAME OF TEAM) _____

NAME OF YOUR LEAGUE _____

The following questions are designed to assess your feelings about YOUR PERSONAL INVOLVEMENT with this team. Please CIRCLE a number from 1 to 9 to indicate your level of agreement with each of the statements.

1. I do not enjoy being a part of the social activities of this team.

1	2	3	4	5	6	7	8	9
STRONGLY DISAGREE								STRONGLY AGREE

2. I'm not happy with the amount of playing time I get.

1	2	3	4	5	6	7	8	9
STRONGLY DISAGREE								STRONGLY AGREE

3. I am not going to miss the members of this team when the season ends.

1	2	3	4	5	6	7	8	9
STRONGLY DISAGREE								STRONGLY AGREE

4. I'm unhappy with my team's level of desire to win.

1	2	3	4	5	6	7	8	9
STRONGLY DISAGREE								STRONGLY AGREE

5. Some of my best friends are on this team.

1	2	3	4	5	6	7	8	9
STRONGLY DISAGREE								STRONGLY AGREE

6. This team does not give me enough opportunities to improve my personal performance.

1	2	3	4	5	6	7	8	9
STRONGLY DISAGREE								STRONGLY AGREE

7. I enjoy other parties more than team parties.

1	2	3	4	5	6	7	8	9
STRONGLY DISAGREE								STRONGLY AGREE

8. I do not like the style of play on this team.

1	2	3	4	5	6	7	8	9
STRONGLY DISAGREE								STRONGLY AGREE

9. For me this team is one of the most important social groups to which I belong.

1	2	3	4	5	6	7	8	9
STRONGLY DISAGREE								STRONGLY AGREE

The following questions are designed to assess your perceptions of YOUR TEAM AS A WHOLE. Please CIRCLE a number from 1 to 9 to indicate your level of agreement with each of the statements.

10. Our team is united in trying to reach its goals for performance.
1 STRONGLY DISAGREE 2 3 4 5 6 7 8 9 STRONGLY AGREE
11. Members of our team would rather go out on their own than get together as a team.
1 STRONGLY DISAGREE 2 3 4 5 6 7 8 9 STRONGLY AGREE
12. We all take responsibility for any loss or poor performance by our team.
1 STRONGLY DISAGREE 2 3 4 5 6 7 8 9 STRONGLY AGREE
13. Our team members rarely party together.
1 STRONGLY DISAGREE 2 3 4 5 6 7 8 9 STRONGLY AGREE
14. Our team members have conflicting aspirations for the team's performance.
1 STRONGLY DISAGREE 2 3 4 5 6 7 8 9 STRONGLY AGREE
15. Our team would like to spend time together in the off season.
1 STRONGLY DISAGREE 2 3 4 5 6 7 8 9 STRONGLY AGREE
16. If members of our team have problems in practice, everyone wants to help them so we can get back together again.
1 STRONGLY DISAGREE 2 3 4 5 6 7 8 9 STRONGLY AGREE
17. Members of our team do not stick together outside of practices and games.
1 STRONGLY DISAGREE 2 3 4 5 6 7 8 9 STRONGLY AGREE
18. Our team members do not communicate freely about each athlete's responsibilities during competition or practice.
1 STRONGLY DISAGREE 2 3 4 5 6 7 8 9 STRONGLY AGREE

Thank You For Your Assistance

ANNEXURE B – ADAPTED GEQ FOR WORK TEAMS

What department do you work for?

How long have you worked in your current work team? (Years)

How much work experience do you have in total? (Years)

What is your age? (Years)

What gender are you? (Male/Female)

Q1 I do not enjoy being a part of the social activities of my work team

1	2	3	4	5	6	7	8	9
Strongly								Strongly
Disagree								Agree

Q2 I am not going to miss the members of this team when I leave this department

1	2	3	4	5	6	7	8	9
Strongly								Strongly
Disagree								Agree

Q3 I'm unhappy with my team's level of desire to achieve goals

1	2	3	4	5	6	7	8	9
Strongly								Strongly
Disagree								Agree

Q4 Some of my best friends are on my work team

1	2	3	4	5	6	7	8	9
Strongly								Strongly
Disagree								Agree

Q5 This work team does not give me enough opportunities to improve my personal performance

1	2	3	4	5	6	7	8	9
Strongly								Strongly
Disagree								Agree

Q6 I enjoy other social events more than work related social events

1	2	3	4	5	6	7	8	9
Strongly								Strongly
Disagree								Agree

Q7 I do not like the work methods of this team

1	2	3	4	5	6	7	8	9
Strongly								Strongly
Disagree								Agree

Q8 For me this work team is one of the most important social groups to which I belong

1	2	3	4	5	6	7	8	9
Strongly								Strongly
Disagree								Agree

Q9 Our work team is united in trying to reach its goals

1	2	3	4	5	6	7	8	9
Strongly								Strongly
Disagree								Agree

Q10 Members of our work team would rather go out on their own than get together as a team

1	2	3	4	5	6	7	8	9
Strongly								Strongly
Disagree								Agree

Q11 We all take responsibility for any loss or poor performance by our work team

1	2	3	4	5	6	7	8	9
Strongly								Strongly
Disagree								Agree

Q12 Our work team members rarely socialise together

1	2	3	4	5	6	7	8	9
Strongly								Strongly
Disagree								Agree

Q13 Our work team members have conflicting aspirations for the team's performance

1	2	3	4	5	6	7	8	9
Strongly								Strongly
Disagree								Agree

Q14 Our work team would like to spend time together after work

1	2	3	4	5	6	7	8	9
Strongly								Strongly
Disagree								Agree

Q15 If members of our work team have problems, everyone wants to help them so we can get back together again

1	2	3	4	5	6	7	8	9
Strongly								Strongly

Disagree

Agree

Q16 Members of our work team do not stick together outside of work

1	2	3	4	5	6	7	8	9
Strongly								Strongly
Disagree								Agree

Q17 Our work team members do not communicate freely about each other's responsibilities during work

1	2	3	4	5	6	7	8	9
Strongly								Strongly
Disagree								Agree

INFORMED CONSENT for
participation in the study

Date: Aug 2019



Private Bag X6001, Potchefstroom
South Africa 2520
Tel: 018 299-1111/2222
Web: <http://www.nwu.ac.za>
NWU School of Business & Governance
Tel: 018 299 1338
Fax: 018 299 1416
<http://commerce.nwu.ac.za/business-school>
Email: jordaan.johan@nwu.ac.za

The form below provides you as respondent in the project with more information, so that you can make an informed decision whether you would like to take part in this research project or not.

Title of the Project: *The role of team cohesion in the production performance of a chemicals manufacturing company*

Institution / School / Subject group / Institute: North West University Business School.

Ethics Reference Number: *To be issued*

Names and contact details of people who could be contacted if there is an ethics issue with the study that you need to discuss with someone.

	Supervisor	Researcher
Title, name & surname	Dr. Johan Jordaan	Mr. Fanus van Wyk
Function in Project	Research Supervisor	Researcher
Qualifications	B.Sc. HDE B.Com. MBA	B.Sc. B.Hons
Telephone (work)	018 299 1338	0766802558
e-mail address	Jordaan.johan@nwu.ac.za	Fanus.vanwyk@sasol.com
	Scientific committee	Ethics committee
Title, name & surname	Prof Stephan van der Merwe	Prof Leon de Beer
Function in Project	Chairman: Scientific committee	Chairman: Ethics
Qualifications	Ph.D	Ph.D.
Telephone (work)	018 299 1414	018 285 2437
e-mail address	Stephan.vandermerwe@nwu.ac.za	Leon.debeer@nwu.ac.za
Any of the people could be contacted if you have concerns regarding the research		

You are invited to take part in a research study that forms part of my MBA degree in business management (sub-discipline: Team cohesion). Please take some time to read

the information presented here, which will explain the details of this study. Please ask the researcher or person explaining the research to you any questions about any part of this study that you do not fully understand. It is very important that you are fully satisfied that you **clearly understand** what this research is about and how you might be involved. Also, your participation is **entirely voluntary** and you are free to refuse to participate or to withdraw at any. You will be completely **anonymous** in this study and all information will be confidential. You are therefore also **free to withdraw** from the study at any later point, even if you do agree to take part now, in which case any submission by you will immediately be deleted. By submitting a completed questionnaire, you give permission for the data to be used in this research, as well as for further research that might arise from the research.

This study has been approved by the **Faculty of Economic and Management Sciences Research Ethics Committee** and will be conducted according to the ethical guidelines and principles of the North West University and other international ethics guidelines applicable to this study. It might be necessary for the research ethics committee members or other relevant people to inspect the research records.

What is this research study all about?

The intention of this study is to obtain an understanding of the role that team cohesion plays within your organisation and how it affects the performance of teams to achieve departmental and company goals. Team cohesion is defined as the degree to which individuals of a group are prepared to contribute towards its functioning as a unit in pursuit of a goal.

This will be investigated by collecting inputs from permanently appointed operations employees within your operating entity, by utilising a questionnaire that will be submitted electronically. The questionnaire's purpose is to establish what your personal perspective is regarding the team cohesion that exists within your natural working group. The questionnaire data together with individual manufacturing unit performance data related to product production targets and plant performance will be analysed and interpreted to form conclusions regarding team cohesion and its effect on performance.

This study will be conducted at Sasol Secunda Chemicals Operations (SCO) and will involve all permanently employed personnel that have a direct involvement in running and maintaining the manufacturing plants.

We plan to use the information gathered from the questionnaires and the available production performance information of the various departments in SCO to improve our understanding of the role of team cohesion in the ability of teams to perform

Why have you been invited to participate?

You have been invited to be part of this research because you are a permanent employee of Sasol that is part of a maintenance or production department within SCO that directly contributes towards the performance of a manufacturing unit. You will not be able to take part in this research if you are not permanently employed by Sasol

What will be expected of you?

You will be expected to complete the online questionnaire within the agreed time frame truthfully and as accurate as possible to ensure that the data submitted is a true reflection your work experience within your team

Will you gain anything from taking part in this research?

Your honest input will enable me to accurately execute the research objectives of this study and enable me to provide scientifically relevant information to Sasol that can be used to make improvements over time which can be beneficial to you and your team

Other gains of the study is for management and the researchers to gain more insight into the role of team cohesion on the performance of teams in the work place. This study will contribute towards the body of knowledge that exists regarding team cohesion and will give management more information and guidelines to manage teams more effectively

Are there risks involved in you taking part in this research and what will be done to prevent them?

The only risk to you in this study is that the information that you provide regarding the team cohesion of your department can become public and expose your personal views of your team. This risk will be mitigated by ensuring that all data that is collected for this study is anonymous and confidential. Your personal inputs will not be made available to any other persons in your company.

Information will only be shared with the persons that are directly involved in conducting the research.

How will we protect your confidentiality and who will see your findings?

Anonymity of your findings will be protected by the fact that all information submitted will be anonymous and confidential. Your privacy will be protected by ensuring that no person that participated in the study is identified.

The findings of the study will be provided to the North West University and Sasol. The findings will not include any personal information.

What will happen with the findings or samples?

The findings of this study will only be used for academic purposes to add to the body of knowledge regarding team cohesion.

How will you know about the results of this research?

The results of this research will be available on request and can be distributed to you via Email.

Will you be paid to take part in this study and are there any costs for you?

There will be no financial rewards or costs involved for you, if you do take part in this study.

Only your time and effort to complete the questionnaire honestly is required to take part in the study.

Declaration by participant

By signing below, I (student number) agree to take part in the research study titled: **A strategy for engaged learning in an MBA program.**

I declare that:

- I have read this information/it was explained to me by a trusted person in a language with which I am fluent and comfortable.
- The research was clearly explained to me.
- I have had a chance to ask questions to both the person getting the consent from me, as well as the researcher and all my questions have been answered.
- I understand that taking part in this study is **voluntary** and I have not been pressurised to take part.
- I may choose to leave the study at any time and will not be handled in a negative way if I do so.
- I may be asked to leave the study before it has finished, if the researcher feels it is in the best interest, or if I do not follow the study plan, as agreed to.

Signed at (*place*) on (*date*) 20....

.....
Signature of participant

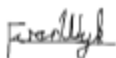
.....
Signature of witness

Declaration by researcher

I *Fanus van Wyk* declare that:

- I explained the information in this document to all participants, including (respondent to fill in his/her name).
- I did not use an interpreter.
- I encouraged him/her to ask questions and took adequate time to answer them or I was available should he/she want to ask any further questions.
- The informed consent was obtained in the presence of an independent person.
- I am satisfied that he/she adequately understands all aspects of the research, as described above.
- I am satisfied that he/she had time to discuss it with others if he/she wished to do so.

Signed at Secunda on 20 August 2019



.....
Signature of researcher



.....
Signature of witness

ANNEXURE D – COMPANY CONSENT

Approval for Research / Dissertation Publication

Applicant:.....Fanus van Wyk.....

Control No:....01024324.....

Please indicate:

Research

☐

Dissertation

☒

MBA studies approved by SCO Exco:

Yes X No

I have read and understand the SCO Disclosure Control Policy

Yes x

Will any price sensitive information be used?

**If yes, separate approval is required from the VP Technical.*

Yes No x

Please give an executive summary of research / dissertation publication:

As part of the completion of a MBA Degree at the North West University (NWU), all students are required to complete a dissertation. The topic that has been select by Mr Fanus Erasmus van Wyk, student number 20425813 is registered under the following title "The role of team cohesion in the production performance of a chemicals manufacturing company".

In order to add to the existing body of knowledge on the topic, Mr van Wyk will be required to undertake both a literature review as well as conduct a survey. For the purposes of the survey, a selected sample of individuals within the Secunda Chemicals Operations environment will be requested to complete a questionnaire to establish their perceptions of the team cohesion that exists within their work teams. The survey will be questionnaire based and anonymous to protect the identity and inputs of all participants.

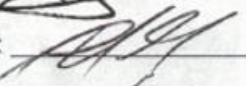
The research will further require the collection of historical data pertaining to the production performance (ATOP) within the divisions of Secunda Chemicals Operations. The research will comply with all ethical rules of the North West University and neither Sasol nor any of the respondent's names will be mentioned in the study.

The target group of the study will be all production and maintenance personnel that are employed by Secunda Chemicals Operations.

The consent is granted on the condition that the study report must not in any manner, form or way reflect any details of the organisation



Recommended by VP:  Date: 4/11/19

*Approved by VP Technical:  Date: 22/11/2019

If any related information will be used in the research / dissertation publication :

Approved by (SVP):   Date: 25.11.19

NB: Copy of approved document to be send to Glory Dlamini (Financial Governance)

ANNEXURE E – ETHICAL CLEARANCE



NORTH-WEST UNIVERSITY
YUNIBESITHI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT

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Economic and Management Sciences Research
Ethics Committee (EMS-REC)
Tel: 018 299-1427
Email: Bennie.Linde@nwu.ac.za

15 November 2019

Dr J J Jordaan
Per e-mail
Dear Dr Jordaan,

EMS-REC FEEDBACK: 15112019

Student: van Wyk, FE (20425813)(NWU-01397-19-A4)

Applicant: Dr J J Jordaan - MBA

Your ethics application on, *The role of team cohesion in the performance of a chemicals manufacturing company*, that served on the EMS-REC Ad Hoc Business School meeting of 15 November 2019, refers.

Outcome:

Approved as a minimal risk study. A number NWU-01397-19-A4 is given for three years of ethics clearance. Kindly take out the promise of anonymity in the questionnaire.

Kind regards,

A handwritten signature in grey ink, appearing to read 'B. Linde'.

Prof Bennie Linde
Chairperson: Economic and Management Sciences Research Ethics Committee (EMS-REC)
Potchefstroom Campus

ANNEXURE F – QUESTIONNAIRE E-MAIL



Thu 11/28/2019 8:46 PM
Van Wyk, Fanus (FE)
Please help me collect data for my research by completing this questionnaire on team cohesion

To Moropa, Lazarus (LM); Miller, Bradley (BJ)

Dissertation permission letter 22 Nov 2019.pdf
748 KB

Informed consent letter Aug 2019.pdf
505 KB

Team cohesion (GEQ) questionnaire

Good day,

Please assist me to collect data for my MBA dissertation by completing a quick survey today. You have been selected to take part in this survey based on your current position and work area.

Your participation in this research project is completely voluntary and your inputs will be completely anonymous.

Please answer the questions in terms of your whole team that reports to your Area manager

By clicking the link below you agree to take part in the survey.

Please contact me for any questions regarding the research.

Please assist employees in your department that do not have access to Email by letting them complete a survey using the same link below.

The permission letter for the study and informed consent is attached for your information.

Click on the link below to start the survey.

I thank you for your participation and contribution to this research project.

Regards
Fanus van Wyk

[Link to survey](#)