USING EYE TRACKING TO EVALUATE THE USABILITY OF THE NEW IMPROVED ONLINE PERFORMANCE MANAGEMENT SYSTEM AT THE UNIVERSITY OF THE FREE STATE.

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DECLARATION

"I declare that the Field Study hereby submitted for the Magister in Business Administration at the UFS Business School, University of the Free State, is my own independent work and that I have not previously submitted this work, either as a whole or in part, for a qualification at another University or at another faculty at this university.

I also hereby cede copyright of this work to the University of the Free State."

Name: Ronald William Brown

Date: 10 November 2015

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CHAPTER 1
RESEARCH PROPOSAL

1.1. Introduction

Chapter one will explain how the research was conducted and the reasons for conducting the study. It will give a brief overview of the online performance management system (PMS) of the University of the Free State (UFS). Furthermore, it will also give an explanation of how eye tracking is used to evaluate the usability of an online system.

This chapter will also state the research problem as well as the research objectives. The methodology for conducting the research will be established, explaining the research design, sampling techniques, limitations and the value of the study.

1.2. Background of the study

1.2.1. Performance management systems

Performance management is “a continuous process of identifying, measuring, and developing the performance of individuals and teams, and aligning performance with the strategic goals of the organization” (Aguinis, 2009, p. 2).

Ferreira and Otley (2009, p. 264) view PMSs as:

> The evolving formal and informal mechanisms, processes, systems, and networks used by organizations for conveying the key objectives and goals elicited by management, for assisting the strategic process and ongoing management through analysis, planning, measurement, control, rewarding, and broadly managing performance, and for supporting and facilitating organizational learning and change.

PMSs have definite benefits for both the organisation and the employees. These systems can provide individual feedback and collated organisational data, which can be used for human resource planning and system evaluation purposes. Studying the collated data can also assist with managerial planning, remuneration schemes and human resource development programmes. “Individual performance management outputs include opportunities for remedial skills development, retention, career

development, training and upskilling programmes", according to Nankervis and Compton (2006, pp. 84-85).

It is important to know whether a PMS is well designed, because if it is, the PMS will have benefits for employees, managers and the organisation. Some of these benefits are shown in Table 1.1 below.

Table 1.1. Benefits resulting from a well-designed PMS (Adapted from: Aguinis, Joo and Gottfredson, 2011)

For employees	Employees may experience improved self-esteem.
	Employees better understand the behaviours and results required of their positions.
	Employees better identify ways to maximise their strengths and minimise their weaknesses.
For managers	Managers develop a workforce with heightened motivation to perform.
	Managers gain greater insight into their subordinates.
	Managers make their employees become more competent.
	Managers enjoy better and timelier differentiation between good and poor performers.
	Managers enjoy clearer communication to employees about employees' performance.
For organisations	Organisations make administrative actions that are more appropriate.
	Organisations make organisational goals clearer to managers and employees.
	Organisations enjoy better protection from lawsuits.
	Organisations facilitate organisational change.
	Organisations develop increased commitment on the part of employees.
	Organisations enjoy enhanced employee engagement.
	Organisations enjoy reduced employee misconduct.

When any new system is implemented, problems may arise. The question that needs to be asked is: What potential problems may arise when a PMS is implemented? De Waal and Counet (2009) conducted a study to identify the main problems that are encountered when a PMS is implemented. They used a literature review to identify possible problems when implementing PMS and used these problems to compile a survey, which was sent to 31 experts in the field of performance management.

The experts had to give their opinion on the frequency, impact and solvability of the problems listed as they have encountered these problems in practice. The findings of the study was that the most severe problems are:

- lack of commitment by top management,
- not having a performance management culture in the organisation,
- performance management receiving low priority,
- performance management being abandoned after a change in management,
- management placing a low priority on the implementation of performance management, and
- employees not realising the benefits of performance management.

Another possible problem that can be added to the list above is a PMS that is not well-designed, more specifically, the online component of the PMS.

1.2.2. Performance management system of the UFS

The current online PMS of the UFS was implemented in 2007. The performance management cycle comprises three phases, namely creating a performance plan, evaluating the effectiveness of the work environment and evaluating the performance, and has two main role players (Line managers and Employees). All three phases take place in the online PMS environment. The complete cycle is shown in Figure 1.

During phase 1, the employee starts by either creating a new performance plan or reviewing a previous performance plan. This phase commences towards the end of the current year, for the next year. Once the employee has signed and submitted the performance plan, the employee's line manager needs to approve and sign the performance plan. If needed, the employee then has to review the performance plan before the half-year discussions the following year, where-after the line manager again has to approve the performance plan.

The improvement and development plan as well as the work environment survey are done in phase 2. The employee starts by completing the work environment survey, followed by the improvement and development plan. These also need to be approved by the line manager at the end of the phase.

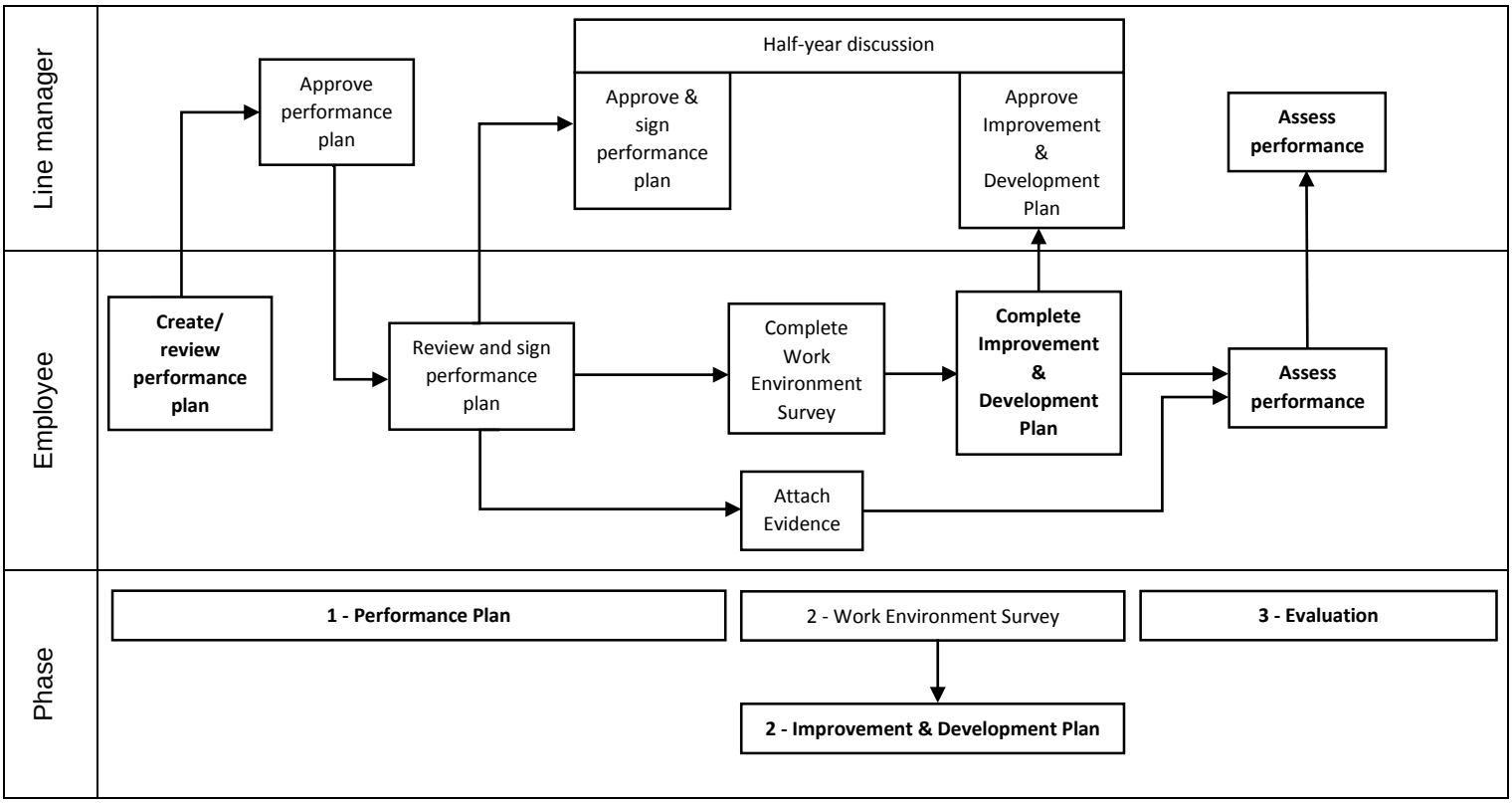

Figure 1.1. UFS performance management cycle (Adapted from: ICT Services, 2010)

The final phase, phase 3, is about employee evaluation. The employee needs to attach all the evidence of his tasks and then assess each task as well. When the employee has finished assessing his tasks, the line manager will assess the employee's tasks.

If the online PMS is difficult to use, it becomes a frustrating and time consuming activity for the employee as well as the line manager. This study will not look into the design of the PMS, but rather focus on the usability of the online PMS in order to determine its ease of use.

If the online PMS is not well-designed it may negatively affect employees' opinion about performance management (PM) in general and about the online PMS. Therefore it is vital to determine the usability of the online PMS in order to improve employees' opinion about the system and increase employee buy-in. In order to perform a usability study on the online PMS of the UFS, the researcher will make use of eye tracking.

1.2.3. Eye tracking

Eye tracking is a methodology that assists researchers in understanding a user's visual attention. Using eye tracking, it is easy to detect where a user is looking at a specific point in time, how long he is looking at something and the path his eyes follow.

There are three types of eye trackers: scleral contact lens, electro-oculography and optical methods (Duchowski, 2007). An optical method, called corneal reflection, will be employed in this study in order to detect and track the movement and location of the eye. Corneal reflection makes use of a light source in order to illuminate the eye, which in turn creates a reflection that is then detected by a high-resolution camera (Bergstrom and Schall, 2014).

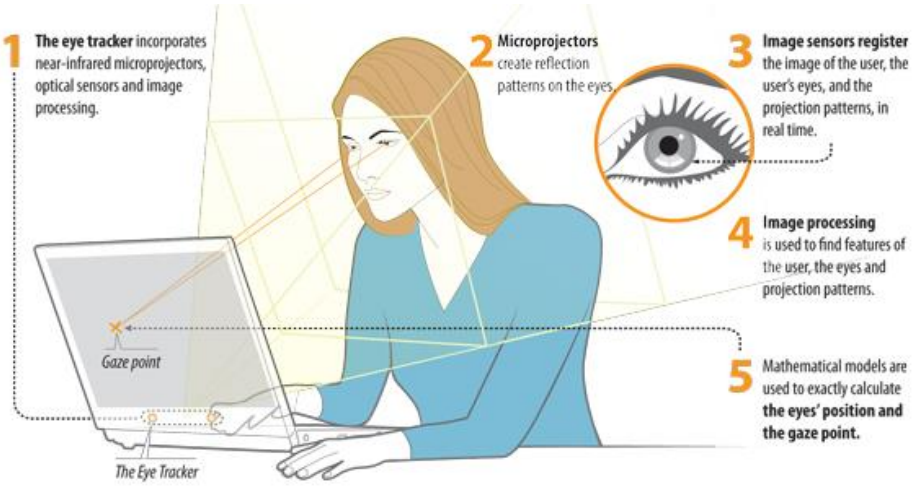

Figure 1.2. Eye tracking step by step (Source: Tobii, n.d.a.)

In order to determine if the online PMS of the UFS is easy to use, a usability study of the said online system will be done with eye tracking.

1.2.4. Usability studies with eye tracking

Usability testing is the technique of evaluating a product by testing it with actual users of the product. This study will use actual employees of the UFS to test the usability of the online PMS of the UFS. This method of testing enables researchers to obtain direct feedback on how real users work with the product. The International Organization for Standardization (ISO) defines usability as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and

satisfaction in a specified context of use" (ISO 9241-11 as quoted in Dix, Finlay, Abowd and Beale, 1998).

This definition of usability is based on three important keywords: effectiveness, efficiency and satisfaction. These keywords are defined as follows (ISO 9241-11):

- Effectiveness – The accuracy and completeness with which specified users can achieve specified goals in particular environments.
- Efficiency – The resources expended in relation to the accuracy and completeness of goals achieved.
- Satisfaction – The comfort and acceptability of the work system to its users and other people affected by its use.

In recent years, eye tracking has been used with usability testing as an additional method to evaluate user experience. The resulting eye tracking data has emerged as a valuable way to inform the design of user interfaces. Website developers can also use eye tracking to determine which features are looked at and which are overlooked, and this will assist them in adapting the website to make it more usable. Therefore, using eye tracking to evaluate the usability of the online PMS of the UFS may lead to suggestions on changing the user interface, which in turn may lead to improved user experience.

1.3. Problem statement

The problem statement of this study is the evaluation of the usability of the online PMS of the UFS in order to make suggestions and recommendations on areas that can be improved.

Research questions:

- How usable is the online PMS of the UFS?
- How can the online PMS of the UFS be improved?

1.4. Objectives

- Primary Objective
  - To evaluate the usability of the online PMS of the UFS, using eye tracking.

- Secondary Objectives
  - To provide a theoretical overview of eye tracking.
  - To identify tasks that users of the online PMS of the UFS find easy to perform.
  - To identify tasks that pose a difficulty to users of the online PMS of the UFS.
  - To hopefully make recommendations about possible changes to the online PMS of the UFS.

1.5. Preliminary literature review

1.5.1. Online PMSs

This section of the preliminary literature review will discuss online PMSs. A large number of organisations worldwide employ online PMSs. UBS, a financial services group based in Switzerland, is one of these organisations. In 2006, John Warner studied the online PMS of UBS. A summary of the case study will follow.

At the beginning of 2006, UBS completed the deployment of a universal performance appraisal system throughout the entire organisation. UBS built their own online PMS that is linked to PeopleSoft, where the company's employee records are stored. Each employee has a unique login that enables the system to recognise the user and automatically display the appropriate information from PeopleSoft. This information includes details such as the individual's current objectives, his role profile, to whom he reports and who reports to him.

According to Warner (2006), the most important benefit of the online PMS is that the system enables UBS to analyse departmental needs more effectively across all of its businesses because of the system's functionality and its ability to provide a more accurate reflection of performance (individuals, teams, businesses and company overall). In turn, this enables the corporate human resources (HR) department to identify training "blind spots" and highlight these specific training needs to the businesses.

John Mahoney-Phillips, the group head of human capital performance at UBS, said the following about their online PMS (Warner, 2006: p.4):

> One of the advantages of the system is that we can drive down the analysis to a business group and then advise on, for example, how a cadre of managers

could be built up, having identified the existing development gaps. A lot of our work in HR starts at group level as we carry out a 'maths' analysis. This helps inform overall talent development, but we can also drill down through the data and give businesses specific information to enable them to target development and manage assets much more effectively that in the past. This is just one of the many areas of added value that the system has brought to the organisation.

Looking at the above case study the advantages for the UFS of having an online PMS can be clearly seen. The biggest advantage is the fact that the online PMS can connect directly to PeopleSoft, which contains all the employee information. Since the PMS is an online system it can be easily accessed from anywhere on any of the campuses and there is no paperwork involved. Also, because the UFS structure is divided into different faculties, departments and divisions, having an online PMS allows the UFS to easily identify struggling departments, divisions or staff members.

Possibly the biggest pitfall of an online PMS is when it is inefficient and ineffective, or has high user dissatisfaction. If the online PMS that staff members must use in order to complete their PM is not "usable" then they will have a negative connotation towards the online PMS and PM in general. This may lead to staff members not buying into the PMS of the UFS.

1.5.2. Eye tracking

This section will focus on the eye tracking method that will be employed in this study as well as an explanation of key eye tracking terms and concepts.

This study will use the corneal reflection technique to determine where the participants are looking on the screen. The corneal reflection technique is based on the principle that when a near infrared light is shone onto the eye, it is reflected off the different structures within the eye to create four Purkinje reflections (Crane and Steele, 1978). The first of these Purkinje images is called the glint (corneal reflection). When using this eye tracking technique the vector difference between the pupil centre and the glint (corneal reflection) is tracked.

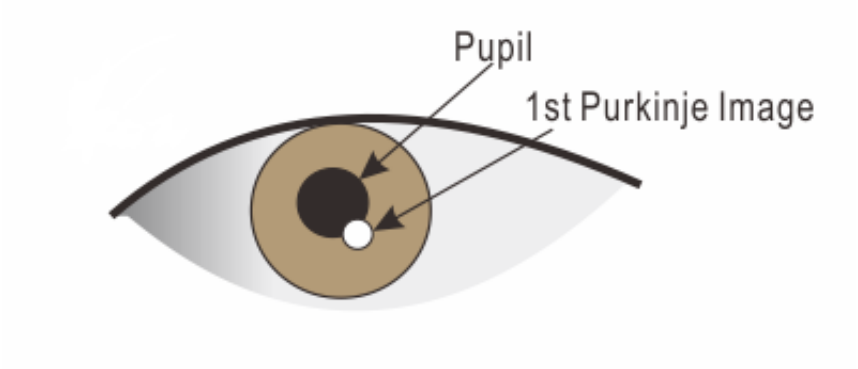

Figure 1.3. Pupil and 1st Purkinje image (Adapted from: Gaze Parser, n.d.)

Eye movements may differ depending on emotional states and cognitive processes, thereby allowing another dimension of a user's experience with an interface to be captured. Common measurements that are captured from eye tracking are fixations and saccades. According to Poole and Ball (2005), a fixation is the moment when the eyes are relatively stationary and taking in information, and last for 218 milliseconds on average, ranging between 66 and 416 milliseconds. A saccade, the purpose of which is usually to move the eyes to the next viewing position, is an eye movement that occurs between fixations and typically lasts for 20 to 35 milliseconds (Poole and Ball, 2005).

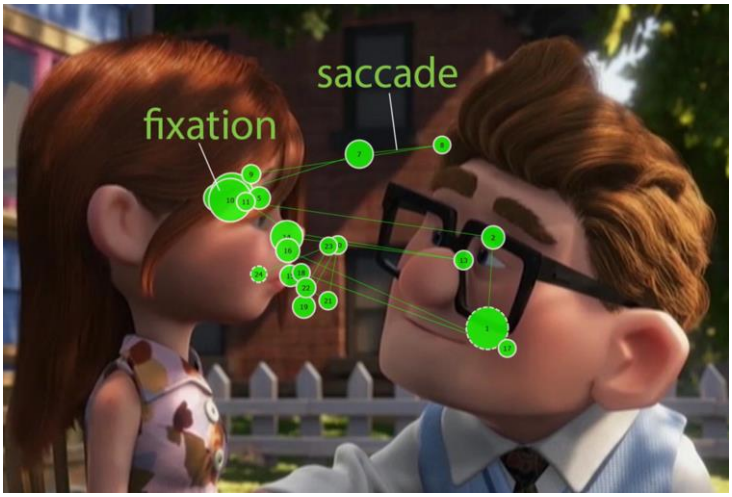

Figure 1.4. Fixations and saccades (Source: Redmond and Sita, 2013)

When analysing eye tracking data, areas of interest (AOIs), heat maps and gaze plots are used. AOIs are the most common way to analyse eye tracking data as it measures visual attention on specific elements or regions (Tullis and Albert, 2013). In Figure 1.5

two AOIs are drawn on the faces of the two characters. When using AOIs, specific eye tracking metrics such as dwell time, number of fixations, fixation duration, time to first fixation and revisits are used to analyse the eye tracking data..

Figure 1.5. Areas of interest (Adapted from: Imgkid, n.d.)

Heat maps are visualisations that represent the value of a variable in terms of colours, where the "heat" is proportional to the value of the specific variable (Bojko, 2013). In Figure 1.6 the heat map shows the fixation duration - the higher the heat (more red) the longer the participant's fixation duration on that specific area.

Figure 1.6. Heat map (Source: Redmond and Sita, 2013)

Gaze plots are visual representations of fixations and saccades, where circles represent the fixations, lines represent the saccades and the size of the circles

represents the fixation duration (Olmsted-Hawala, Holland, and Quach, 2014). Figure 1.7 shows gaze plots from various users, where the different colour circles represent the different users and the numbers represent the sequence of fixations.

Figure 1.7. Gaze plots from various users (Source: Redmond and Sita, 2013)

1.5.3. Usability studies with eye tracking

This section of the chapter will discuss, with examples from various research projects, how eye tracking can be used in usability studies.

According to Cooke (2005), eye tracking is also useful from the standpoint of usability for testing hypothesis about design. Cooke (2005) further states that an analysis of eye movement can add an additional dimension to usability testing by providing information about human behaviour that would be difficult to obtain through traditional usability testing alone.

Eghdam, Forsman, Falkenhav, Lind and Koch (2011) conducted an explorative study to measure effectiveness, efficiency and user satisfaction of a prototype called Infobiotika, which is aimed at supporting antibiotic use in intensive care units. They combined traditional usability methods with eye tracking technology. With the use of eye tracking methods they were able to identify several unexpected issues in terms of navigation, design problems and user performance.

This study will evaluate the effectiveness, efficiency and user satisfaction of the online PMS of the UFS. Participants will be given specific tasks to perform in the online PMS environment and the eye tracking data as well as the results from the questionnaires will be used to evaluate the effectiveness, efficiency and user satisfaction of this system.

1.6. Research methodology

This section will describe the methods that were used to collect the data in an effort to answer the research questions.

Research design

Effectiveness, efficiency and satisfaction form the basis of the definition of usability (ISO 9241-11 as quoted in Dix et al., 1998). Therefore, when testing the usability of an online system the effectiveness, efficiency and satisfaction when performing specific tasks were measured.

The research design was both quantitative and qualitative. Looking at effectiveness and efficiency, the study made use of different AOIs with eye tracking measurements such as the number of visits (the number of times a participant "visits" a specific AOI), time to first fixation (the time it took the participant to fixate on a specific AOI for the first time) and fixation duration (the time a participant was fixated on a specific AOI), which are quantitative.

User satisfaction was determined through a questionnaire, which was subjective and qualitative of nature. When the completed questionnaires were summarised it gave a quantitative indication of the qualitative impressions of the participants. The questionnaire was based on the Questionnaire for User Interaction Satisfaction (QUIS), developed at the University of Maryland. This questionnaire was developed in order to assess a user's subjective satisfaction with specific aspects of the human-computer interface (Chin, Diehl and Norman, 1988). The QUIS make use of a 9-point scale to rate specific aspects of the human-computer interface.

Once a conclusion has been reached, heat maps (Figure 1.6) will be used to support the other eye tracking measurements. Heat maps, which are qualitative in nature, are

visual representations of specific eye tracking variables (the intense the colour of the heat map, the higher the value of the specific variable).

Research strategy

The research strategy is divided into 8 sections: apparatus, stimulus, tasks to perform, profile of participants, protocol, data analysis, conclusion and recommendations. The research strategy is summarised in Table 1.2.

Table 1.2. Summary of research strategy

Apparatus	The eye tracker that was used for this study is the Tobii TX300, which is a table mounted eye tracker.
Stimulus	The stimulus for the study was a demo version of the online PMS of the UFS.
Tasks to perform	Participants were given specific tasks to perform within the online PMS of the UFS.
Profile of participants	Discussed under sampling design.
Protocol	The protocol is a step-by-step explanation of what happened during each eye tracking test. It was developed in order to ensure that all participants are treated in exactly the same manner.
Data analysis	Data was analysed as discussed in the research design.
Conclusion	After the data has been analysed a conclusion will be reached regarding the usability of the online PMS of the UFS.
Recommendations	From the conclusion, recommendations were made in order to improve the usability of the online PMS of the UFS.

Sampling Strategy

Population

The population was support staff of the UFS who all make use of the online PMS.

Sampling design

The sample was chosen through nonprobability, purposive sampling (Sekaran and Bougie, 2013). As stated earlier the PMS of the UFS has two role players, namely employees and line managers. Every employee has a line manager and every line manager is also an employee with a line manager. Therefore, the sample consisted of support staff and non-academic line managers for support staff.

Data collection method

Data was collected through questionnaires and eye tracking tests. Questionnaires were based on the Questionnaire for User Interaction Satisfaction (QUIS), developed at the University of Maryland (Chin, Diehl and Norman, 1988). The QUIS makes use of a 9-point scale to rate specific aspects of a human-computer interface. The eye tracking test followed the protocol discussed under research strategy.

The sessions took place in the Usability Laboratory of the Department of Computer Science and Informatics at the UFS and a session took approximately 30 minutes.

Ethical considerations

No personal information will be shared (or recorded) during the sessions.

1.7. Demarcation of field of study

Field of study

Organisational Behaviour

When

Second quarter of 2015

Where

Bloemfontein Campus of the UFS

Who

Identified support staff and non-academic line managers at the UFS.

1.8. Chapter layout of study

Chapter 1 – Research proposal

Chapter 2 – Literature review

Chapter 3 – Research methodology

Chapter 4 – Findings and analysis

Chapter 5 – Conclusion, recommendations and limitations

1.9. Conclusion

PM is a very important aspect of any organisation and it is imperative that the PMS must be well-designed, especially when the organisation makes use of an online PMS. If the online PMS is not well designed it may lead to serious problems and the implementation of the PMS in general may be under threat. This study will conduct a

usability study, which will be done by means of eye tracking, on the online PMS of the UFS in order to determine its efficiency, effectiveness and user satisfaction. Line managers from the UFS's support services will be the participants for the eye tracking study. The next chapter will focus on an in-depth literature review of eye tracking and usability studies.

CHAPTER 2
LITERATURE REVIEW

2.1. Introduction

Chapter 2 will give an in-depth literature review of performance management, eye tracking and usability studies with eye tracking.

2.2. Performance management

A well-designed PMS has definite benefits to employees, managers and organisations, as shown in Table 1.1. For a PMS to be well-designed it must have a sound process behind it, hence the following discussion on a number of PM processes.

It is very important to understand the PM process because it lies behind the online PMS. PM processes differ from organisation to organisation and from industry to industry. Seeing that the UFS is part of the tertiary education sector, it is necessary to compare its PM process with that of other tertiary education institutions.

The first PM process under examination is from an international university, namely Cornell University in the United States of America (New York). Cornell University states that an effective PM process is “a series of ongoing conversations” (Cornell University, n.d.) and their PM model represents all the components of the PM process. Their PM process is divided into four main components: plan, assess, develop and recognise. The PM process is shown in Figure 2.1.

Cornell University’s PM process has nine elements that fall under the four main components. These nine elements are (Cornell University, n.d.):

- Ask employees to complete the Performance Dialogue as a self-evaluation.
- Review Staff Position Description for each employee and then with the manager.
- Complete Performance Dialogue and assign an overall performance rating.
- Schedule a personal meeting with each employee to discuss the manager’s and the employee’s evaluation.

- Review the previous year's goals with the employee and develop goals for the coming year.
- Employee and manager must sign and date the Performance Dialogue.
- Discuss the Individual Development Plan that was completed by the employee.
- Return original signed form to the Human Resource Lead for inclusion in the HR file.

Figure 2.1. Cornell University Performance Management Process (Source: Cornell University, n.d.)

The PM process of the University of Cape Town (UCT) will also be examined, as a South African example. The PMS being reviewed is used only for support staff of pay classes 6 to 12 and is called the Personal Performance System (PPS). The PPS process is divided into two main parts: Performance development cycle (Step 1-6) and Pay for performance cycle (Step 7-10). For the purpose of this research study, only the performance development cycle (Step 1-6) will be discussed. The complete PPS process is shown in Figure 2.2. UCT states that the aim of a PMS is "to empower staff members to take ownership of their work and, through an interactive process, improve individual and team performance" (University of Cape Town, 2015).

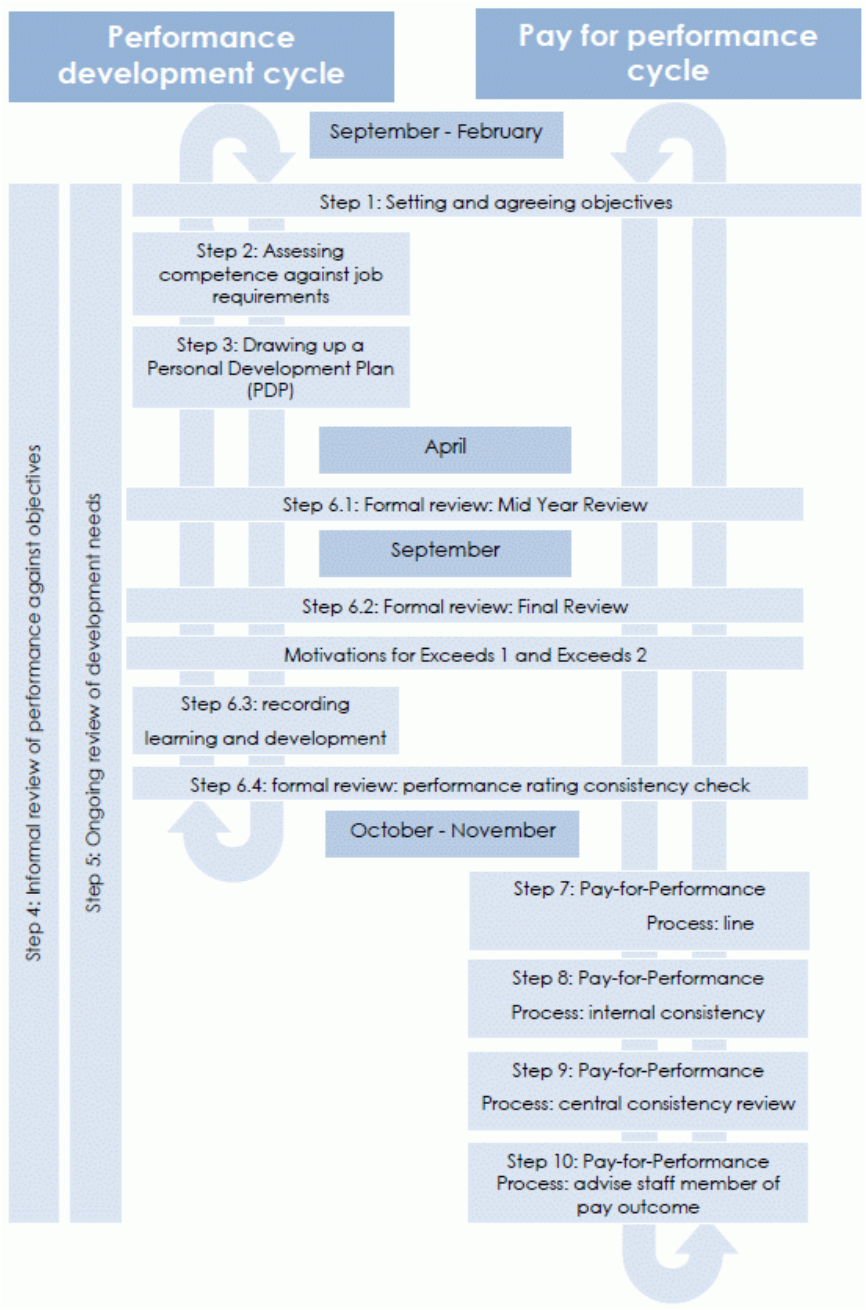

Figure 2.2. University of Cape Town Personal Performance System (Source: University of Cape Town, 2015)

The performance development cycle is divided into six steps and a discussion of each of the steps will follow (University of Cape Town, 2015).

Step 1 – Setting and agreeing objectives

By using the employee's job description, a list of key performance areas for the specific job must be identified. Each key performance area will have at least one associated objective, which refers to a specific tasks or goal that should be achieved within a specified period of time.

Step 2 – Assessing competence against job requirements

Any job has a set of required competencies in order for the incumbent to perform at the highest level in that position. Different types and levels of competencies are needed for different levels of jobs. The line manager and staff member should compare the competencies needed (to achieve above set objectives) with the current competencies of the staff member, and identify any gaps between the competencies. These gaps are the staff member's "learning and development needs".

Step 3 – Compiling a Personal Development Plan

Once the learning and development needs have been identified, appropriate learning and development initiatives and activities should be identified, planned, agreed and documented. This plan is called the Personal Development Plan (PDP) and is person-specific.

Step 4 – Informal review of performance against objectives

Line managers should review an employee's performance on a regular and on-going basis in order to ensure that the employee's performance is on-track against the objectives set in Step 1. These informal discussions can be used to give feedback and to discuss challenges and successes, and should happen over and above the required two formal review meetings per year.

Step 5 – On-going review of development needs

As performance is regularly reviewed and revised, the PDP should also be reviewed in order to ensure that the PDP stays relevant. If an objective changes, the PDP should also be adapted.

Step 6 – Formal review

There are two formal reviews taking place each year, namely the half-year review and the final review. The main objectives of these formal reviews are to review the actual performance of the staff member against the objectives set in step 1 and to review the PDP. Another aspect of step 6 is the recording of the learning and development activities that were completed during the reporting cycle. Finally, a performance rating consistency review needs to be completed in order to ensure that the system and performance rating scale are consistently applied throughout the university.

The complete PM cycle of the UFS is shown in Figure 1.1. When looking at the PM cycle of the UFS, it can be deduced that the fundamentals of the UFS system are quite similar to the other two systems discussed. The PM tool that is used by the UFS is an online system and the steps involved in this system are shown in Figure 2.3.

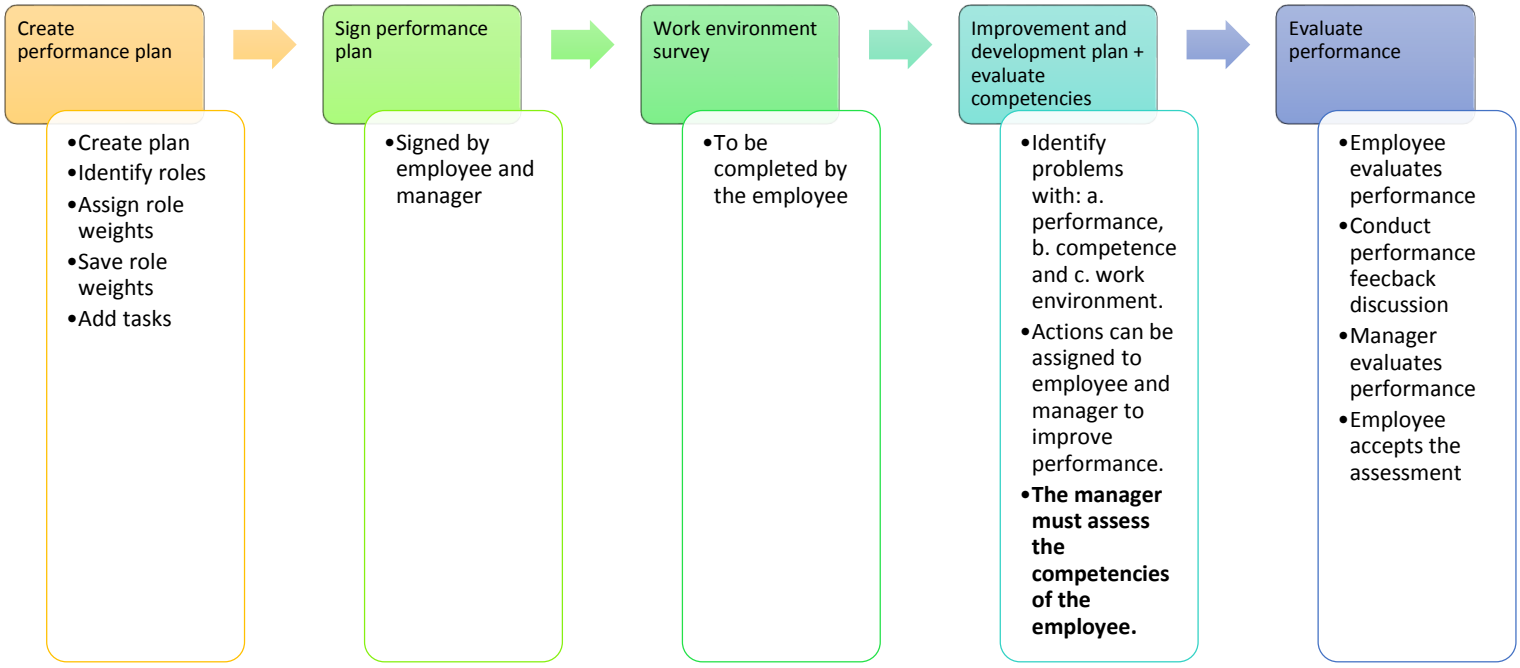

Figure 2.3. Steps of the online performance management system of the University of the Free State (Adapted from: University of the Free State, 2015)

How users of the online PMS of the UFS experience the system is extremely important, because that can cause the PMS to fail completely. This is why it is important to look at the usability of the online PMS of the UFS using eye tracking.

2.3. Eye tracking

This section will look at eye tracking in more detail, including a discussion on the history of eye tracking, the different types of eye trackers and the working of an eye tracker.

2.3.1 The history of eye tracking

Louis Émile Javal (1839-1907) is seen as a leader in the field of Orthoptics. Javal is the first (documented) person interested in observing the eye movement of individuals.

He made use of a semi-transparent occluder when he tested individuals (Roper-Hall, 2007).

At the start of the 20th century, Dodge and Cline developed the first accurate, non-invasive eye tracking technique by reflecting light from the cornea (Dodge and Cline, 1901). In the 1930s, Miles Tinker started to make use of photographic techniques to look at eye movements during reading. In his study he changed the font type, font size and page layout and determined the effects these changes had on reading speed and eye movement patterns (Tinker, 1963).

Fitts, Jones and Milton, in 1947, studied the movement of pilots' eyes when they used cockpit controls, with motion picture cameras. They had to do the analysis on a frame-by-frame basis, which was quite a painstaking task (Fitts, Jones & Milton, 1950). The first head-mounted eye tracker was invented by Hartridge and Thompson in 1948. This was the start of freeing participants from tight constraints on head movement (Hartridge & Thompson, 1948).

As stated above, before the introduction of computers in the 1970's, analysis of eye tracking data was an extremely painstaking task. "It is not uncommon to spend days processing data that only took minutes to collect" (Monty, 1975: 331-332). Card wanted to understand how users search for specific commands in computer menus and did the first usability study with eye tracking in 1984 (Card, 1984).

2.3.2 Types of eye trackers

All eye trackers fall into one of the following three categories: scleral contact lens; electro-oculography (EOG) and optical methods.

Scleral contact lens

The scleral contact lens is by far the most precise of all the eye movement measuring methods, but it is also the most intrusive. The left picture of Figure 2.4 shows a scleral contact lens being used, and as can be seen from the picture in Figure 2.4 it causes some discomfort to the wearer.

This method employs the wire coil on the contact lens and measures it moving through an electromagnetic field. This method is generally not used for point of regard measurement (Duchowski, 2007).

Figure 2.4. Scleral contact lens (left) and electromagnetic field frame (right) (Source: 3D Kinematics, n.d.)

Electro-oculography (EOG)

In the 1970s, EOG was the most widely used eye movement measurement method and is still used today. EOG makes use of electrodes placed around the eyes, which measure the skin's electric potential differences as shown in Figure 2.5. EOG is not a suitable measurement for point of regard unless the position of the head is also measured (Duchowski, 2007).

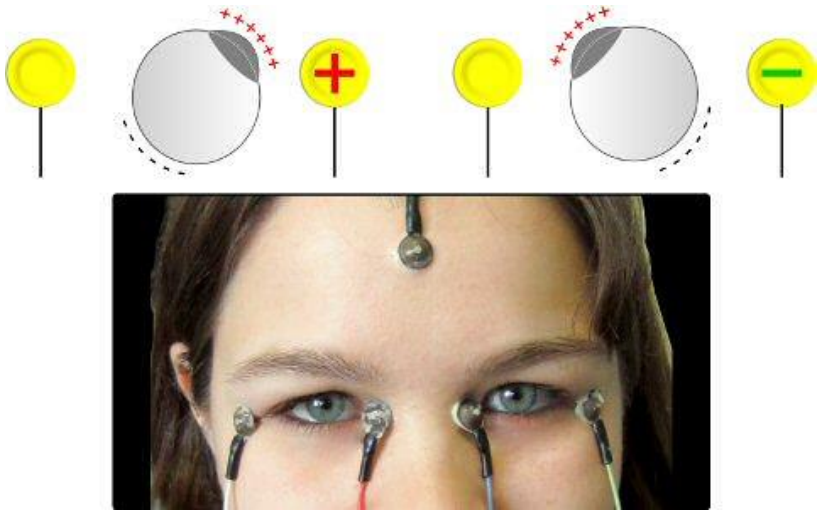

Figure 2.5. Electro-oculography (Source: Metrovision, n.d.)

Optical Methods

Optical methods make use of a non-contact method for measuring eye movement. Infrared light is shone in to the eye and the reflection from the eye is then recorded by a video camera. These video-based eye trackers use the corneal reflection (first Purkinje image as shown in Figure 1.3) and the centre of the pupil as features to track eye movement over time. The location of the pupil centre is measured relative to the corneal reflection, and is known as the pupil-glint vector (Duchowski, 2007).

In order to determine a participant's point of regard, the correct calibration procedures need to be followed. Calibration will be discussed later in this section. Although video-based eye trackers may be table-mounted or worn on the head (Figure 2.6) both have the same operational principles. These optical methods are widely used for gaze tracking and are favoured for being non-invasive and relatively inexpensive.

Figure 2.6. Table-mounted and head-mounted Tobii eye trackers. (Source: Tobii, n.d.b.)

2.3.3 Video-based eye trackers

As in a study by Beelders (2009), this usability study will also make use of a video-based eye tracker. When using a video-based eye tracker, the pupil-glint vector changes as the eye moves. Figure 2.7 shows the pupil and glint on the left and the pupil glint vector on the right. In order to determine the point of regard a regression model needs to be used and will calculate the difference in x-coordinates (x') and y-coordinates (y') between the pupil centre and the glint, which is then mapped to screen coordinates (X, Y).

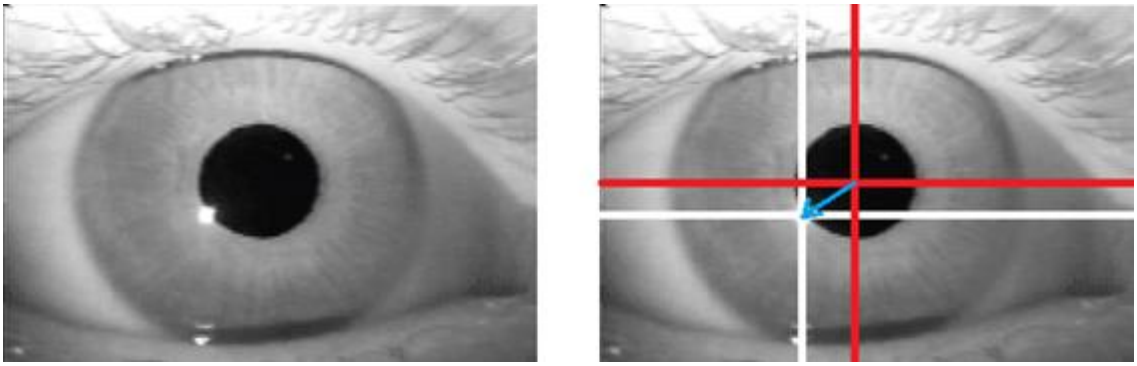

Figure 2.7. Pupil glint vector (Source: Visual perception laboratory, n.d.)

In order to make corrections for head movement, the pupil-glint vector needs to be normalised. A regression-based system makes use of polynomial expressions or neural networks to determine the point of regard as a function of the features of the eye image. A polynomial model needs to include two independent variables, the x and y components of the pupil-glint vector, for each of the dependent variables (X and Y components of the point of regard) separately. A simple linear polynomial model with four terms can look like this:

$$X_{left} = a_0 + a_1x + a_2y + a_3xy$$

$$Y_{left} = b_0 + b_1x + b_2y + b_3xy$$

In the above equations x and y refer to the normalised x and y components of the pupil-glint vector at a specific point in time. X_{left} and Y_{left} refer to the coordinates of the point of regard for the left eye on the horizontal plane of the screen.

The coefficients a_i and b_i are determined through the calibration process. During the calibration process, the user is required to focus on a number of dots at known positions on the screen. A least squares regression is done to determine the polynomials that will minimise the differences between the recorded point of regards and the actual point of regards. A typical layout of a 9-point calibration process is shown in Figure 2.8. These points are shown one-at-a-time in a randomly determined order.

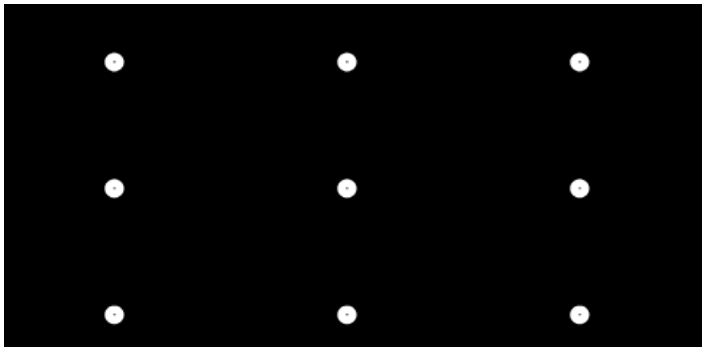

Figure 2.8. Positioning of dots for a 9-point calibration process

The lower the number of calibration points, the more limited the accuracy that can be achieved. The typical calibration schemes require either 5 or 9 pre-defined points and will seldom have more than 20 points (Borah, 1998). Figure 2.9 shows the feedback from a calibration procedure.

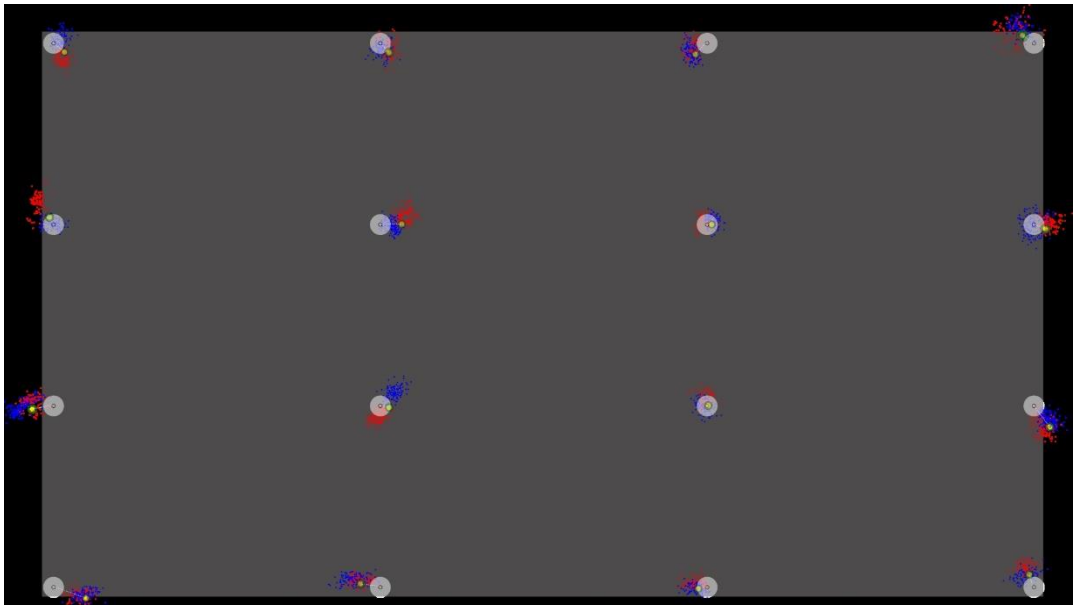

Figure 2.9. Feedback from calibration (Source: Gazegroup, 2010)

Figure 2.9 is a 16-point calibration procedure and the red and blue dots are two sets of calibration data. An aggregated fixation point has been calculated and is indicated by the small yellow dot. The distance between the small yellow dot and the centre of the larger white dot determines whether the calibration was good enough to continue with the experiment. If the facilitator is not satisfied with the result of the calibration, he may want to repeat the calibration process. If the repeated result is still not acceptable, it is possible that the participant's eyes cannot be "tracked" successfully.

The “trackability” of a person’s eyes can be influenced by features such as ethnicity, eye colour, wearing glasses, shape and size of the eyes, corneal bulge and the foveal area of the eye. External factors that can influence the quality of eye tracking data are aspects such as viewing angle, distance from the screen, head position and light conditions (Hansen and Ji, 2010; Holmqvist, Nyström, Andersson, Dewhurst, Jarodzka & Van de Weijer, 2011).

If the calibration procedure has been successful, the facilitator can continue with the eye tracking test. As the participant is completing the eye tracking test, raw data points are recorded at a specific frequency. The Tobii TX300 that will be used for this study operates at 300Hz, which means that a raw data point is captured every 3.3 milliseconds, Figure 2.10 shows raw data points that were recorded.

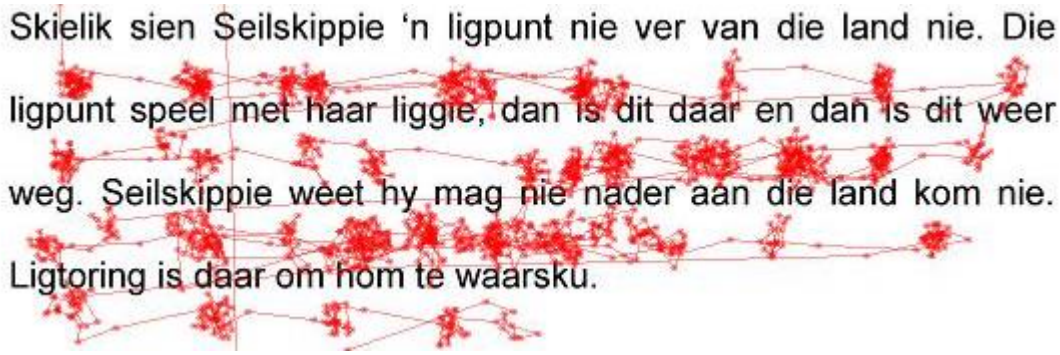

Figure 2.10. Raw data points

These raw data points need to be converted to fixations. A fixation is on average 218 milliseconds long, but can range from 66 to 416 milliseconds (Poole and Ball, 2005). When the data of Figure 2.10 are converted to fixations it looks like Figure 2.11. With regard to fixations, it is important to remember that the larger the circle, the longer the fixation.

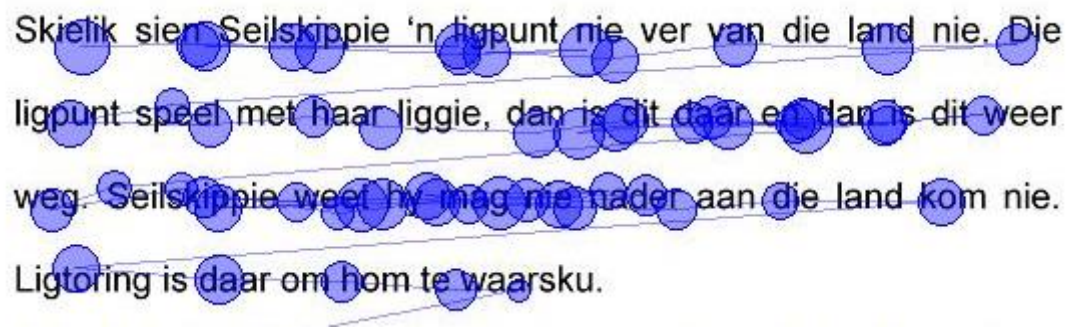

Figure 2.11. Raw data converted to fixations

When conducting a usability study the fixations alone can give an idea of what the participant was looking at during testing, but it is not sufficient to study the usability of an online system/website. For usability studies, specific eye tracking metrics need to be used and, in order to calculate these metrics, the researcher must use areas of interest (AOI). Figure 2.12 shows a website (on the left) and the same website divided into different AOIs (on the right).

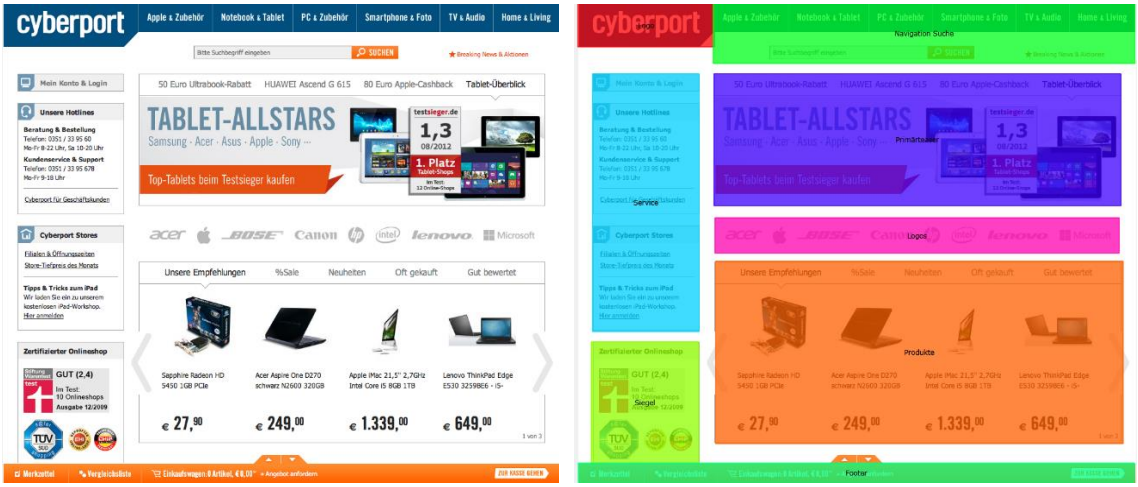

Figure 2.12. Website and AOIs (Source: Hubert, 2013)

Each of these AOIs can now be evaluated using some eye tracking metrics, which can include time to first fixation, fixation length, fixation count, observation length, observation count and fixations before. Each of these metrics will give provide information in order to evaluate a specific AOI. An explanation of each of the metrics follows below:

- Time to first fixation (Figure 2.13 A) – The time (in seconds) from when the stimulus was shown until the start of the first fixation within the AOI.
- Fixation length (Figure 2.13 B) – The total time (in seconds) of all the fixations within the AOI.
- Fixation count (Figure 2.13 C) – The total number of fixations within an AOI.
- Observation length (Figure 2.13 D) – The total time in seconds for every time a participant has looked within an AOI, starting with the fixation inside the AOI and ending with the fixation outside the AOI.
- Observation count (Figure 2.13 E) – The number of visits and re-visits to an AOI.

- Fixations before (Figure 2.13 F) – The number of fixations before the participant fixated within an AOI for the first time.

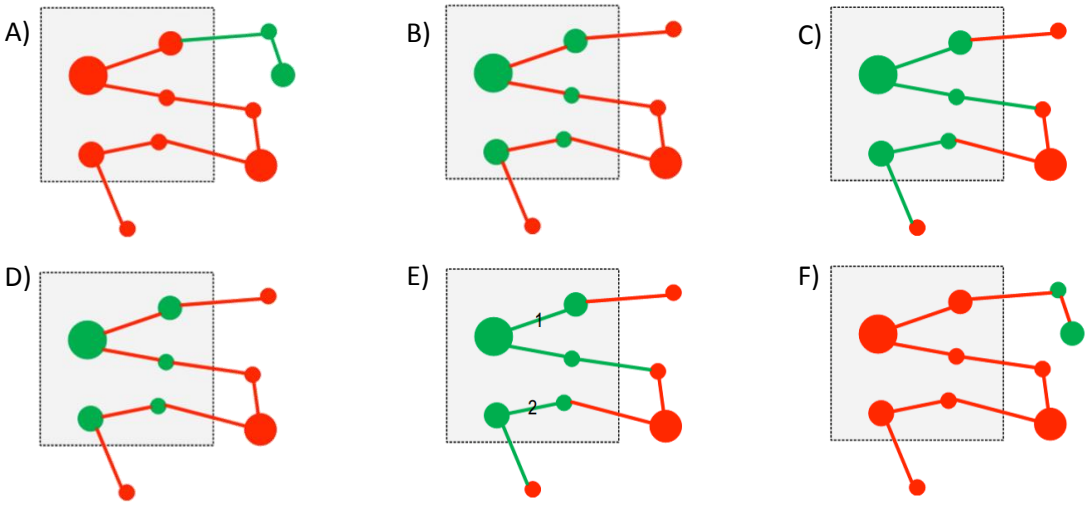

Figure 2.13. AOI metrics

Another eye tracking measurement that can be used is heat maps, which are also more qualitative in nature. A heat map is a visualisation that represents the value of a variable (in this case fixations) in terms of colour, where the “heat” is representative to the value of the specific variable (Bojko, 2013). Figure 2.14 shows heat maps of participants who had to perform two different tasks on a website. These heat maps give a clear indication of where a participant looked when performing the given tasks.

Figure 2.14. Heat maps (Source: Hubert, 2013)

This study will make use of eye tracking in order to conduct a usability study on the online PMS of the UFS. Therefore it is important to consider usability studies as a whole as well as usability studies using eye tracking.

2.4. Usability studies using eye tracking

This section will focus on usability studies, previous usability studies using eye tracking and the lessons learnt from these usability studies.

Olmsted-Hawala et al., (2014, p49) give the following definition for usability testing:

> Usability testing is a technique in user-centered design used to evaluate a product by testing it with actual users. It enables us to obtain direct feedback on how real users work with a product. We can measure how well they perform with respect to accuracy or efficiency and note if they meet preset goals. Users can often surprise us; they do the unexpected. To create a design that works, it is helpful for developers to see what real people do and look at as they interact with a product.

According to Dumas and Redish (1993), usability tests have five common features:

- The primary goal is to improve the usability of a product/system.
- All participants should represent actual users of the product/system.
- Participants should perform actual tasks with the product/on the system.
- What participants do and say should be recorded.
- The data obtained should be analysed and used to improve the usability of the product/system.

In a typical usability study (not using eye tracking) of an online system/website, participants will be asked to think aloud (giving running commentary) about their experience while using the online system/website. This may cause some participants to feel uncomfortable and they may not be completely honest in their feedback. When eye tracking is combined with typical usability study methodologies, this problem can be eliminated and, furthermore, answers provided to a number of questions that could not be answered accurately before. These questions are linked to the placement of links, input fields, images and slogans, i.e. questions such as “Do users notice this

link?" and "Do users know the steps they need to follow in order to complete a given task?"

In 2006, Jakob Nielson examined how 232 participants looked at thousands of websites. He came to the interesting conclusion that people follow an F-shaped reading pattern when reading online, which is very different from how they were taught to read at school. At first, participants read in a horizontal movement across the top part of the content. Next, the participants made a second horizontal movement that typically covers a shorter area than the first movement. Lastly, participants look at the left side of the content in a vertical movement (Nielsen, 2006). This F-shaped reading pattern is shown in Figure 2.15.

Figure 2.15. F-Shaped reading pattern of online content
(Source: Nielsen, 2006)

Several usability studies of online systems/websites have been conducted using eye tracking. Chu, Paul and Ruel (2009) conducted a study that examined the effectiveness of the design elements on news websites. The design elements that they considered were the different methods of *slide show navigation*, *breaking news* formats and design options for *supplemental links*. The study comprised 96 participants who were randomly recruited on site. Their ages ranged between 16 and 60 years and they were from a variety of ethnic groups. Each of the participants viewed the website for 20 to 30 minutes. The main goal of the study was to identify and inspect the three areas mentioned above within different news websites and to determine which layout/design used in the study was the most informative, had the highest

engagement as well as the highest level of participant involvement. From their study, the most interesting conclusions are (Chu, Paul and Ruel, 2009):

Slide show navigation

- Results show that the “next” button was the most used form of navigation.
- Thee participants who used the “next” button to navigate, viewed more slides than participants who used other forms of navigation.
- The participants who used the “arrow” navigation method spent more time examining the slides than participants who used other forms of navigation.

Breaking news

- When the breaking news was designed in a box format, it captured the most attention. In total 89% of participants looked at the headlines in box format.
- Participants looking at the boxed headlines performed worse when asked to recall the headlines than participants looking at the other two formats.

Supplemental links

- Participants read all the embedded links.
- Only 4 participants of 96 actually clicked on the links.

More recent usability studies include: a study on the position of boxes in web surveys (Lenzner, Kaczmirek and Galesic, 2014), a study on the usability of a university registrar’s office website (Tüzün, Akinci, Kurtoğlu, Atal and Pala, 2013) and a study that evaluated the visualisation support for antibiotic use in ICU (Eghdam et al., 2011). All these studies aimed at improving the usability of online systems by giving the participants actual tasks to perform on each system. The eye tracking data was then analysed and specific recommendations were made. This is directly in line with the purpose of this study.

2.5. Conclusion

The online PMS of the UFS is the system that is being analysed from a usability point of view, and this analysis will be done with eye tracking. Once a participant has logged in to the online PMS, they will see the screen shown in Figure 2.16.

Figure 2.16. Home screen of the online PMS

The participants will be given some tasks to complete on the online PMS, for example to create a new plan. In order to create a new plan, the participant will have to click on the Performance Management link at the top of the screen. In order to determine how long it took the participant to find the Performance Management link, an AOI can be drawn around the link (Figure 2.17) and the time to first fixation (TTFF) can be determined.

Figure 2.17. Home screen of online PMS with AOI

The first step in creating a new plan is to click on the Performance Management link and determining the time to first fixation for the PM AOI (as shown in Figure 2.17) will indicate if the participant “knew where to go” in order to start the given task. For each task, multiple AOIs will be used. Chapter 3 will give an explanation of the research methodology of this study.

CHAPTER 3
RESEARCH METHODOLOGY

3.1. Introduction

This chapter will give a detailed explanation of the research methodology that this usability study of the online Performance Management System (PMS) of the University of the Free State (UFS) followed. The definition of usability refers to three components, namely effectiveness, efficiency and satisfaction (ISO 9241-11 as quoted in Dix et al., 1998). Each of these components was tested through eye tracking or questionnaires.

When the eye tracking tests were conducted, a specific protocol was followed (Appendix A). The protocol is a detailed order of events that will take place to ensure that each participant is treated in the same manner. Participants completed a pre-test and a post-test questionnaire. The pre-test questionnaire (Appendix B) was used to gather demographical information about the participants. The post-test questionnaire (Appendix C) was used to determine the level of satisfaction of the participants.

3.2. Research design

There are many ways to design a study in order to reach reliable, well-argued conclusions. Hofstee (2006) lists the following research designs:

- An extended literature review is undertaken to provide an overview of the academic scholarship in a particular field or of a particular aspect in a field.
- Survey-based research is undertaken if the researcher is collecting information from a limited number of participants. These participants should be able and willing to undertake the survey, have the information the researcher is looking for and represent the larger population.
- Case studies are conducted when a researcher is interested in examining a specific case in a highly structured manner.
- Correlation-based research can be used when the researcher wants to compare two or more variables to determine if there is a relationship between them.

- Comparative analysis allows a researcher to do an in-depth investigation of two items and then compare the items to identify the reasons for similarity or difference.
- Content analysis is used when the content of preserved records are closely examined. The aim of content analysis research is to identify the “hidden” meaning that is contained in the records.
- The critical theories design questions the assumptions forming the basis of the understanding of reality.
- A historical study can be used to examine present or past events or issues to shed light on the specific event.
- Evaluative research is used when a researcher seeks to reach a conclusion about the success level or effect of an intervention.
- A specific group of people can be observed through ethnographic research to understand the behaviour of the said group.
- Action research refers to a form of research where the researcher involve the participants actively in the research process, either to solve a problem or to reach a specific learning outcome.
- Experiments are usually done to test a theory or hypothesis. These experiments can be done either in the field or in a laboratory.
- Secondary data analysis can be done if there is data available for analysis in order to answer the research question.
- Simulation/Statistical modelling is used when a researcher attempts to capture the essence of a specific process through the identification of key variables and then create a representation of the process.
- Interdisciplinary research takes place when the researcher uses methods, ideas or concepts of one discipline and applies them to an issue in another discipline.
- Theory development are usually limited to the testing and refining of existing theories or expanding the applicability of the existing theories.

This research study followed a blended design that consisted of survey-based and evaluative research.

- Survey-based research (questionnaires) can be used to great effect to determine people's opinions, attitudes and desires. This study made use of a pre-test questionnaire (Appendix B) and a post-test questionnaire (Appendix C) to acquire the information needed.
- Eye tracking was used as an evaluative research technique. This technique can be used in a wide variety of study fields and is well suited for the evaluation of the online PMS as a case study in the field of organisational behaviour.

3.3. Sampling strategy

The support staff of the UFS, who use the online PMS, formed the population of the study. The sample was drawn from this population through nonprobability, purposive sampling (Sekaran and Bougie, 2013).

In order to conduct the usability study, a group of 3 "power users" of the online PMS was identified and used as a benchmark. These "power users" are users that are very familiar with the system and use it on a daily basis. The remaining 20 participants were divided into two groups: line managers (12) and employees (8). The line managers are also employees and therefore have to perform both these roles.

3.4. Data collection methods

The data for the study was collected through questionnaires and eye tracking. The eye tracking data was recorded with the Tobii TX300. Test sessions were scheduled from 17 August 2015 – 1 September 2015, at the Usability Laboratory of the Department of Computer Science and Informatics at the UFS. Each session took approximately 30 minutes and was divided into three parts, namely the pre-test questionnaire (Appendix B) (5 minutes), the eye tracking test (20 minutes) during which the participant had to complete certain typical tasks (Appendix A), and a post-test questionnaire (5 minutes) (Appendix C) that was completed once the eye tracking test has been completed.

3.4.1. Questionnaire

The pre-test questionnaire (Appendix B) was used to determine the demographics of the participants (questions 1 – 4), their computer usage (questions 5 – 7) and the frequency with which they make use of the online PMS of the UFS (question 8).

The post-test questionnaire (Appendix C) was used to determine the satisfaction of the participants when performing the given tasks. The questions used in the post-test questionnaire was made up of subjective questions, such as the concept of ease of use. It was believed that, although different respondents might have had different frames of reference for the same concept, the general trend would become evident.

3.4.2. Eye tracking test

Participants followed the same protocol (Appendix A) to ensure that each participant received exactly the same instructions and that the results would be comparable.

Participants were given a generic user name / password combination to access the online PMS of the UFS. Participants were asked to log out of the system after completion of every task to ensure that all participants started at the same point so that their responses are comparable with regard to the time spent on each task.

Figure 2.3 shows the steps involved in the online PMS of the UFS. These steps are mapped to typical tasks in the protocol (Appendix A):

- Create a performance plan – Task 2.1
- Add tasks to the performance plan – Task 2.2
- Sign the performance plan – Task 2.3
- Complete the work environment survey – Task 2.4
- Create an improvement and development plan – Task 2.5

The additional tasks of line managers were tested with Task 2.6, sign an employee's performance plan, and Task 2.7, to assess the performance of an employee.

3.5. Statistical analysis

The statistical analysis was done with Tobii Studio (Version 3.4.0), the same software that was used to capture the eye tracking data. The definition of usability is built on three components, namely effectiveness, efficiency and satisfaction (ISO9241-11 as quoted in Dix,et al., 1998):

- Effectiveness determines whether the system meets the demands of the users, and whether a user is able to use the individual elements of the system. The answers will become evident when participants are given tasks to do during testing.
- Efficiency is reflected by the time and effort users need to perform specific tasks. One possible measurement is the number of mouse clicks made to perform a task, especially the number of clicks on the “wrong path”. The time it takes participants to complete each task will be recorded by Tobii Studio. Specific areas in the interface will be marked as areas of interest (AOI) for which the number of visits and the duration of fixations will be reported.
- Satisfaction refers to the comfort and acceptability of the system to its users and will be tested with the post-test questionnaire (Appendix C). The post-test questionnaire will be compiled using self-created questions but will also include questions from the Questionnaire for User Interaction Satisfaction (QUIS), developed at the University of Maryland (Chin, Diehl and Norman, (1988).

Due to the fact that the online PMS is a web-based system, which is dynamic in nature, each task had to be divided into different static scenes in order to process the eye tracking data. These scenes are explained in Table 3.1 below. AOIs were drawn on the scenes in order to attain certain eye tracking metrics. Mainly two eye tracking metrics were used, time to first fixation and time to first mouse click. Two scenes were created without AOIs (Scenes 3C and 6D), because the intention was to make use of only the heat maps of these two scenes.

Table 3.1. Tasks divided into scenes

Task	Scene	Start of scene	End of scene	Reference
Task 1	1A	Home page of PMS.	When participant clicked on “Performance Management”.	Figure D.1
	1B	Home page of Performance Management.	When participant clicked on “New Plan”.	Figure D.2
	1C	Home page of Performance Plan.	When participant clicked on “Roles”.	Figure D.3
	1D	Once “Roles” page has been loaded.	When participant submitted the selected role.	Figure D.4
	1E	Once “Weights” section has been loaded.	When participant saved the weight.	Figure D.5
Task 2	2A	Home page of PMS.	When participant clicked on “Performance Management”.	Figure D.6
	2B	Home page of Performance Management.	When participant clicked on “View/Edit” of the performance plan.	Figure D.7
	2C	Once the performance plan has loaded.	When participant clicked on “Add task”.	Figure D.8
	2D	Once participant has finished entering the task.	When participant clicked on “Submit”.	Figure D.9
Task 3	3A	Home page of Performance Management.	When participant clicked on “View/Edit”.	Figure D.10
	3B	Once the performance plan has loaded.	When participant clicked on “Sign”.	Figure D.11
	3C	Once the sign dialog box has loaded.	When participant clicked on the sign button.	Figure D.12
Task 4	4A	Home page of PMS.	When participant clicked on “Work Environment Survey”.	Figure D.13
	4B	Home page of Work Environment Survey.	When participant clicked on “View”.	Figure D.14
	4C	Once the Work Environment Survey has loaded.	When participant clicked on “Submit”.	Figure D.15

Task	Scene	Start of scene	End of scene	Reference
Task 5	5A	Home page of PMS.	When participant clicked on “Performance Management”.	Figure D.16
	5B	Home page of Work Performance Management.	When participant clicked on “View/Edit”.	Figure D.17
	5C	Once improvement and development plan has loaded.	When participant clicked on “Add employee action”.	Figure D.18
	5D	Once add employee action screen has loaded.	When participants clicked on “Submit”.	Figure D.19
Task 6	6A	Home page of PMS.	When participant clicked on “Performance Management”.	Figure D.20
	6B	Home page of Performance Management.	When participant clicked on “View/Edit” of the employee’s performance plan.	Figure D.21
	6C	Once the employee’s performance plan has loaded.	When participant clicked on “Sign”.	Figure D.22
	6D	Once the sign dialog box has loaded.	Once participant clicked on sign.	Figure D.23
Task 7	7A	Home page of Performance Management.	When participant clicked on “View/Edit” of the employee’s performance plan.	Figure D.24
	7B	Once the employee’s performance plan has loaded.	When participant clicked on “Assess”.	Figure D.25
	7C	Once the assess dialog box has loaded.	Once participant clicked on submit.	Figure D.26

Due to the fact that the data is not necessarily normally distributed and the small number of power users, the non-parametric alternative to t-tests (non-parametric Mann-Whitney U) was used to test the hypothesis that there is no difference in the performance of regular and power users. Two measures were used to measure performance, namely the time it took participants to fixate on a specific area of interest for the first time (T2FF) and the time it took them to click on the required button or link (T2MC).

3.6. Ethical considerations

The online PMS ran in a demo mode, meaning that it did not show any personal information about the participants. Participants used generic information to complete each task, for example the tasks and indicators listed under Task 2.1 in Appendix A. In order to ensure anonymity, participants used a generic user name and password to access the system.

3.7. Conclusion

The usability study of the online PMS of the UFS will have a blended research design, consisting of survey-based and evaluative research. The sample will be 3 “power users” that will be used as a benchmark as well as 20 participants (12 line managers and 8 employees). The pre-test questionnaire will be used to group the 20 participants into categories of computer literacy. Every step of the online PMS of the UFS will be tested through eye tracking and by the tasks set out in the protocol (Appendix A). The post-test questionnaire will be used to determine the satisfaction of the participants when working with the online PMS of the UFS. The study will take place from 26 August – 2 September 2015 at the Usability Laboratory of the Department of Computer Science and Informatics at the UFS and each session will take approximately 30 minutes.

CHAPTER 4
FINDINGS AND ANALYSIS

4.1. Introduction

This chapter will discuss the findings of the questionnaires and eye tracking data in order to answer the research questions, which are:

- How usable is the online PMS of the UFS?
- How can the online PMS of the UFS be improved?

4.2. Pre-test questionnaire (Appendix B)

The main purpose of the pre-test questionnaire was to collect demographic information about the participants. The participants consisted of 7 males and 13 females, with an average age of 42 years.

Participants belong to the following departments/divisions:

- Business School;
- Computer Science and Informatics;
- Centre for Teaching and Learning;
- Finance;
- Performance Management and Staff Development;
- Protection Services;
- Communication and Brand Management;
- Student Counselling and Development;
- Student Affairs;
- Library;
- Plant Sciences; and
- Financial Aid.

Of the 20 participants, only 3 do not own a computer at home and all of the participants use a computer for most of the working day. The most common computer applications used by participants in their working environment are: Microsoft Word, Microsoft Excel, Microsoft PowerPoint and an Internet browser.

The last question of the pre-test questionnaire was about the frequency of use of the Online Performance Management System. Results were as follows:

- Once a year – 6 participants;
- Once every six months – 13 participants; and
- Once a month – 1 participant.

4.3. Eye tracking data

Each employee had to perform 5 tasks and each line manager had the employee's 5 tasks, plus an additional 2 tasks to perform. As described in Chapter 3 (Table 3.1), each task had to be divided into scenes. The eye tracking metrics used are time to first fixation (T2FF) and time to first mouse click (T2MC). The times mentioned in the discussions are measured from the start of each scene.

4.3.1. Task 1

In Task 1 the participants had to create a new performance plan and set the role and role weights for the performance plan. In Appendix D, Figures D.1 to D.5 show the different scenes of Task 1, as well as the AOIs used for each scene. Participants found this task rather tricky with only 9 participants being able complete the task on their own. Eight participants had to be assisted in completing the task and the facilitator had to complete the task for 3 participants. A discussion of each of the 5 scenes follows:

4.3.1.1. Task 1A (Figure D.1)

In this scene, participants had to click on the *Performance Management* button at the top of the screen in order to continue with the task. During testing it was noticed that some participants clicked on the links to the *Help* files and therefore an AOI was added for these links. On average it took participants only 2.36 seconds to see the links to the *Help* documents (T2FF) and it took them 8.74 seconds to see the *Performance Management* button. Furthermore, there were 6 participants who wrongly clicked on the *Help* links when trying to complete the task.

Figure 4.1 compares the average time it took participants to see the *Performance Management* button and the average time it took them to click on the button (T2MC). The average time it took all the participants to see the button was 8.74 seconds and

the average time it took them to click on the button was 16.87 seconds – an additional 8.13 seconds. The average time it took the power users to see the button was 5.00 seconds and it took them 5.36 seconds to click on the button – an additional 0.36 seconds. From this we can deduce that on average, the participants did not know where to click to continue with the process.

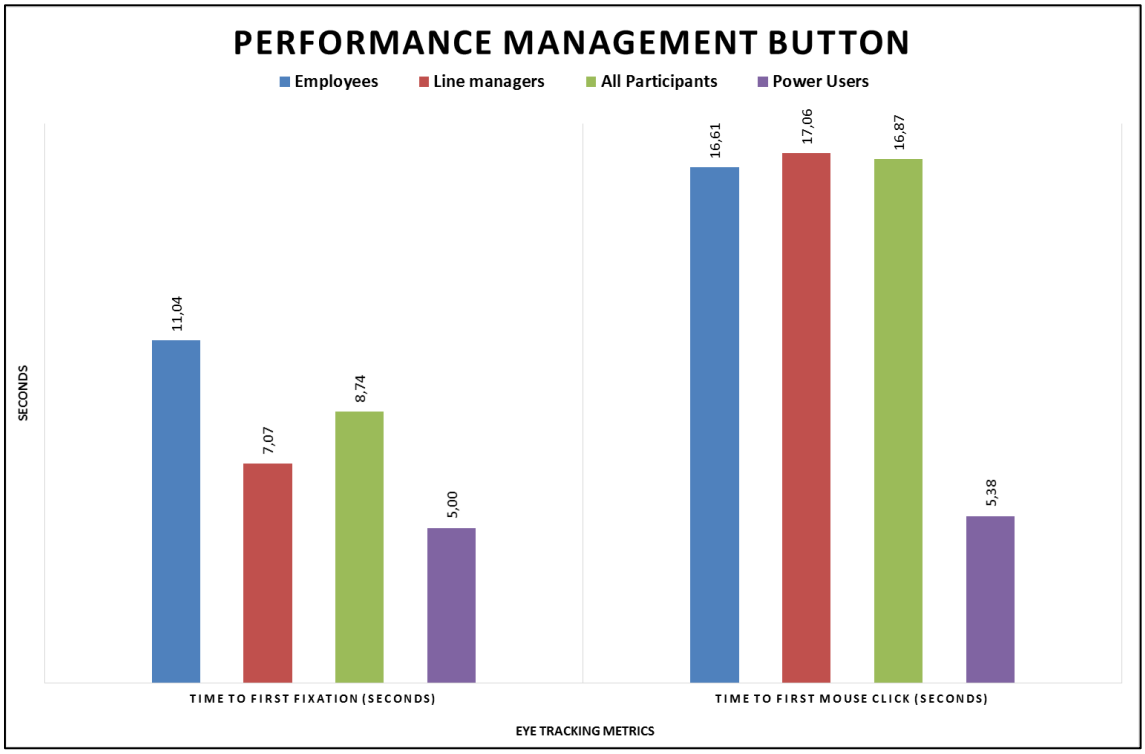

Figure 4.1. Eye tracking metrics for Performance Management button

4.3.1.2. Task 1B (Figure D.2)

This scene required participants to click on the *Add New Plan* link in order to continue. During testing it was noticed that the participants found it easy to complete this part of the task, as can also be seen in the eye tracking data. On average the participants took 2.34 seconds to see the link and 4.57 seconds to click on it, where the power users took 0.86 seconds to see the link and 3.2 seconds to click on it.

4.3.1.3. Task 1C (Figure D.3)

This scene started once the new plan had been created and participants had to click on the *Roles* button in the toolbar. Figure 4.2 compares the times of participants with the times of the power users. It took participants an average of 8.41 seconds to see the *Roles* button and 11.90 seconds to click on it. On the other hand, it took power

users only 1.08 seconds to see the button and 4.61 seconds to click on it. From this it is clear to see that the participants struggled to find the *Roles* button.

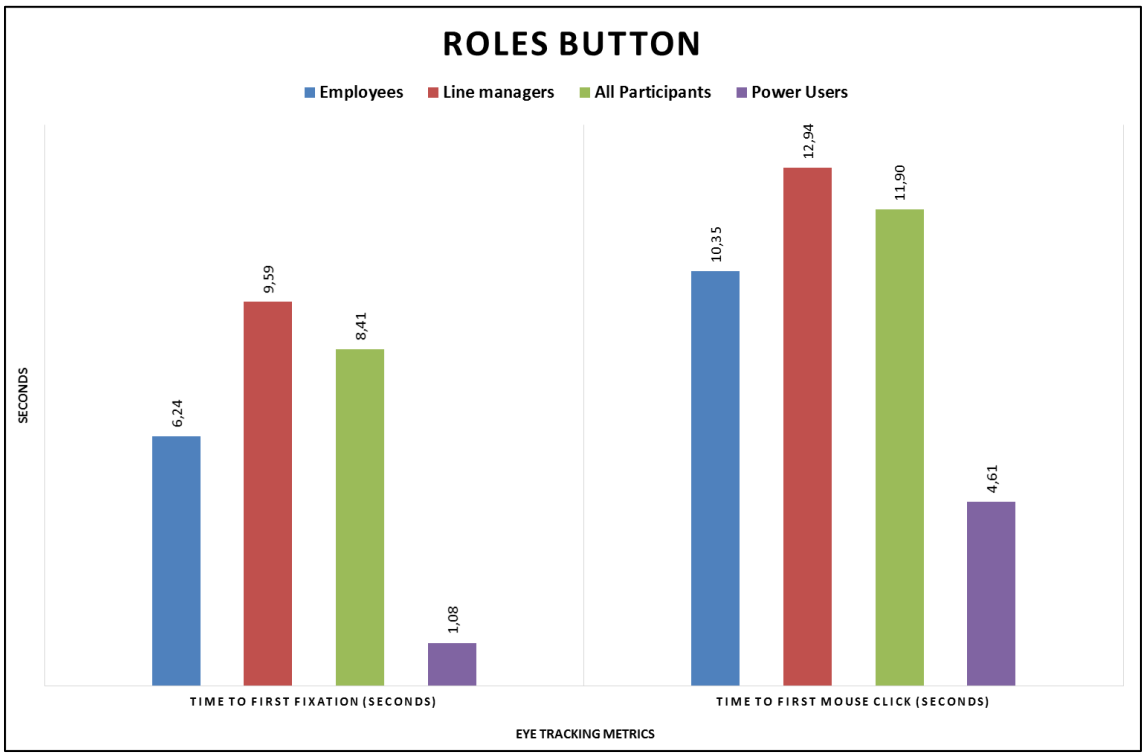

Figure 4.2. Eye tracking metrics for Roles button

4.3.1.4. Task 1D (Figure D.4)

During this scene, participants had to select *Role 5* from the list and then submit the selected role. From the data it is clear that participants did not struggle with the task associated with this scene. It took participants 2.24 seconds to see where they had to select the roles and a further 6.07 seconds to select and submit the role. The power users took 0.34 seconds to see where they had to select the roles and a further 3.94 seconds to select and submit the role.

Figure 4.3 shows the heat map of all participants for this scene. It can be seen that participants did not read the descriptions of the roles, they simply selected the role and then submitted the role.

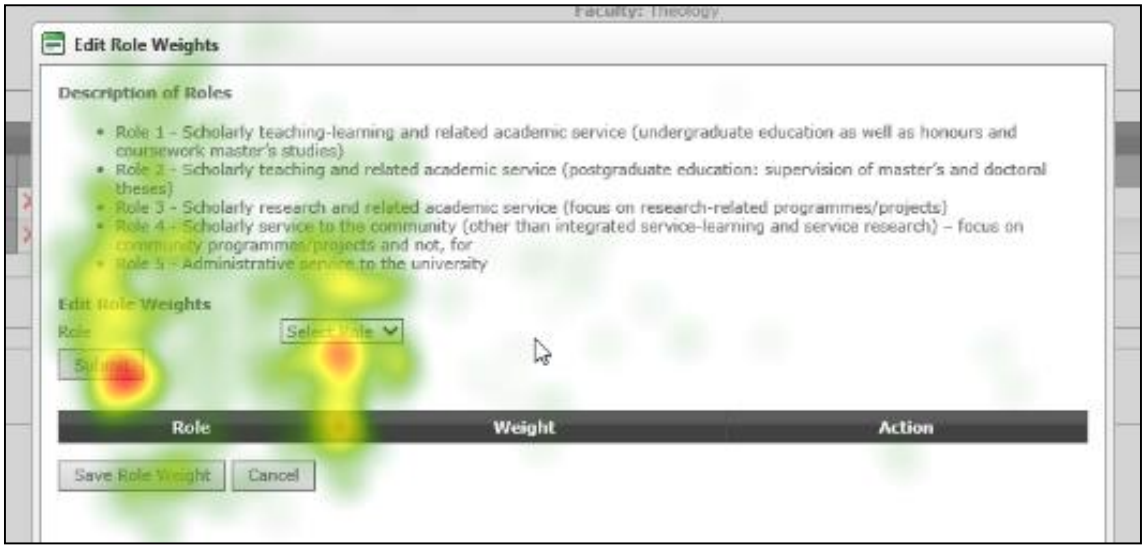

Figure 4.3. Heat map for Task 1D

4.3.1.5. Task 1E (Figure D.5)

For the last scene of this task, participants had to select the weight that should be associated with the role created in Task 1D. The data indicate that participants did not struggle to perform the tasks needed for this scene. On average, the participants took 3.09 seconds to see where they had to select the weight and a further 7.34 seconds to select and save the weight. The power users took 0.41 seconds to see where they had to select the weight and a further 6.22 seconds to select and save the weight.

4.3.2. Task 2

In Task 2 the participants had to add tasks to the newly created performance plan. In Appendix D, Figures D.6 to D.9 show the different scenes of Task 2, as well as the AOIs used for each scene. In total, 11 participants were able to complete this task themselves and the remaining 9 participants struggled to find the submit button once they were finished entering the new task and indicator. A discussion of each of the 4 scenes follows:

4.3.2.1. Task 2A (Figure D.6)

In this scene, participants had to click on *Performance Management* at the top of the screen in order to continue with the task. When completing Task 2A there was still one participant who clicked on the links to the *Help* files. On average it took participants 1.76 seconds to see the links to the *Help* documents and it took them 2.13 seconds to see the *Performance Management* button. The significantly shorter time to see the

Performance Management button can be attributed to the fact that it is the second time participants followed this route.

4.3.2.2. Task 2B (Figure D.7)

In order to continue with the task, participants had to click on the *View/Edit* link of the performance plan created in Task 1. Figure 4.4 compares the times of participants with the times of the power users in completing this scene. On average, the participants took 3.89 seconds to see the link and 9.74 seconds to click on it, where the power users took 1.68 seconds to see the link and 3.77 seconds to click on it. The participants took on average 5.97 seconds longer than the power users to click on the *View/Edit* link, indicating that the participants did not know how to complete this scene.

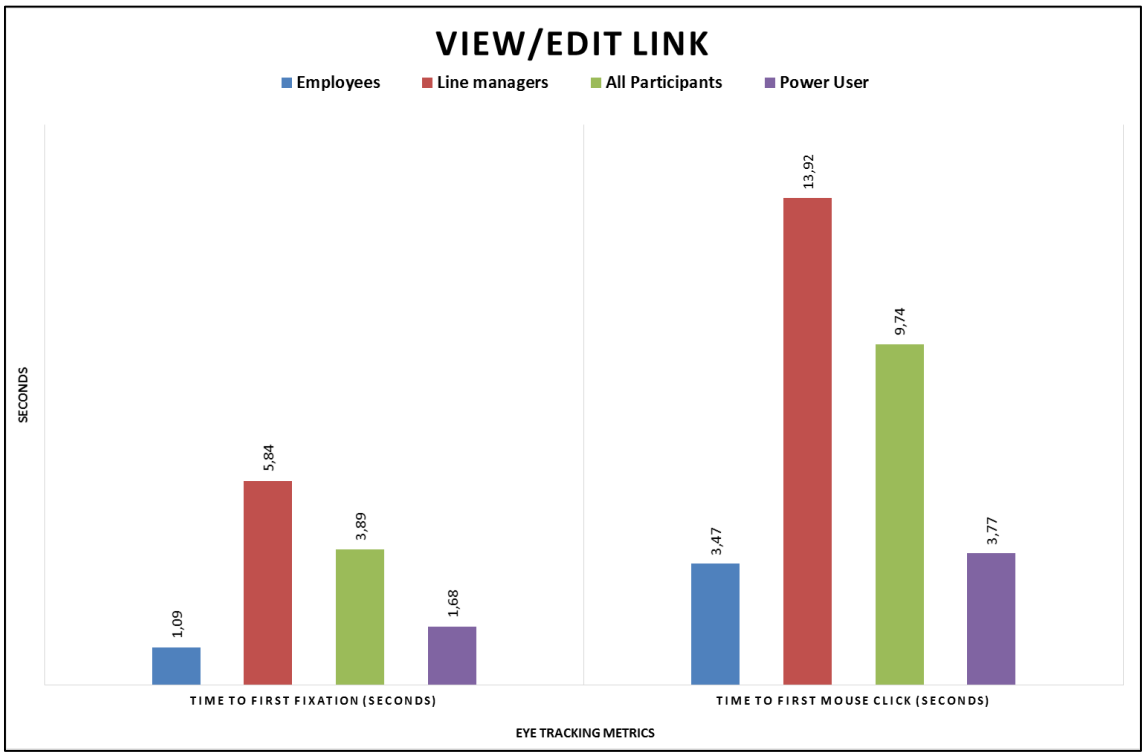

Figure 4.4. Eye tracking metrics for View/Edit link

4.3.2.3. Task 2C (Figure D.8)

This scene required participants to click on the *Add Task* link in order to add the new tasks. From the data it appears that the participants found it easy to complete this scene, because on average the participants took 1.53 seconds to see the *Add Task* link and 4.17 seconds to click on it. The power users took 2.12 seconds to click on the *Add Task* link, which is just 2.07 seconds less than the participants. Participants knew

exactly where to go to add a new task to their performance plan as can be seen from the heat map for Task 2C in Figure 4.5.

Figure 4.5. Heat map for Task 2C

4.3.2.4. Task 2D (Figure D.9)

When adding a new task, users of the online performance management system (PMS) must add the task as well as indicators for the task. Once the indicator has been entered, users must scroll down in order to find the *Submit* button.

Scene 2D was set up in order to determine how long it took participants to notice that they need to scroll down in order to submit the new task. Therefore, Task 2D started once participants finished entering the task and indicator.

During testing, 9 of the participants had to be assisted to find the *Submit* button. Figure 4.6 shows the times of participants with the times of the power users in completing this scene. On average the participants took 6.92 seconds to click on the *Submit* button, where the power users only took 3.19 seconds.

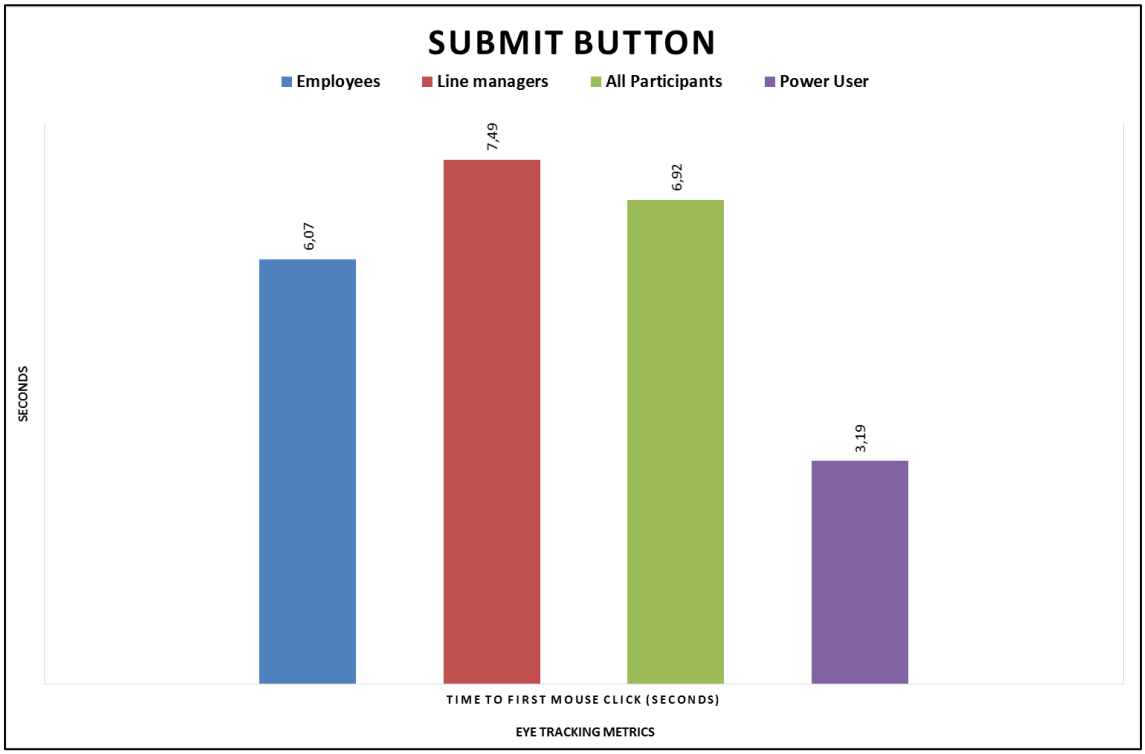

Figure 4.6. Time to click on the Submit button

4.3.3. Task 3

For Task 3, participants had to go into the performance plan that they created in Task 1 and sign the plan. In Appendix D, Figures D.10 to D.12 show the different scenes of Task 3, as well as the AOIs used for each scene. In total 10 participants were able to complete Task 3 on their own and 10 participants were assisted by the facilitator in order to complete the task. The task was divided into 3 scenes.

4.3.3.1. Task 3A (Figure D.10)

This scene starts at the performance management home page, where participants had to click on the *View/Edit* link to continue. On average, participants took 2.28 seconds to see the link for the first time and took 8.09 seconds to click on the link. During testing the reason for this long delay in clicking on the link was attributed to the fact that participants were not sure where they needed to go to sign the performance plan. The power users took 1.79 seconds to see the link and 2.44 seconds to click on the link.

4.3.3.2. Task 3B (Figure D.11)

During this scene, participants had to click on the *Sign* button in the toolbar. The participants took 5.38 seconds before they first saw the *Sign* button, where the power

users took 3.87 seconds to see the button. The difference can be attributed to the fact that participants spent more time searching for the button.

4.3.3.3. Task 3C (Figure D.12)

No eye tracking data will be discussed for this scene as it was added only to determine whether participants read the description before they signed their performance plan. Figure 4.7 shows a heat map of this scene, from which it can be seen that the majority of participants did not read the description. Looking at this heat map, the feint green dots along the description shows that participants did not read the description thoroughly before signing their performance plan.

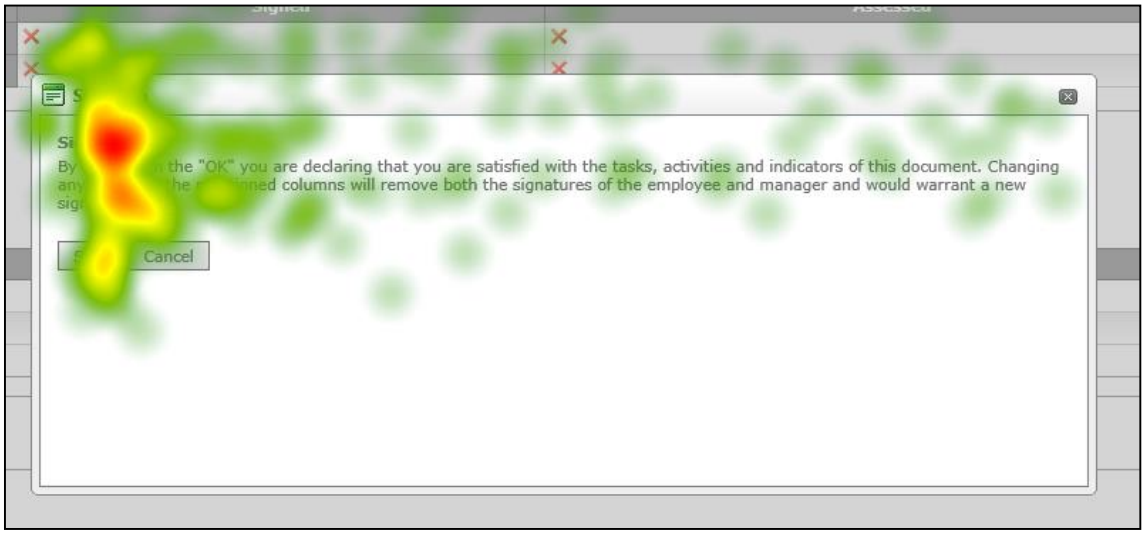

Figure 4.7. Heat map of Task 3C

4.3.4. Task 4

For Task 4 participants had to complete the concise version of the Work Environment Survey (WES). In Appendix D, Figures D.13 to D.15 show the different scenes of Task 4, as well as the AOIs used for each scene. Overall participants did not have difficulty completing this task. Fifteen participants were able to complete it themselves and only 5 had to be assisted to complete the task. This task was divided into 3 scenes.

4.3.4.1. Task 4A (Figure D.13)

This scene starts at the PMS Homepage, where participants had to click on the *WES* button at the top of the screen. Participants took 3.27 seconds on average to see the *WES* button, while the power users took 0.23 seconds to see the button. The

participants took 5.34 seconds to click on the button and the power users took 3.32 seconds to click on the button. Figure 4.8 compares the performances of employees and line managers to that of the power users.

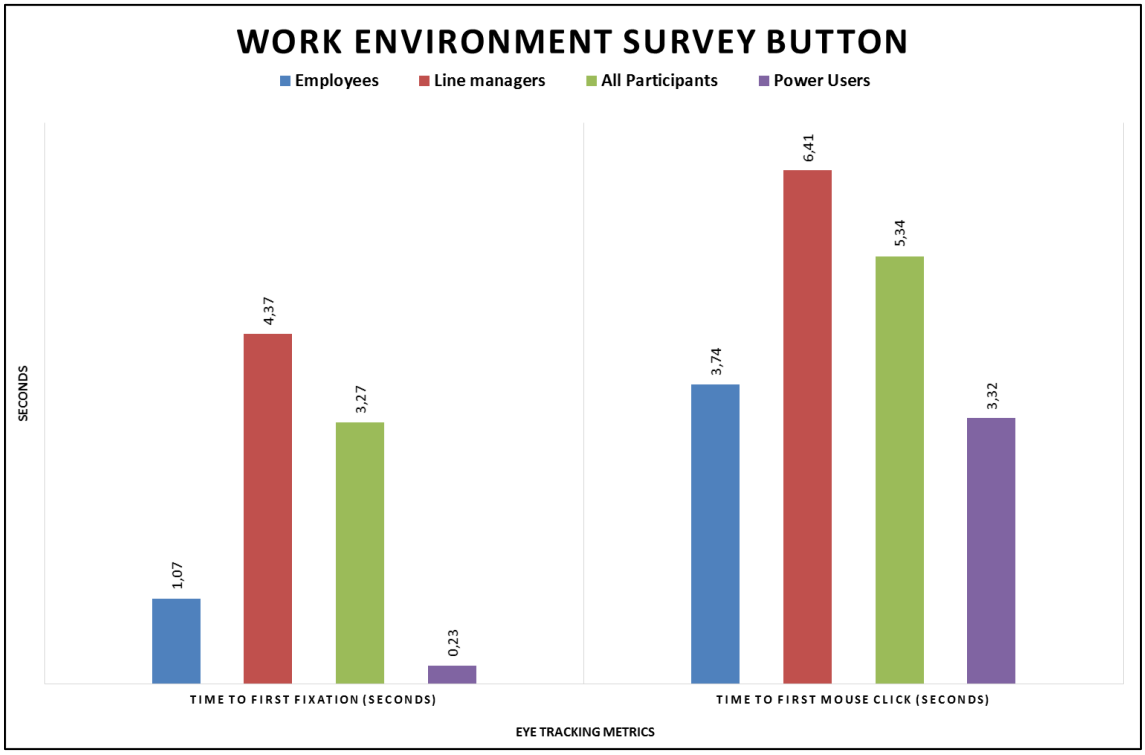

Figure 4.8. Eye tracking metrics for the Work Environment Survey button

4.3.4.2. Task 4B (Figure D.14)

Scene 4B starts on the WES Homepage, where participants had to click on the *View* button to continue to the WES. Participants saw the name of the survey (1.25 seconds) first and then saw the *View* button (3.93 seconds). Figure 4.9 shows the heat map for this scene. This heat map shows that there were two main areas on the screen where participants focussed. The one is the location of the name of the survey and the other is the *View* button where they needed to click to complete the WES.

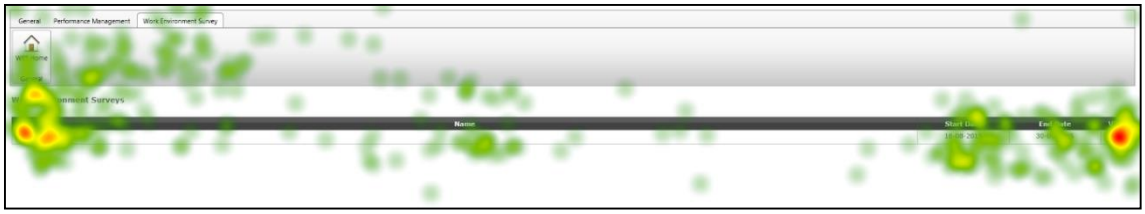

Figure 4.9. Heat map for Task 4B

4.3.4.3. Task 4C (Figure D.15)

This scene is about completing the WES. It consists of various sections, including questions, an explanation of the importance and satisfaction ratings and the area where importance and satisfaction had to be selected. As stated previously, this was a concise version of the actual WES. From the heat map shown in Figure 4.10 it can be deduced that participants did not spend much time reading the questions, although they answered all the questions.

Figure 4.10. Heat map for Task 4C

When examining the scan paths of participants, there were two that were specifically significant and these are shown in Figure 4.11. The top scan path in Figure 4.11 shows that the participant only read the first question and then answered the rest of the questions without reading the questions. The bottom scan path in Figure 4.11 shows a participant who read each of the questions and even read the ratings.

Figure 4.11. Scan paths of two participants for Task 4C

4.3.5. Task 5

Participants had to add items to an improvement and development plan under the following headings:

- Area of Performance to be Improved,
- Area of Work Environment to be Improved, and
- Actions and Training Taken by Employee.

During testing it became clear that participants did not know where and how to access the improvement and development plan. Most participants responded that the reason they struggled was because they had never created such a plan before. This task was divided into four scenes and a discussion on the four scenes will follow:

4.3.5.1. Task 5A (Figure D.16)

The first scene for this task starts at the home screen of the PMS, where participants had to click on the *Performance Management* button in order to continue. Participants took 2.54 seconds to see the *Performance Management* button and a further 4.78 seconds to click on the button. Power users took 0.67 seconds to see the *Performance Management* button and a further 1.82 seconds to click on the button. Figure 4.12 compares T2FF and T2MC of the different participant groups.

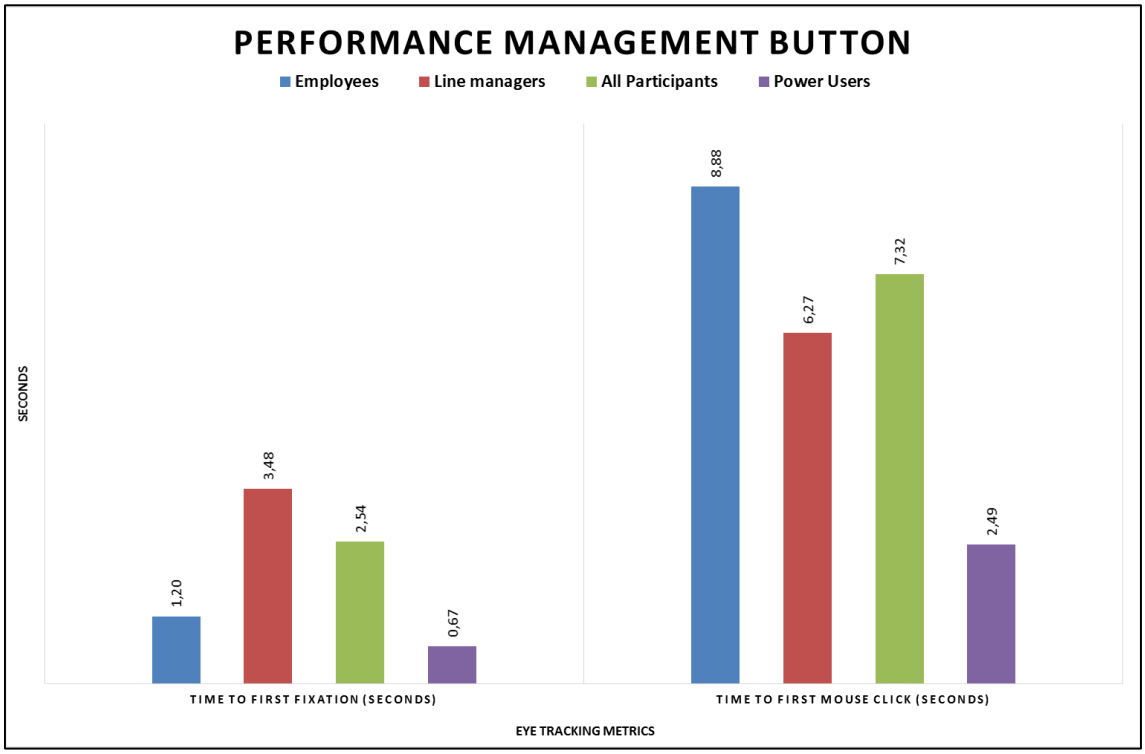

Figure 4.12. Eye tracking metrics for Performance Management button

The large significant difference between the time it took participants to see the *Performance Management* button and the time it took them to click on it is an indication that the participants did not know where to go in order to create the improvement and development plan. Fifteen participants had to be assisted to complete this task and only 5 were able to complete it on their own.

4.3.5.2. Task 5B (Figure D.17)

In this scene, participants had to click on the *View/Edit* link in order to access the improvement and development plan. On average it took participants 2 seconds longer than the power users to see the *View/Edit* link and a further 4.95 seconds longer to actually click on the *View/Edit* link. This can be attributed to the fact that participants spent more time deciding which link to follow. Figure 4.13 compares the scan path of a participant with the one of the power users.

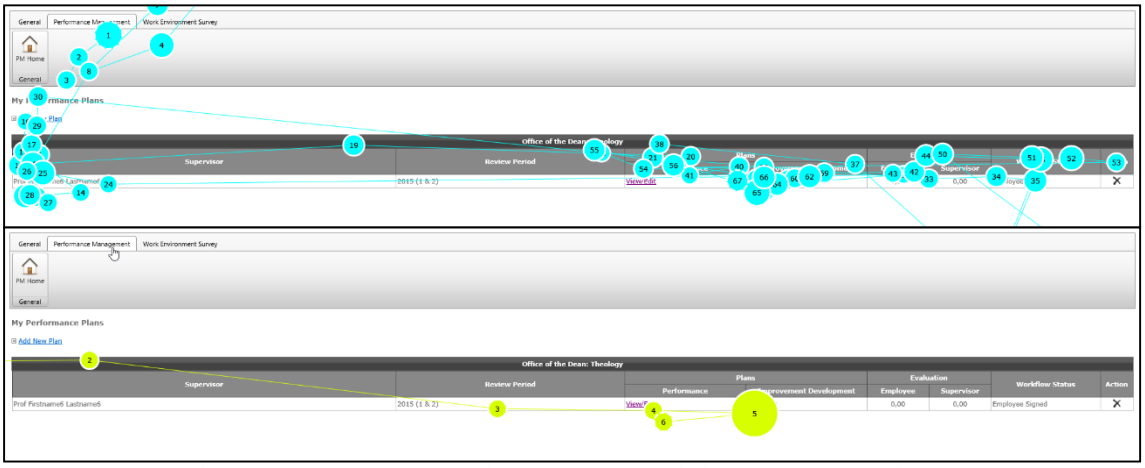

Figure 4.13. Scan paths of two participants for Task 5B

The top image in Figure 4.13 is the scan path of one of the employees and the bottom image is the scan path of one of the power users. The power user had only 6 fixations before he clicked on the *View/Edit* link. The participant had about 67 fixations before he clicked on the *View/Edit* link, indicating that he spent more time searching for the correct link to click.

4.3.5.3. Task 5C (Figure D.18)

The participants did not struggle with this scene, as can be seen from the data that participants' T2MC click was very close to that of the power users. For example, the T2MC click for the *Area of performance to be improved* was only 2 seconds longer than that of the power users.

4.3.5.4. Task 5D (Figure D.19)

The last scene of this task was created because participants struggled quite a bit to add the actions and training taken by the employee. Fifteen participants had to be assisted to complete this part of the task. This part of the task had to be completed in a specific order:

- Firstly, participants had to set the status as completed,
- Secondly, participants had to enter/select the date of completion, and
- Thirdly, participants had to enter a description.

During testing it became clear that participants struggled because they assumed all the information had to be entered into the description box (which is very large in size), without carefully scanning the box. Figure 4.14 shows the T2MC click for this scene.

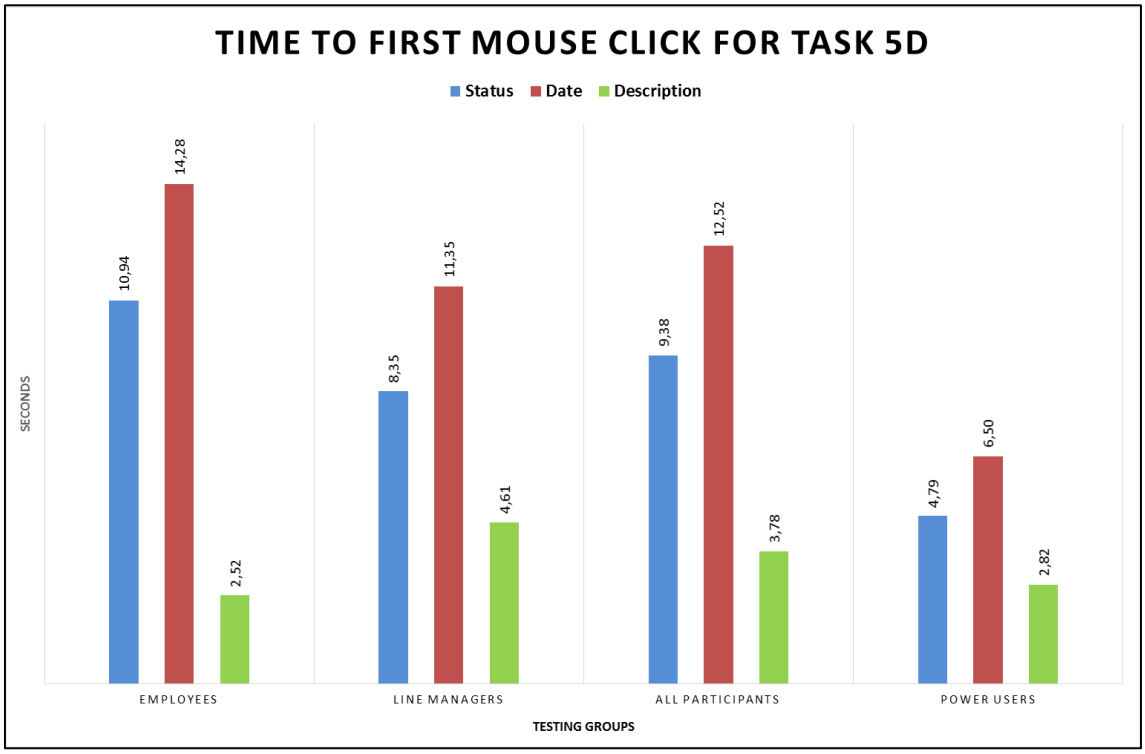

Figure 4.14. Time to first mouse click for Task 5D

From Figure 4.14 it is clear that even the power users clicked in the description box before clicking on the status box. As soon as participants clicked in the description box and started entering information into the box, they were assisted in locating the correct places where they had to enter the relevant information.

4.3.6. Task 6

Only line managers had to perform this task. In this task participants had to go into an employee's performance plan and sign the plan. Half of the participants had to be assisted to complete this task and the other half was able to complete the task on their own. This task was divided into 4 scenes:

4.3.6.1. Task 6A (Figure D.20)

This scene started on the home page of the PMS and participants had to click on the *Performance Management* button in order to continue. Participants did not struggle to complete this scene, because there was only a difference of 1.21 seconds between the time it took participants to click on the *Performance Management* button and the time it took the power users to click on the button.

4.3.6.2. Task 6B (Figure D.21)

In this scene, participants had to click on the *View/Edit* link on the employee's performance plan in order to continue. Participants took much longer than power users to complete this scene, as shown in Figure 4.15. Participants took 6.07 seconds to see the *View/Edit* link for the first time and another 5.79 seconds to click on the link. Power users knew where to look for the link and took only 0.78 seconds to see the link and another 1.67 seconds to click on it. Participants took 9.41 seconds longer than the power users to complete this scene, indicating that participants struggled did not know where they had to go in order to sign an employee's plan.

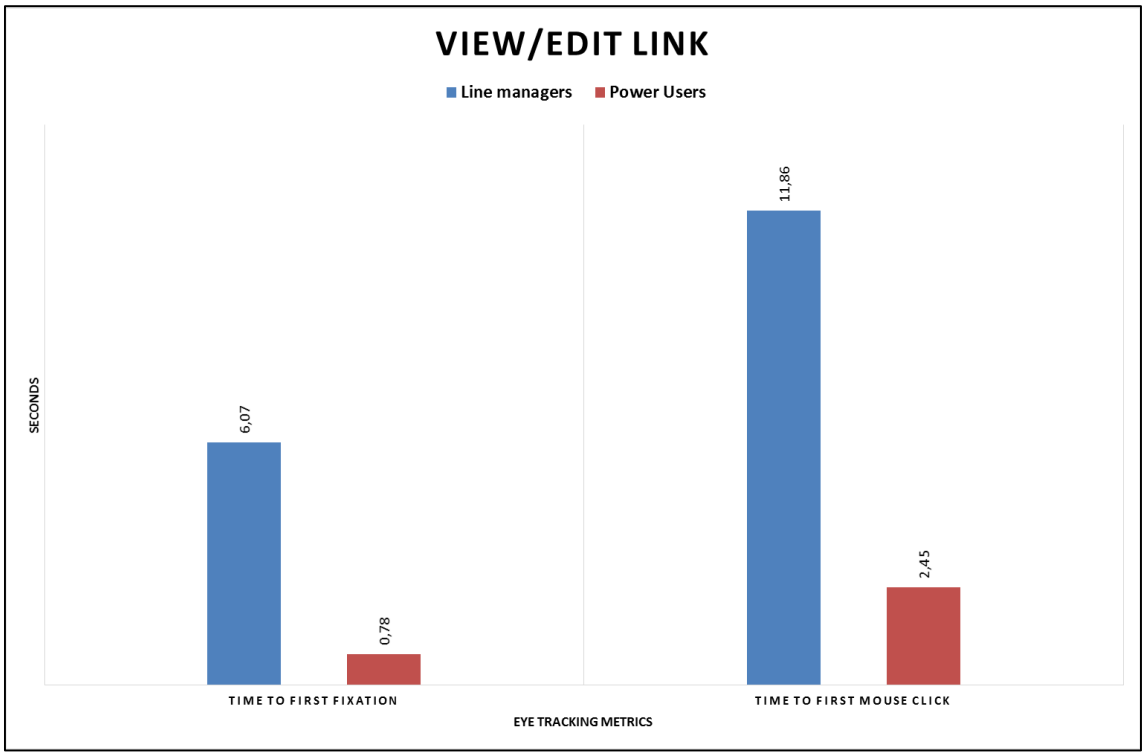

Figure 4.15. Eye tracking metrics for Task 6B

4.3.6.3. Task 6C (Figure D.22)

After the employee's performance plan was loaded, the participant had to click on the *Sign* button in order to sign the plan. Participants spent a long lime locating the *Sign* button, seeing that the T2FF of the *Sign* button was 7.09 seconds while power users only took 0.26 seconds to see the *Sign* button. Once they saw the *Sign* button, both participants and power users took approximately 2 seconds to click on the button.

4.3.6.4. Task 6D (Figure D.23)

For this task there were no AOIs drawn - it was set up to determine if participants read the message in the sign dialog box. Figure 4.16 shows the heat map of this scene. It is clear that participants did not read the message that appears in the dialog box thoroughly.

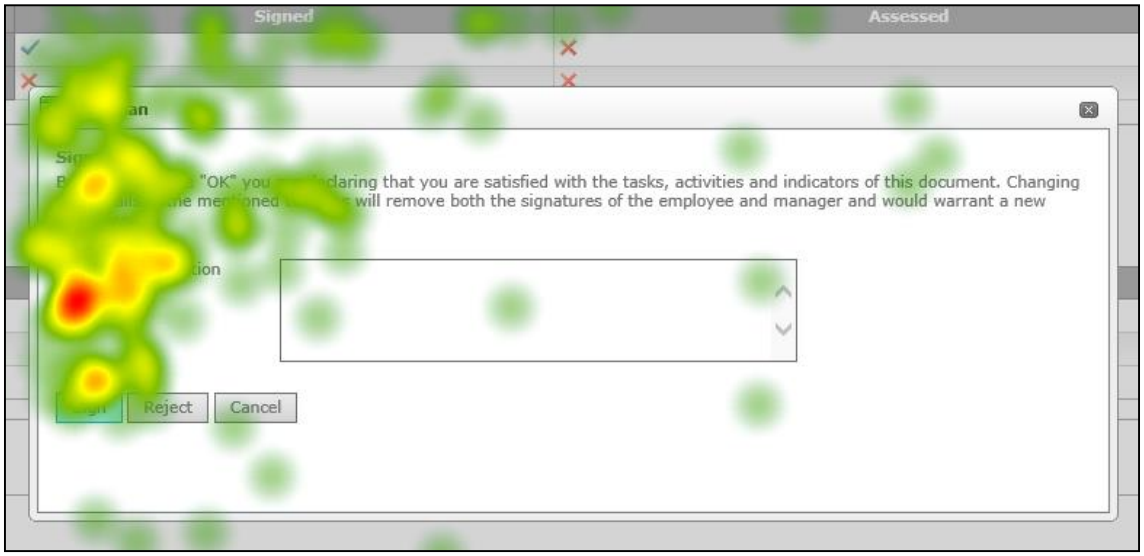

Figure 4.16. Heat map for Task 6D

4.3.7. Task 7

Only line managers had to perform this task and it was the last task that participants had to perform. In this task participants had to assess an employee's performance plan. Participants struggled to complete this task, with 8 participants who had to be assisted to complete the task and only 4 participants being able to complete the task on their own. The task was divided into 3 scenes:

4.3.7.1. Task 7A (Figure D.24)

This scene begins on the home page of the performance plan, where participants had to click on the *View/Edit* link to continue. Participants took 8.05 seconds before they clicked on the *View/Edit* link, where it took the power users only 1.61 seconds to click on the link. Participants saw the *View/Edit* link after 2.58 seconds, but searched further as if they did not know that they had to click on the link. More than half of the participants also looked at the evaluation section of the performance plan (fixated on it after 4.62 seconds), before they clicked on the *View/Edit* link.

4.3.7.2. Task 7B (Figure D.25)

To complete this scene participants had to click on *Assess* in order to assess the performance of the employee. Participants struggled to find the *Assess* button and took 15.36 seconds to click on the *Assess* button. The power users took 5.10 seconds to click on the *Assess* button. Participants first viewed the *Supervisor Assessment* section of the performance plan (1.44 seconds) before they saw the *Assess* button (9.79 seconds). This shows that participants expected to be able to assess the performance under the *Supervisor Assessment* section, which is also shown in the heat map in Figure 4.17.

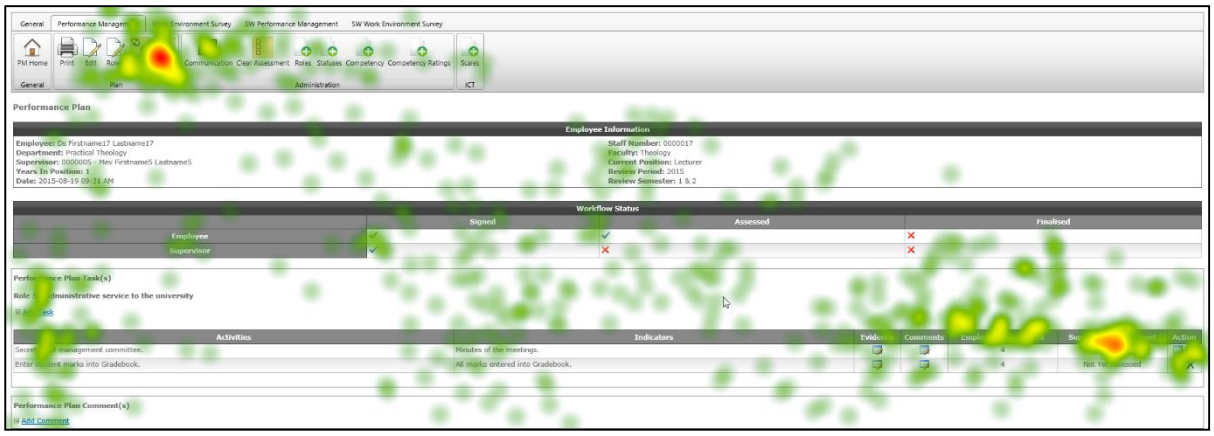

Figure 4.17. Heat map of Task 7B

4.3.7.3. Task 7C (Figure D.26)

This task started once the *Assess Plan* dialog box opened and ended as soon as a participant submitted his assessment. Participants took 2.99 seconds to see where they had to select the assessment and power users took 0.47 seconds to see where they had to select the assessment. Participants took an additional 3.13 seconds to click on an assessment for the first time and power users only an additional 1.37 seconds.

4.3.8. Log Out

Logging out was part of every task, but not a task on its own. During the eye tracking tests the researcher noticed that participants struggled to log out for the first time. This is the reason why an additional scene, which is the first time participants had to log out, was created. The scene starts when the participant has completed Task 1E and ends when he click on the *Log Out* button.

Power users took 6.83 seconds, employees took 10.79 seconds and line managers took 14.92 seconds to click on the *Log Out* button. This is summarised in Figure 4.18.

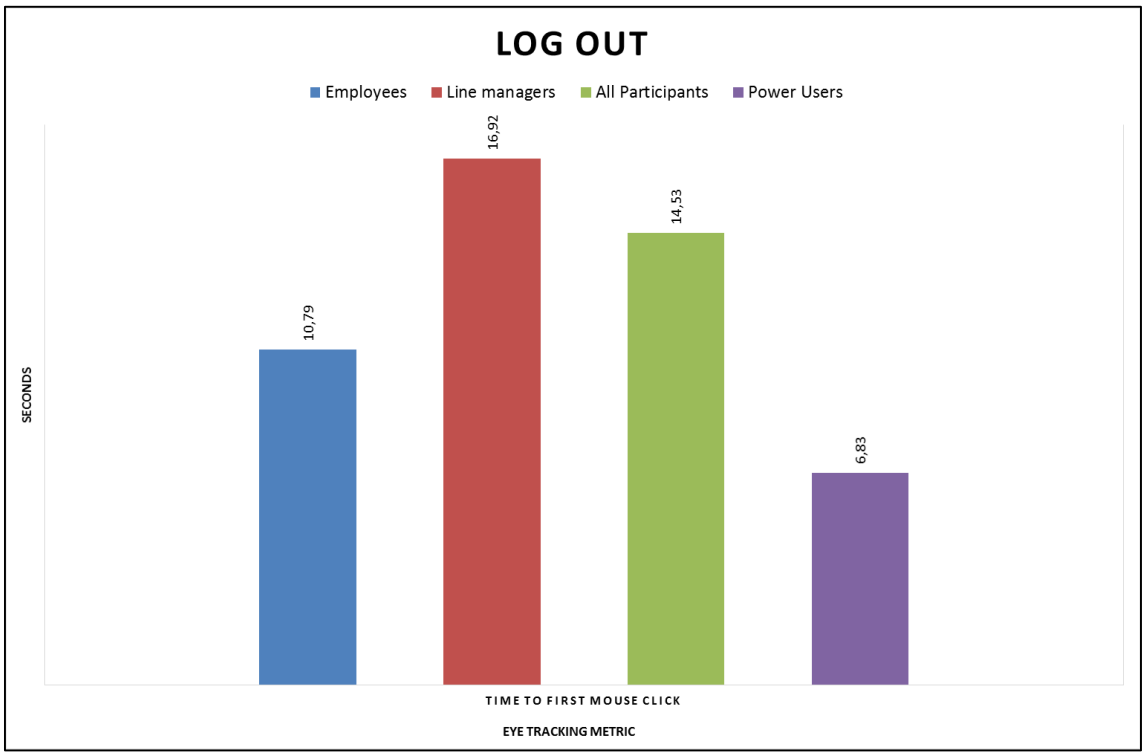

Figure 4.18. Time to first mouse click – Log Out button

During testing some participants suggested that the *Log Out* button should permanently appear on the toolbar and not only under the *General* tab.

4.4. Post-test questionnaire (Appendix C)

The purpose of the post-test questionnaire was to determine the satisfaction of the participants. The feedback received from participants do not align with what was found during the eye tracking test and the notes made by the facilitator. This may be due to three reasons:

- Participants completed the questionnaire giving the feedback they thought were expected of them.
- Participants are so used to struggling with online systems that they did not struggle more with the online PMS than with other systems.
- Participants were assisted in completing some tasks and they may have taken the assistance into account when completing the questionnaire.

Table 4.1. Summary of post-test questionnaire

	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
I found the online performance management system easy to use.	1	11	3	4	1
I found the online performance management system enjoyable to use.	2	7	5	6	0
I found the online performance management system frustrating to use.	1	7	4	5	3
I found it easy to create a new performance plan. (Task 2.1 & 2.2)	4	9	3	4	0
I found it easy to sign my performance plan. (Task 2.3)	5	14	0	0	1
I found it easy to complete the work environment survey. (Task 2.4)	4	13	1	2	0
I found it easy to create an improvement and development plan. (Task 2.5)	3	10	1	5	1
I found it easy to sign an employee's performance plan. (Task 2.6)	4	7	0	1	0
I found it easy to assess an employee's performance. (Task 2.7)	2	7	1	1	1

When asked why participants found the online PMS frustrating to use, the following responses were received:

- *"Difficult to always know where to click and sign"*;
- *"Change of commands and program only using it once in 6 months – tend to forget procedures"*;
- *"To log out I have to click on the General tab"*; and
- *"It was easy to use, however I battled to find some tabs"*.

The last question of the post-test questionnaire was open-ended, asking for any comments. The feedback received was:

- *"Assess should be next to the name/task; Description for assessment must be available; Year of assessment must have current year as default"*;
- *"Die stelsel is baie omslagtig om te voltooi, omdat daar aparte blokkies vir elke punt is wat ingevul moet word"*;
- *"Die goed is nie op logiese plekke nie; mens verwag nie sign gaan 'n button bo-aan wees nie; jy verwag nie om terug te gaan na general om by logout uit te kom nie"*;

- *“Abbreviations on WES not clear”*; and
- *“Die scroll op die vensters is onnodig”*.

4.5. Statistical analysis

As stated in Chapter 3 (Section 3.5), a non-parametric alternative to t-tests will be used to test the hypothesis that there is no difference in the performance of regular and power users. The results of the non-parametric Mann-Whitney U (MWU) test for each sub-task, with sufficient valid observations, are shown in Table 4.2. The overall results per task are also shown. Although the MWU test is based on rank sums and not on the means of the two samples, the means are shown since they are informative for interpretation of the results. Significant p values (α = .05) are highlighted. In some instances, the T2FF could be misleading because it is possible that a participant’s eyes were focused on a specific area on the screen – resulting in a zero time for the T2FF.

It is important to note that the test may have failed to prove that the regular and power users differ significantly on a specific task due to the small number of power users who took part in the study. A larger number of power user observations could have led to a different result. One can be sure to some extent of the outcome for tasks where a significant result was proven.

Table 4.2. Results of a series of Mann-Whitney U tests for the difference in performance.

Task	Time to first fixation					Time to first click				
	Regular users		Power users		p	Regular users		Power users		p
	N	Mean	N	Mean		N	Mean	N	Mean	
Log out	17	7.4	3	5.2	.341	18	14.5	3	9.4	.291
1A PM Button	19	8.7	2	5.0	.590	19	16.9	3	5.4	.022
1A Help docs	18	2.4	3	1.4	.880	6	8.5	0		-
1B New plan	18	2.3	2	0.9	.413	16	4.6	2	3.2	.725
1C Roles	17	8.4	2	1.1	.054	20	11.9	3	4.6	.075
1D Define roles	19	0.5	2	0.0	-	0		0		-
1D Select roles	18	2.2	3	0.3	.014	20	3.8	3	1.5	.016
1D Submit	18	3.2	3	3.1	.651	19	8.3	3	4.3	.028
1E Set Weights	19	3.1	3	0.4	.007	20	4.0	3	1.5	.025
1E Save Weights	12	5.3	3	1.3	.386	18	10.4	3	6.6	.291
Task 1	**158**	**4.0**	**23**	**1.5**	**.017**	**138**	**8.6**	**20**	**3.9**	**.000**
2A PM Button	15	2.1	2	0.6	.264	19	5.5	3	1.4	.035
2A Help docs	15	1.8	2	0.4	.941	1	4.0	0		-
2B Performance Plan	17	3.9	2	1.7	.550	20	9.7	3	3.8	.218
2C Add task	18	1.5	3	0.9	.651	19	4.2	3	2.1	.180
2D Submit	12	6.5	3	2.3	.036	20	6.9	3	3.2	.032
Task 2	**77**	**3.0**	**12**	**1.3**	**.158**	**79**	**6.6**	**12**	**2.6**	**.001**
3A View/Edit	18	2.3	2	1.8	.753	20	8.1	3	2.4	.050
3B Sign	18	5.4	2	3.9	.850	20	7.4	3	3.3	.157
Task 3	**36**	**3.8**	**4**	**2.8**	**.982**	**40**	**7.8**	**6**	**2.9**	**.011**
4A WES	15	3.3	1	0.2	-	20	5.3	3	3.3	.438
4B WES Name	17	1.3	2	0.2	.207	1	5.0	0		-
4B WES View	19	3.9	2	0.7	.042	20	6.0	3	2.2	.025
4C Importance	18	4.4	1		-	0		0		-
4C Satisfaction	18	5.8	0		-	0		0		-
4C Questions	20	1.3	2	0.2	.332	0		0		-
Task 4	**107**	**3.3**	**8**	**0.3**	**.003**	**41**	**5.7**	**6**	**2.8**	**.031**
5A PM Button	17	2.5	2	0.7	.259	20	7.3	3	2.5	.061
5B View/Edit	19	2.5	3	0.5	.015	20	8.9	3	2.0	.012
5C Add performance	20	0.6	3	0.3	.294	20	9.1	3	7.1	.494
5C Add WE	20	18.0	2	7.9	.775	20	37.1	3	27.3	.294
5C Add actions	19	48.8	3	21.5	.028	19	56.1	3	40.5	.126
5D Status	15	6.0	2	3.1	.502	20	9.4	3	4.8	.132
5D Date	20	10.3	3	4.1	.254	20	12.5	3	6.5	.075
5D Description	20	5.1	3	9.4	.438	20	3.8	3	2.8	1.000
Task 5	**150**	**11.9**	**21**	**6.2**	**.091**	**159**	**17.8**	**24**	**11.7**	**.027**
6A PM Button	10	1.1	3	0.8	.933	12	3.7	3	2.4	.220
6B View/Edit	11	6.1	3	0.8	.013	12	11.9	3	1.7	.012
6C Sign	10	7.1	2	0.3	.107	12	9.5	3	2.5	.130
Task 6	**31**	**4.8**	**8**	**0.7**	**.010**	**36**	**8.3**	**9**	**2.2**	**.002**
7A Evaluation	8	4.6	0		-	0		0		-
7A View/Edit	10	2.6	3	0.6	.108	12	8.1	3	1.6	.012
7B Assess	12	9.8	3	3.9	.130	12	15.4	3	5.1	.071
7B Sub-assess	9	1.4	1	1.7	-	2	7.4	0		-
7C Assessment	12	3.0	3	0.5	.097	12	6.1	3	1.8	.025
Task 7	**51**	**4.5**	**10**	**1.7**	**.005**	**38**	**9.7**	**9**	**2.9**	**.000**

4.6. Conclusion

As mentioned in previous sections, the facilitator had to assist some participants to complete the tasks. Figure 4.19 shows a summary of the facilitator assistance. From the facilitator's figures in Figure 4.19 it is clear that the only task that most of the participants were able to complete themselves was Task 4.The task where most participants had to be assisted with was Task 5. Most of the other tasks were about 50/50 between the participants completing the task themselves and being assisted by the facilitator.

According to the statistical analysis discussed in Section 4.5, power users in general performed significantly better in each of the tasks, although the results were not significant for all the scenes. It seems that participants struggled to find the initial button needed to start Task 1 (Appendix D, Figure D.1). The participants also took about twice the time that power users took to select roles and set and save roles. A similar trend was found for Task 2 (Figure D.6) where participants struggled to find the button to start the task and to finally submit their responses (Figure D.9). Participants struggled to find the *View/Edit* links in Task 3A (Figure D.10), 5B (Figure D.17) and 6B (Figure D.21), which could indicate that participants did not know that they had to click on *View/Edit* to continue with the task.

On the facilitator's summary of tasks it was also noted that 14 participants struggled to find the *Log Out* button and had to be assisted in locating the button, although the difference between the participants and power users is not significant. Even though Task 4 was the only task that the majority of participants completed themselves, participants did comment that the *View* column should have a different name and that the headings/ratings of the WES are not clear.

The majority of participants (15) struggled to complete Task 5D and had to be assisted in order to finish the task. Participants did not examine the dialog box carefully and simply wanted to enter all the information into the *Description* box. Participants struggled with task 7B (Figure D.25) as they took almost 10 seconds longer than the power users to click on the *Assess* button, although this difference was not significant.

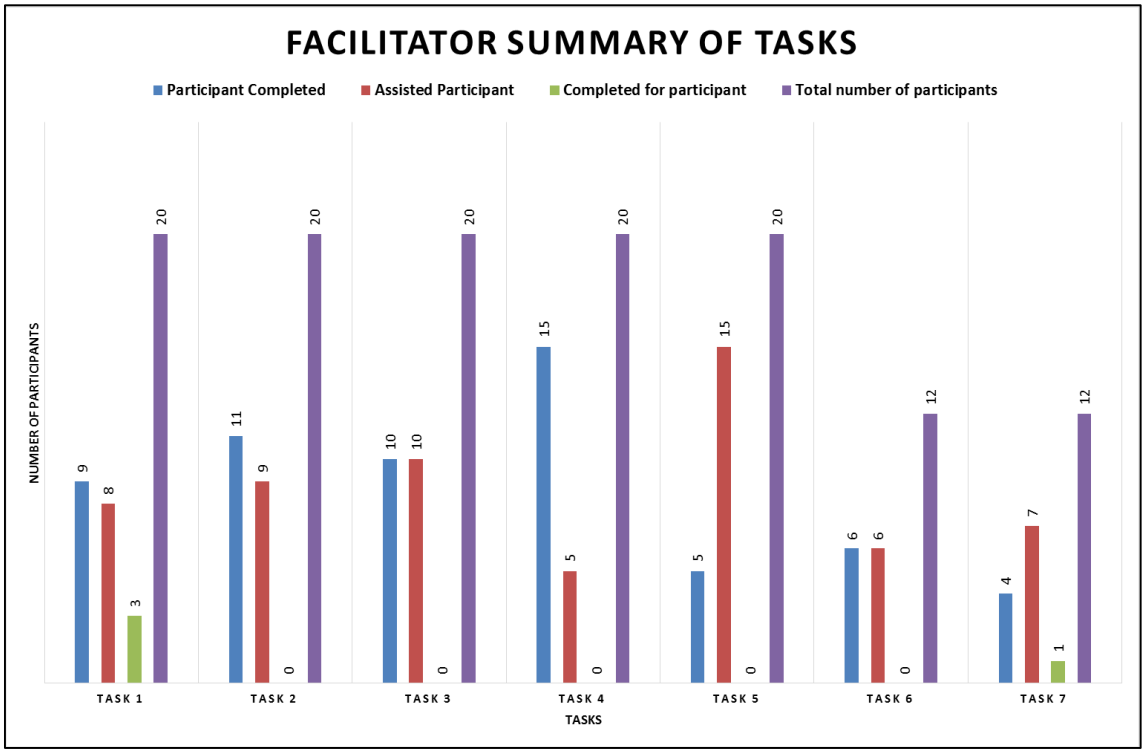

Figure 4.19. Facilitator's summary of tasks

There is a definite indication that participants were not totally comfortable working with the online PMS. Recommendations on how the online PMS of the UFS can be improved, together with a discussion on the limitations of this study, will be presented in Chapter 5.

CHAPTER 5
CONCLUSION, RECOMMENDATIONS AND LIMITATIONS

5.1. Introduction

The results from the study were discussed in the previous chapter. In this chapter, the usability of the online Performance Management System (PMS) will be evaluated. Recommendations will be made on how the online PMS can be improved, the limitations of the study will be mentioned and the possibilities for future studies will be discussed.

5.2. Usability of the Online Performance Management System

The primary objective of the study was to evaluate the usability of the online PMS of the University of the Free State (UFS). The aim of this section is to address this objective and the other objectives of the study, as stated in section 1.4. The other objectives of the study were:

- To identify tasks that users of the online PMS of the UFS find easy to perform.
- To identify tasks that pose a difficulty to users of the online PMS of the UFS.
- To make recommendations about improvements to the online PMS of the UFS.

The facilitator took notes during testing about how the participants completed each task and these notes will be used to determine whether participants found a specific task difficult to perform. A summary of the notes is shown in Table 5.1. It is important to note that the tasks can only be evaluated relative to each other. Keeping this in mind, the following trends were identified:

- All participants found it more difficult to complete Task 5 and the initial log out than the other tasks.
- Line managers found it quite difficult to complete Task 7.
- Participants found it relatively easy to perform Task 4.

Table 5.1. Task completion by participants

	Participant Completed	Assisted Participant	Completed for participant	Total number of participants
All Participants				
Task 1	9	8	3	20
Task 2	11	9	0	20
Task 3	10	10	0	20
Task 4	15	5	0	20
Task 5	5	15	0	20
First Log Out	7	13	0	20
TOTAL	57	60	3	120
Line Managers				
Task 6	6	6	0	12
Task 7	4	7	1	12
TOTAL	10	13	1	24

In Section 3.3, power users were defined as the benchmark. Even though Table 5.1 shows that participants only found 3 tasks more difficult to perform than the other tasks, the eye tracking data shows that there were certain scenes where there was a statistically significant difference in the performance of participants and power users. The difference between the participants and power users indicate that the participants were not sure how to perform certain tasks.

As stated in Section 3.5 - Table 1, each of the tasks was divided into different sections to analyse the eye tracking data and that a non-parametric alternative to t-tests were used to test the hypothesis that there is no difference in the performance of regular and power users. Table 5.2 contains a summary of the scenes, with a statistically significant difference in the time to first mouse click (Table 4.2) between the participants and the power users. There is at least one scene in each task that participants struggled with. These scenes will form the basis for the discussion in Section 5.3.

Table 5.2. Summary of time to first mouse click for the tasks with statistically significant differences

Task	Figure	Regular User	Power User	p
1A PM Button	D.1	16.9	5.4	.022
2D Submit	D.9	6.9	3.2	.032
3A View/Edit	D.10	8.1	2.4	.050
4B WES View	D.14	6.0	2.2	.025
5B View/Edit	D.17	8.9	2.0	.012
6B View/Edit	D.21	11.9	1.7	.012
7A View/Edit	D.24	8.1	1.6	.012

5.3. Recommendations

It is important that a PMS is well designed because of the benefits for the employees, managers and the organisation. These benefits are shown in Table 1.1. In order to determine if a PMS is well designed, the usability of the PMS will have to be evaluated. The International Organization for Standardization (ISO) defines usability as: “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use” (ISO 9241-11 as quoted in Dix et al., 1998).

Important findings of the study stress the need for a usable online PMS:

- Most participants only use the system once every six months or once per year.
- The online PMS of the UFS is changed every year.
- From the information in Table 5.1, it became clear that participants struggle to click on the *View/Edit* links. This would indicate that participants do not know where to go to perform the tasks.

No framework exists for the design of an online system and specifically for an online PMS, therefore there is no framework to compare the online PMS of the UFS with. It is the view of the researcher that this study can lead the way to the development of such a framework for the design of an online PMS.

In order to make recommendations on how to improve the usability of the online PMS of the UFS, the results of this study will be used in association with the heuristics that can be used when designing web pages, as stated by Galitz (2002).

Table 5.3. Web page heuristics (Source: Galitz, 2002)

1. Speak the user's language	• Use familiar words, phrases and concepts. • Present information in a logical and natural order.
2. Be consistent	• Indicate similar concepts through identical terminology and graphics. • Adhere to uniform conventions for layout, formatting, typefaces, labelling, and so on.
3. Minimise the user's memory load	• Take advantage of recognition rather than recall. • Do not force users to remember key information across documents.
4. Build flexible and efficient systems	• Accommodate a range of user sophistication and diverse user goals. • Provide instructions where useful. • Lay out screens so that frequently accessed information is easily found.
5. Design aesthetic and minimalist systems	• Create visually pleasing displays. • Eliminate information that is irrelevant or distracting.
6. Use chunking	• Write materials so that documents are short and contain only one topic. • Do not force the user to access multiple documents to complete a single thought.
7. Provide progressive levels of detail	• Organise information hierarchically, with more general information appearing before more specific detail. • Encourage the user to delve as deeply as needed, but to stop whenever sufficient information has been obtained.
8. Give navigational feedback	• Facilitate jumping between related topics. • Allow the user to determine his/her current position in the document structure. • Make it easy to return to the initial state.
9. Do not lie to the user	• Eliminate erroneous or misleading links. • Do not refer to missing information.

From the eye tracking data, the following heuristics were identified as being absent from the online PMS of the UFS:

- Speak the user's language – Present information in a logical and natural order;
- Minimise the user's memory load – Take advantage of recognition rather than recall;
- Design aesthetic and minimalist systems – Eliminate information that is irrelevant or distracting;
- Use chunking – Do not force the user to access multiple documents to complete a single thought;
- Give navigational feedback – Make it easy to return to the initial state; and
- Do not lie to the user – Eliminate erroneous or misleading links.

These heuristics were taken into account when recommendations were developed. The recommendations will be made in 3 categories: home screen of the online PMS, home screen of performance management and home screen of work environment survey.

5.3.1. Home screen of the online PMS

The home screen of the online PMS is where users start using the system. It is recommended that the home screen (Figure D.1 and D.20) be redesigned as shown in Figure 5.1 (for employees) and Figure 5.2 (for line managers) below. It is suggested that the links to the *Performance Management* and *Work Environment Survey* be removed from the toolbar at the top of the screen and moved to a position below the toolbar where the links to the *Help* document are currently. This decision was based on the fact that it took employees 3.33 seconds and line manager 1.73 seconds to see the links to the *Help* documents, compared to the 11.04 seconds (employees) and 7.07 seconds (line managers) it took them to see the *Performance Management* button (Task 1A).

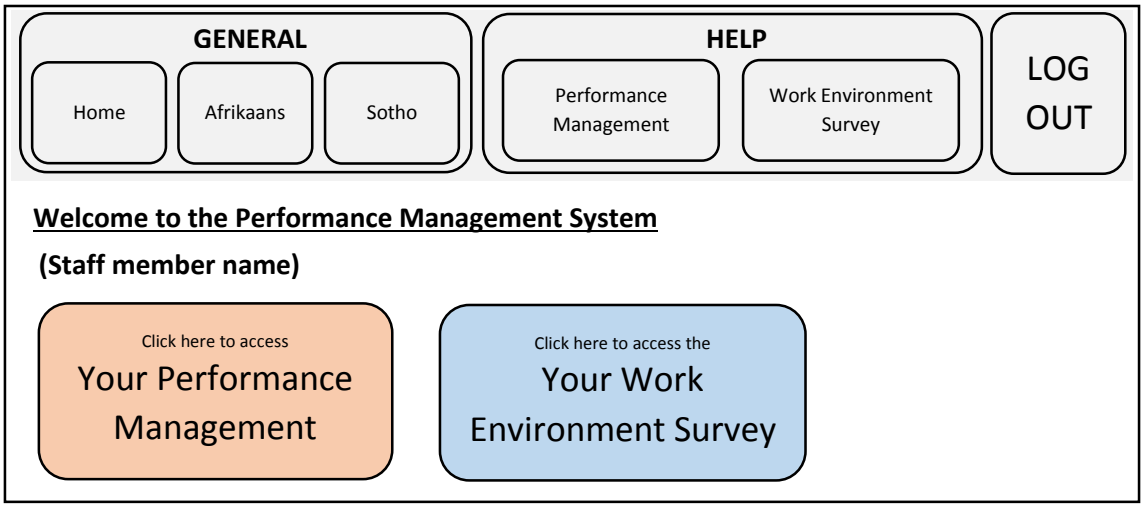

Figure 5.1. Redesigned home screen of the online PMS for employees

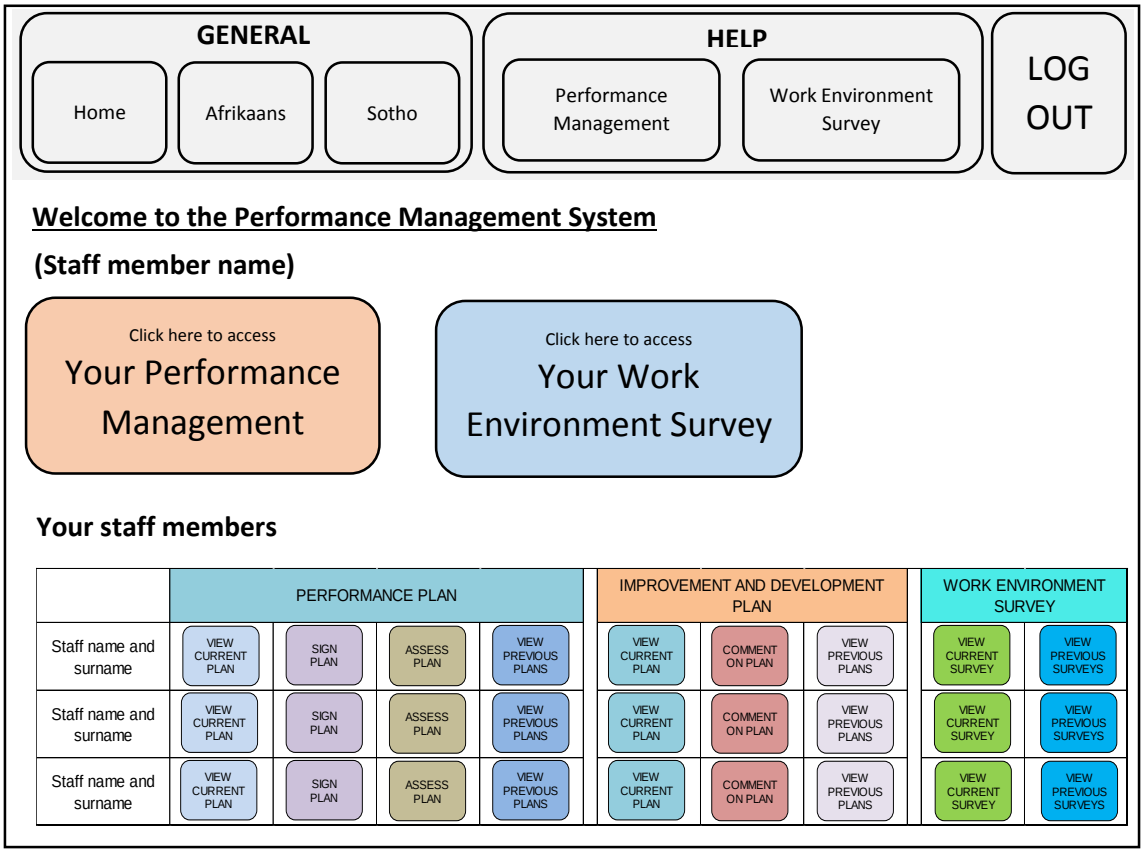

Figure 5.2. Redesigned home screen of the online PMS for line managers

5.3.2. Home screen of performance management

The home page of performance management for all employees (Figures D.2, D.7, D.10, D.17, D.21 and D.24) will be considered next. A redesign is necessary, because participants were not sure where they had to go to complete tasks (Tasks 1 to 5). The recommended design is simplified and it is presented in Figure 5.3.

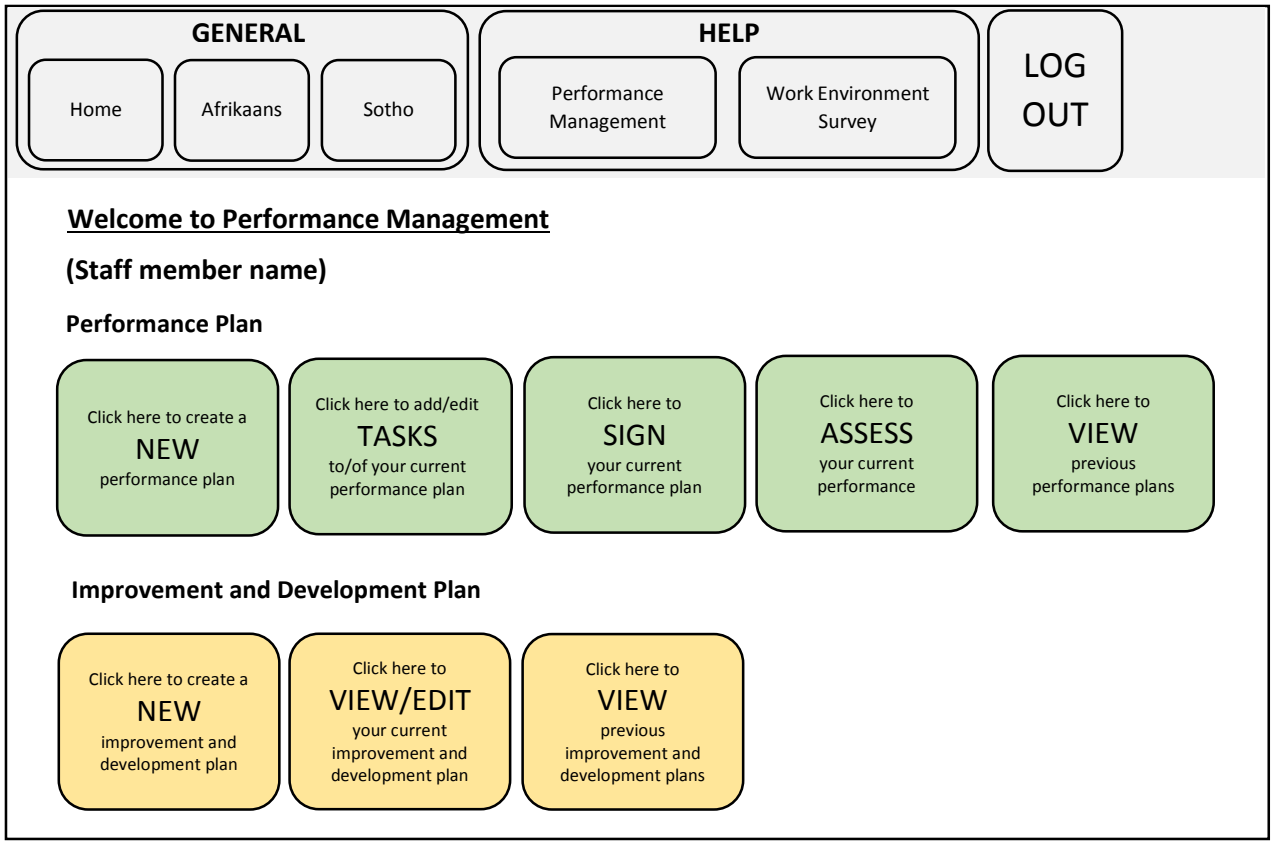

Figure 5.3. Redesigned home screen of performance management

5.3.3. Home screen of the work environment survey

The redesign of the work environment survey home page (Figure D.14) will be discussed next. The need for the redesign hereof became evident since participants were not sure where to click to complete the work environment survey. The redesigned home screen of the work environment survey is shown in Figure 5.4.

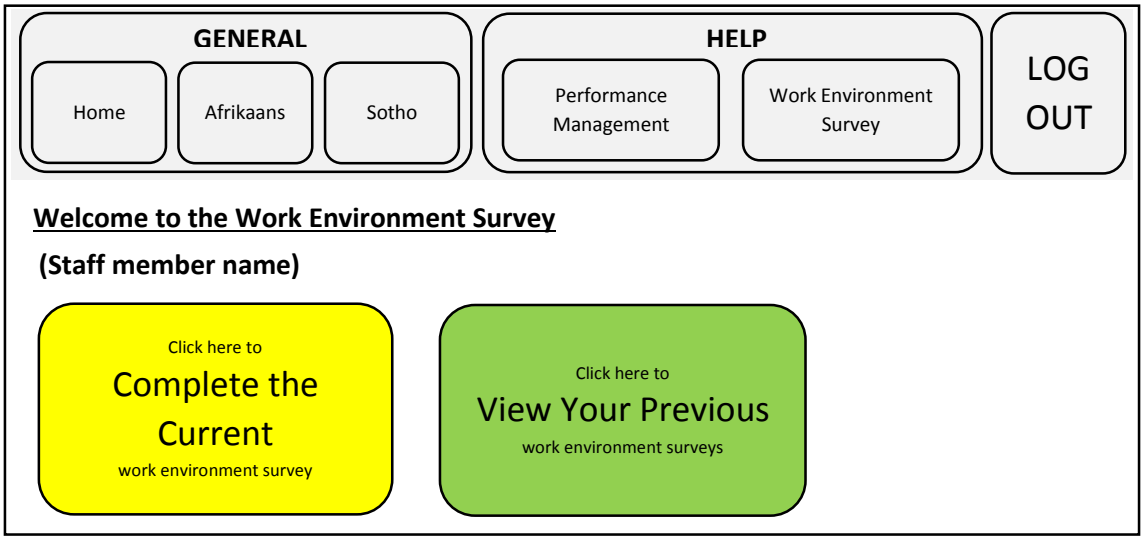

Figure 5.4. Redesigned home screen of the work environment survey

An additional aspect that needs improving is the windows used for entering new tasks (Figure D.9). These windows should be resized in order to remove the need for scrolling down when submitting the task.

5.4. Limitations

As stated in Section 4.5, the Mann-Whitney U test may have failed to prove that there is a significant difference between the regular and power users due to the small number of power users tested. If more power users were tested, the results of the test may have been different.

Due to the scope of the study as well as time constraints, not all tasks of the online Performance Management System were tested.

5.5. Importance of the study

This study has provided useful information to the UFS about the usability of the online PMS. This information can be used to improve the online PMS and in turn improve staff members' perception of the system.

Furthermore, this study is unique and is building the body of knowledge around the usability of online performance management systems. The principles of this study can also be applied to most systems that are developed in the Human Resources field.

5.6. Future studies

If the above recommendations are implemented, another eye tracking study should be performed in order to determine the usability of the new system before it is implemented. This should be done in order to determine if the recommendations made actually improved the online PMS of the UFS.

5.7. Conclusion

The purpose of this study was to evaluate the usability of the online PMS of the UFS in order to make suggestions and recommendations on areas that can be improved.

The research design used for the study was both quantitative and qualitative, with eye tracking as well as questionnaires as methods of data collection. The 23 participants

(12 line managers, 8 employees and 3 power users) were chosen through nonprobability, purposive sampling (Sekaran and Bougie, 2013). All participants were given 5 tasks to perform and line managers were given an additional 2 tasks. Each task was divided into different scenes to analyse the eye tracking data.

In general, the power users performed significantly better in all of the tasks than the participants. The reason behind this is that participants were not sure where to click to continue with the tasks.

In this chapter a number of recommendations were made with respect to the design of the online PMS of the UFS and the researcher sincerely hopes that these recommendations will contribute to improving the online PMS of the UFS.

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APPENDIX A

USABILITY TESTING OF THE ONLINE PERFORMANCE MANAGEMENT SYSTEM OF THE UNIVERSITY OF THE FREE STATE

PROTOCOL

1. Pre-test questionnaire

Participants will be asked to complete the pre-test questionnaire. Time limit is 5 minutes.

2. Eye tracking test

General information

Participants will be required to log into the online performance management system for every task. The login page will be opened automatically and each participant must use the specified login details. Once a task has been completed, the participant must log out of the system

Tasks

All participants will have to complete the following tasks:

2.1. Create a new performance plan consisting of only Role 5 (Administrative service to the university).

2.2. Create the following two tasks:

Task 1:

- Task: Secretary of management committee.
- Indicator: Minutes of the meeting.

Task 2:

- Task: Enter marks into Gradebook.
- Indicator: All marks entered into Gradebook.

2.3. Sign your performance plan.

2.4. Complete the work environment survey.

2.5. Create an improvement and development plan with the following:

- Area of Performance to be Improved
    i. Entering marks into Gradebook.
    ii. Click on Submit.
- Area of Work Environment to be Improved
    i. Communication.
    ii. Click on Submit.
- Actions and Training Taken by Employee
    i. Status – Complete
    ii. Date – 30 March 2015
    iii. Description – Gradebook training.

Only line managers will have to complete the following tasks:

2.6. Evaluate and sign an employee's performance plan.

- Open employee's performance plan.
- Sign employee's performance plan.

2.7. Assess an employee's performance.

- Open employee's performance plan.
- Give employee a 4 for each of the tasks.

Time limit for eye tracking test is 30 minutes.

3. <u>Post-test questionnaire</u>

Participants will be asked to complete the post-test questionnaire. Time limit is 5 minutes. After the completion of the post-test questionnaire, participants will be thanked for their participation in the study.

APPENDIX B

USABILITY TESTING OF THE ONLINE PERFORMANCE MANAGEMENT SYSTEM OF THE UNIVERSITY OF THE FREE STATE

PRE-TEST QUESTIONNAIRE

1. Gender: Male/Female
2. Age: _____
3. To which University department do you belong?

   _____
4. What is your job title? _____
5. Do you own a computer at home? Yes/No

For Question 6, 7 and 8 make a cross below the applicable item

6. How often do you use a computer in your **work environment**?

NEVER	MOST OF THE DAY	ONCE A DAY	ONCE A WEEK	ONCE A MONTH

7. Which computer applications do you use in your **work environment**?

MICROSOFT WORD	MICROSOFT EXCEL	MICROSOFT POWERPOINT	MICROSOFT ACCESS	INTERNET BROWSER

   Other: _____

   _____

   _____

8. How often do you use the online performance management system of the University of the Free State?

ONCE A YEAR	ONCE EVERY SIX MONTHS	ONCE A MONTH	ONCE A WEEK	DAILY

APPENDIX C

USABILITY TESTING OF THE ONLINE PERFORMANCE MANAGEMENT SYSTEM OF THE UNIVERSITY OF THE FREE STATE

POST-TEST QUESTIONNAIRE

Please answer the following questions using the provided scale:

	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
1. I found the online performance management system <u>easy</u> to use.					
2. I found the online performance management system <u>enjoyable</u> to use.					
3. I found the online performance management system <u>frustrating</u> to use.					
If so, please elaborate on your answer:					
4. I found it easy to create a new performance plan.					
5. I found it easy to sign my performance plan.					
6. I found it easy to complete the work environment survey.					
7. I found it easy to create an improvement and development plan.					
The following questions are only for the line managers:					
8. I found it easy to sign an employee's performance plan.					
9. I found it easy to assess an employee's performance.					

Comments and suggestions: _____

_____

_____

_____

_____

_____

_____

APPENDIX D

SCENES CREATED FOR TASKS AND AREAS OF INTEREST

FOR EACH SCENE

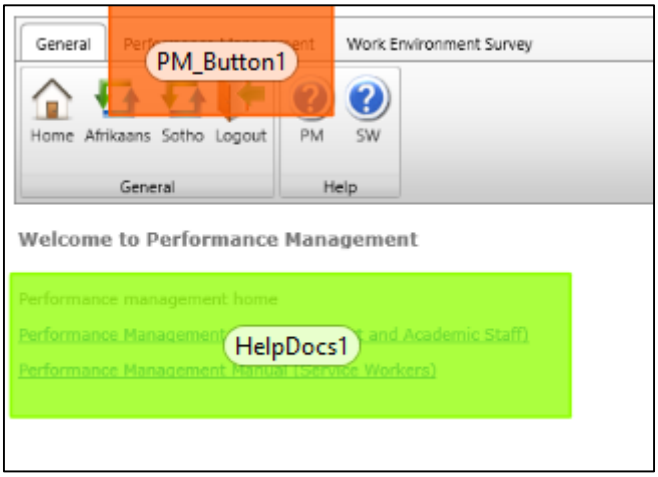

Figure D.1. Start of Task 1A

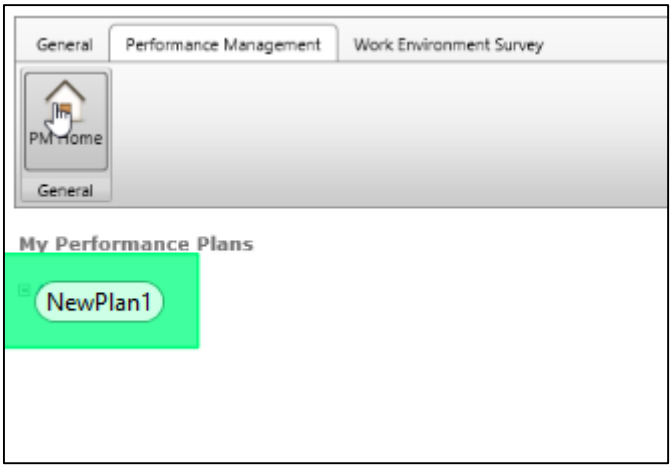

Figure D.2. Start of Task 1B

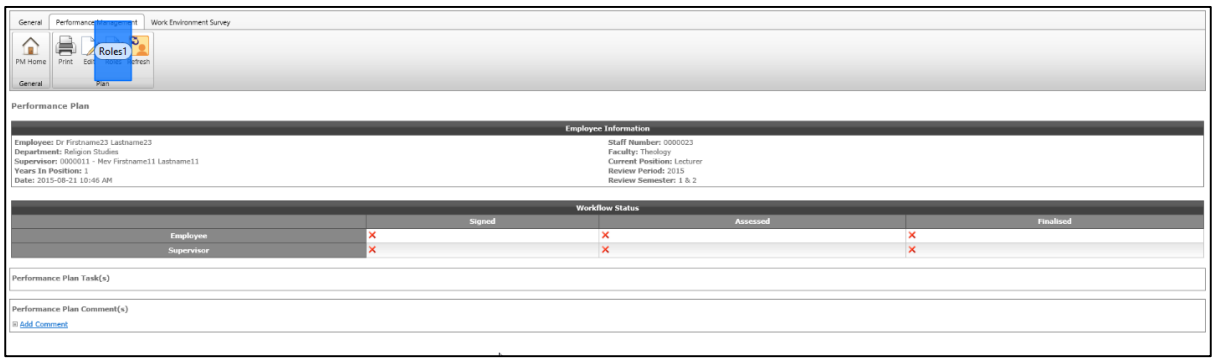

Figure D.3. Start of Task 1C

Figure D.4. Start of Task 1D

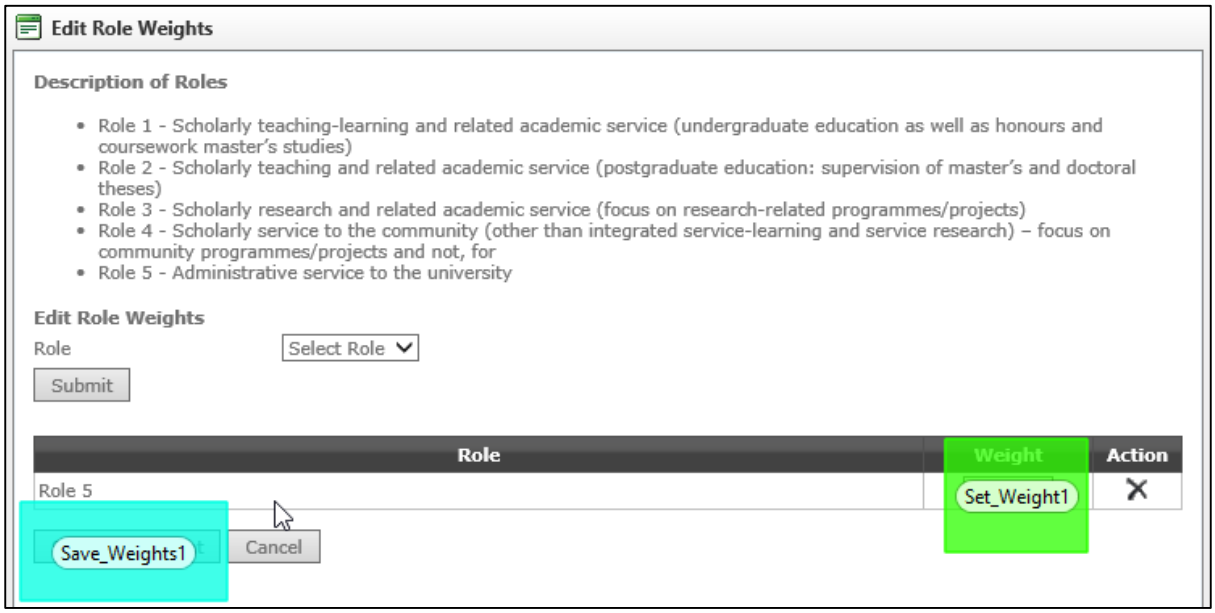

Figure D.5. Start of Task 1E

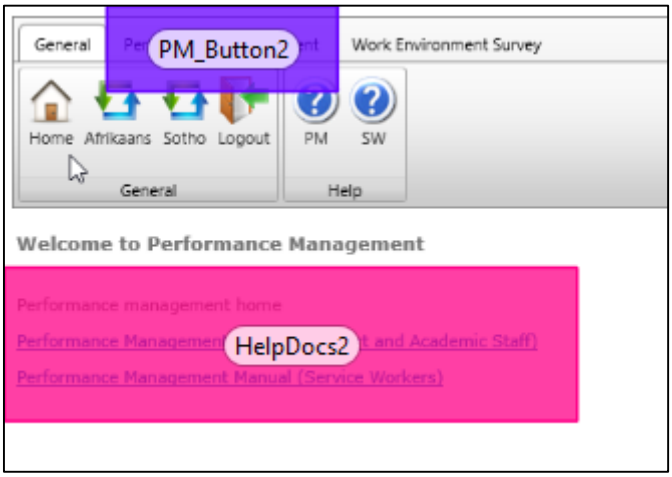

Figure D.6. Start of Task 2A

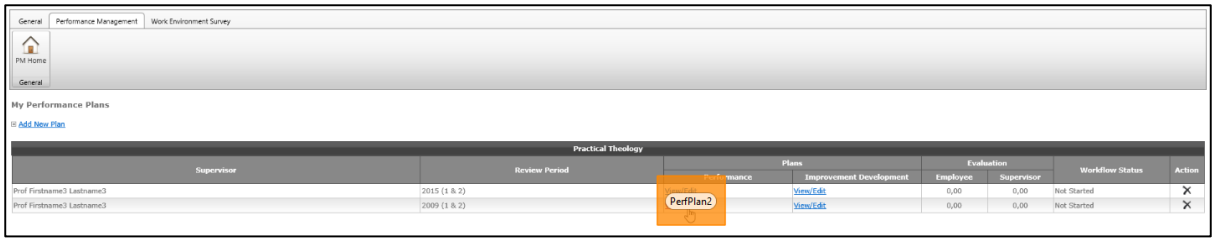

Figure D.7. Start of Task 2B

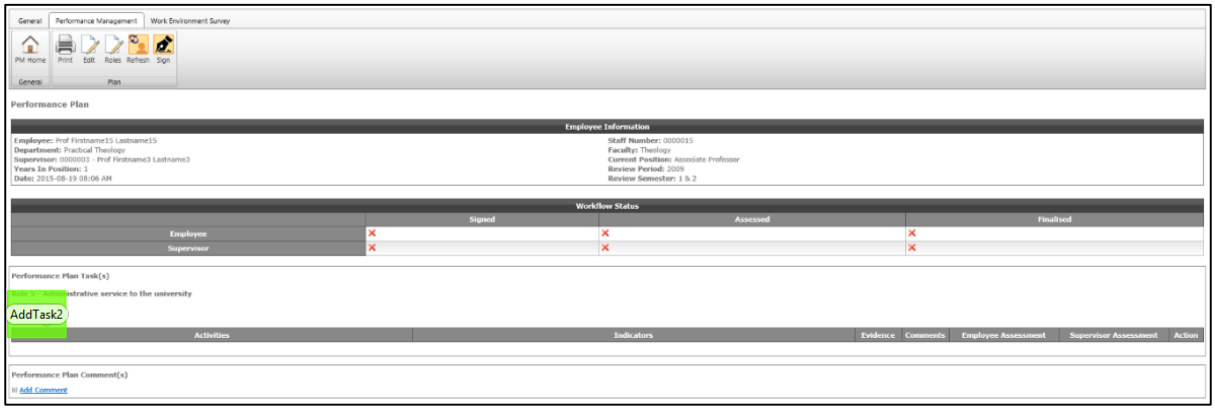

Figure D.8. Start of Task 2C

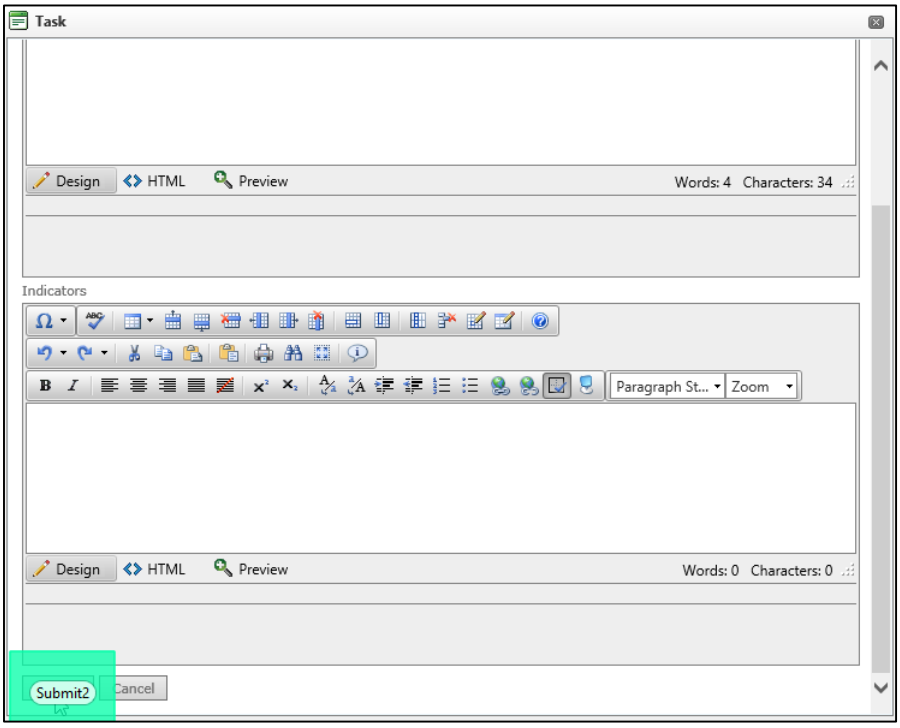

Figure D.9. Start of Task 2D

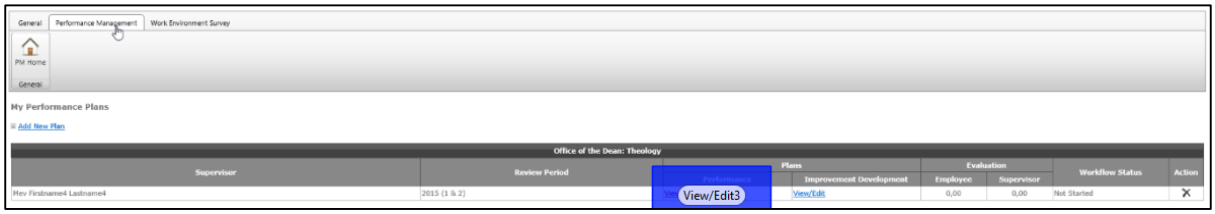

Figure D.10. Start of Task 3A

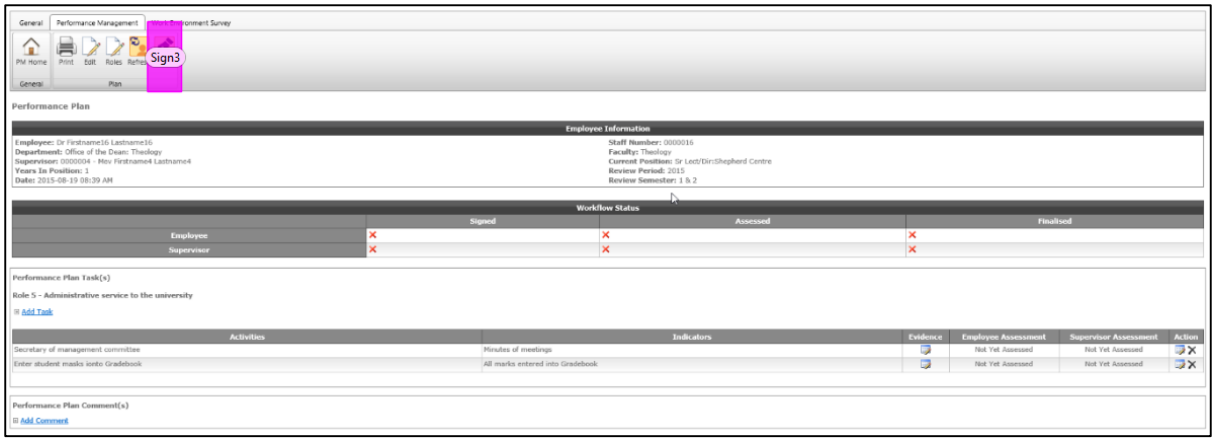

Figure D.11. Start of Task 3B

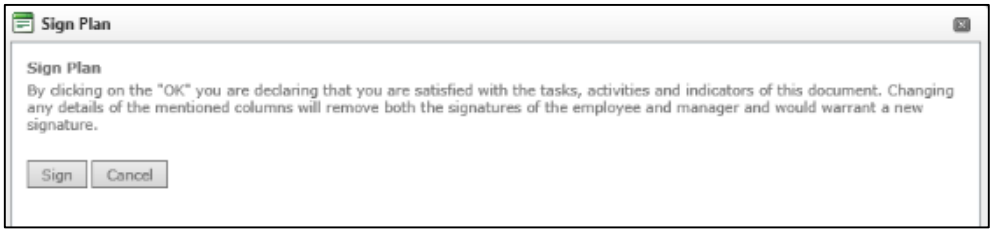

Figure D.12. Start of Task 3C

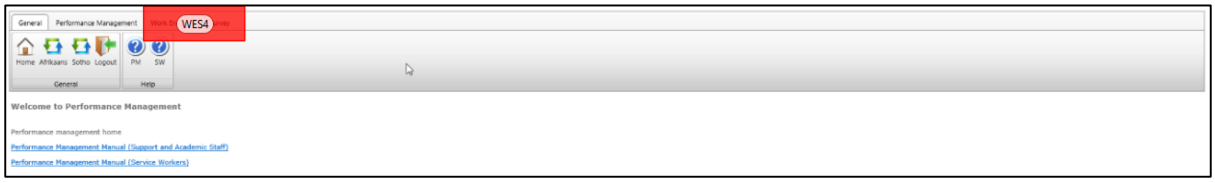

Figure D.13. Start of Task 4A

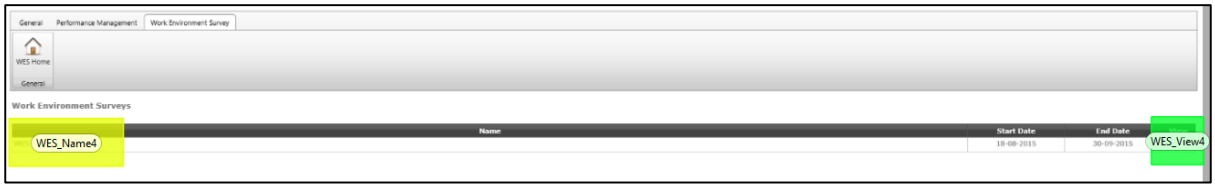

Figure D.14. Start of Task 4B

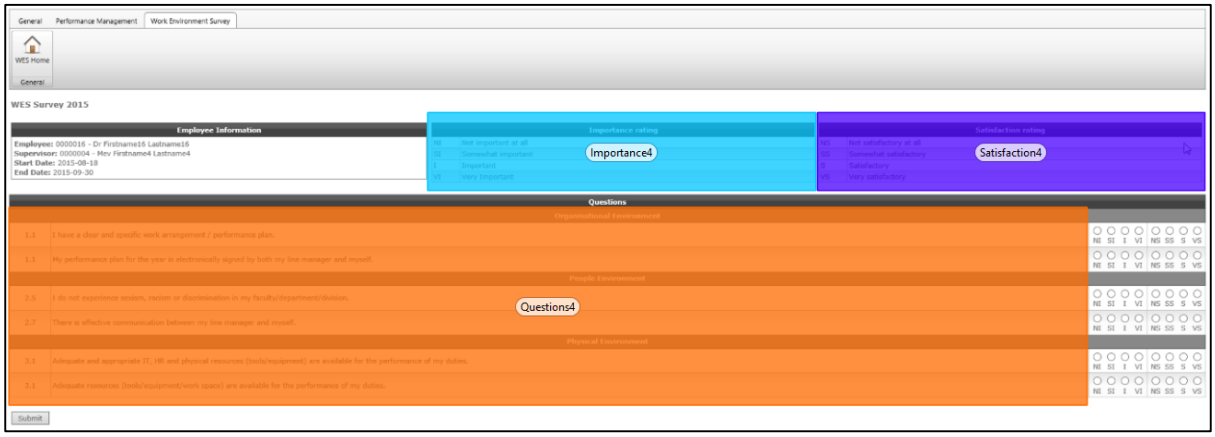

Figure D.15. Start of Task 4C

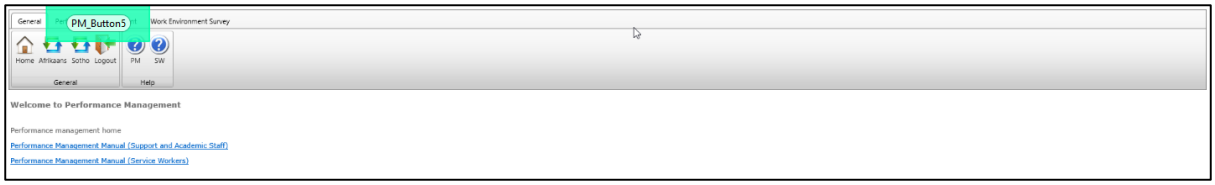

Figure D.16. Start of Task 5A

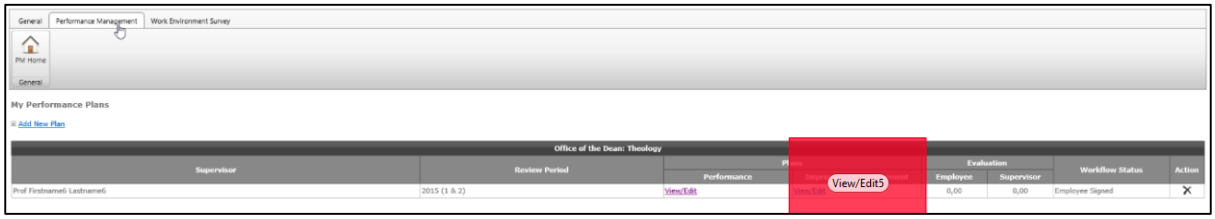

Figure D.17. Start of Task 5B

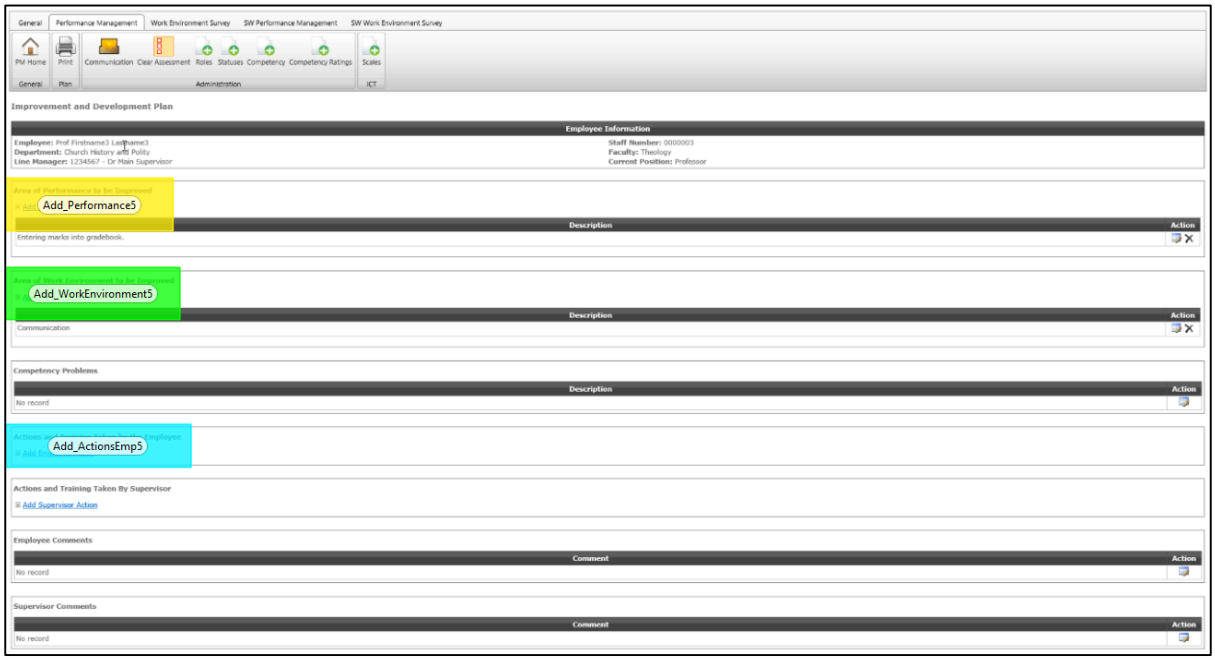

Figure D.18. Start of Task 5C

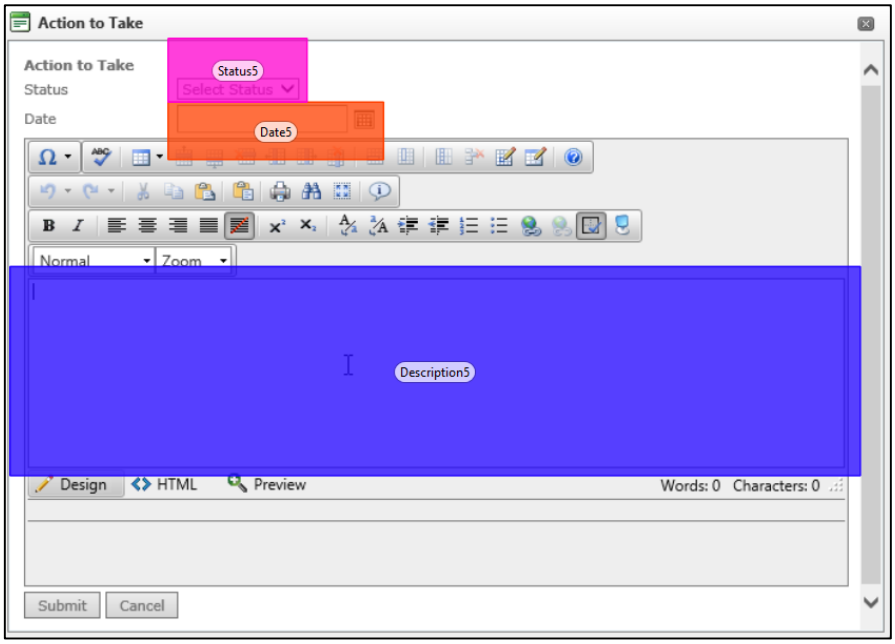

Figure D.19. Start of Task 5D

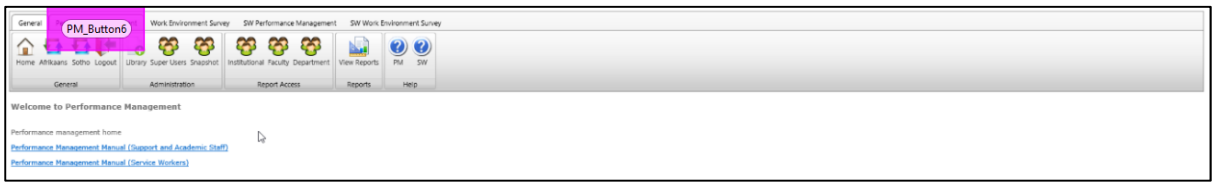

Figure D.20. Start of Task 6A

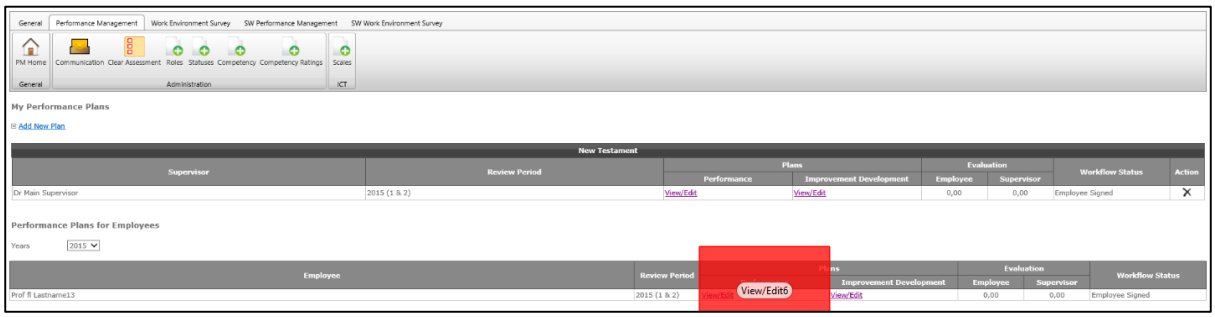

Figure D.21. Start of Task 6B

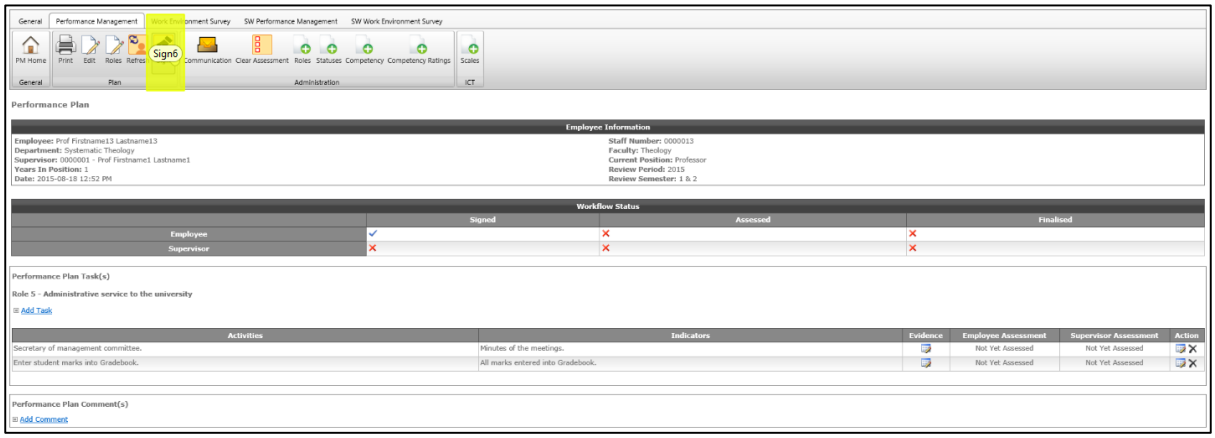

Figure D.22. Start of Task 6C

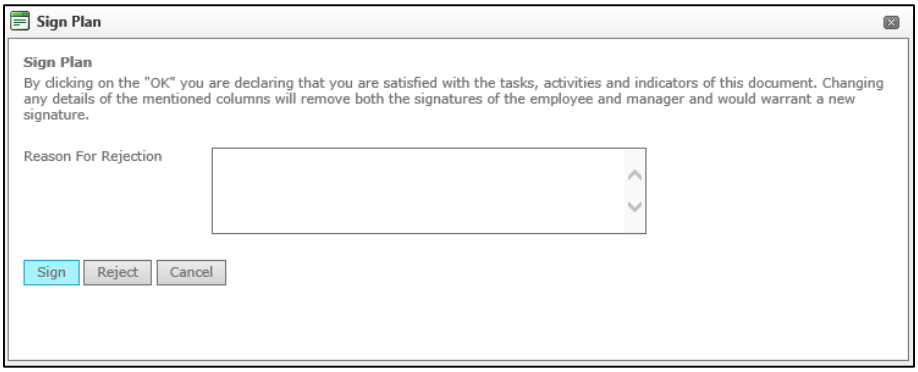

Figure D.23. Start of Task 6D

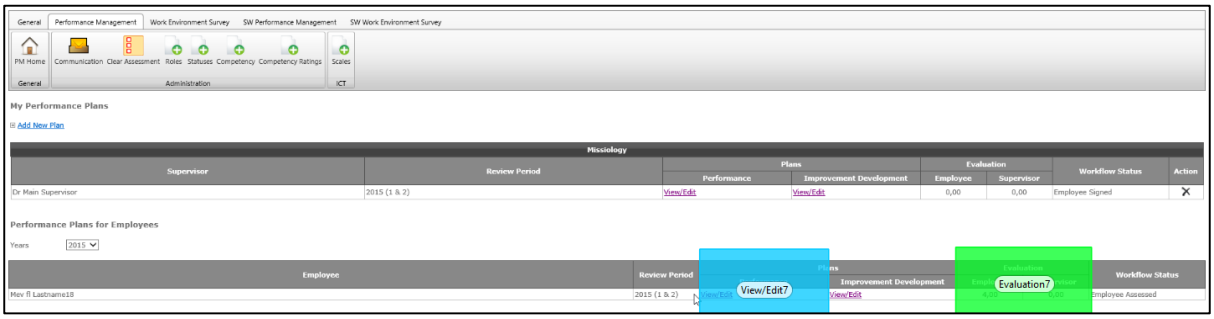

Figure D.24. Start of Task 7A

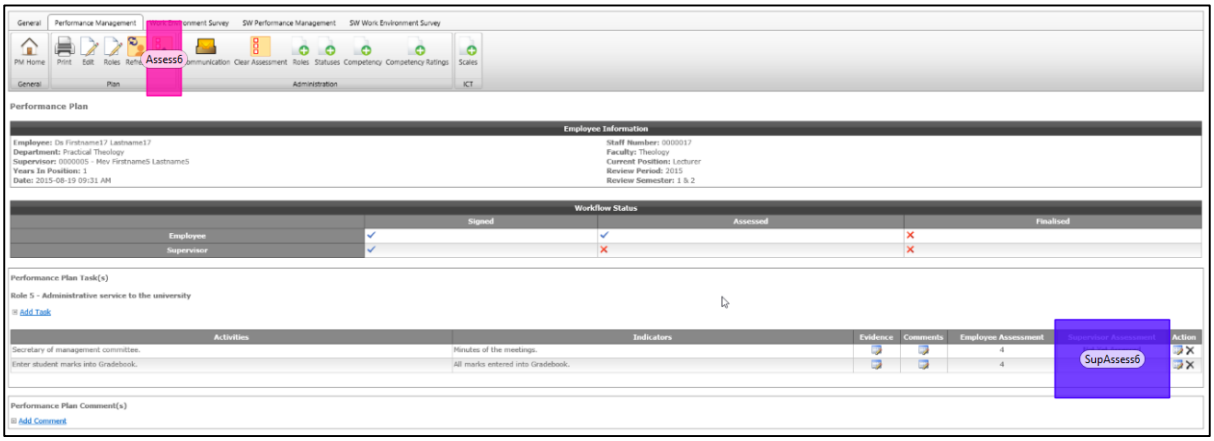

Figure D.25. Start of Task 7B

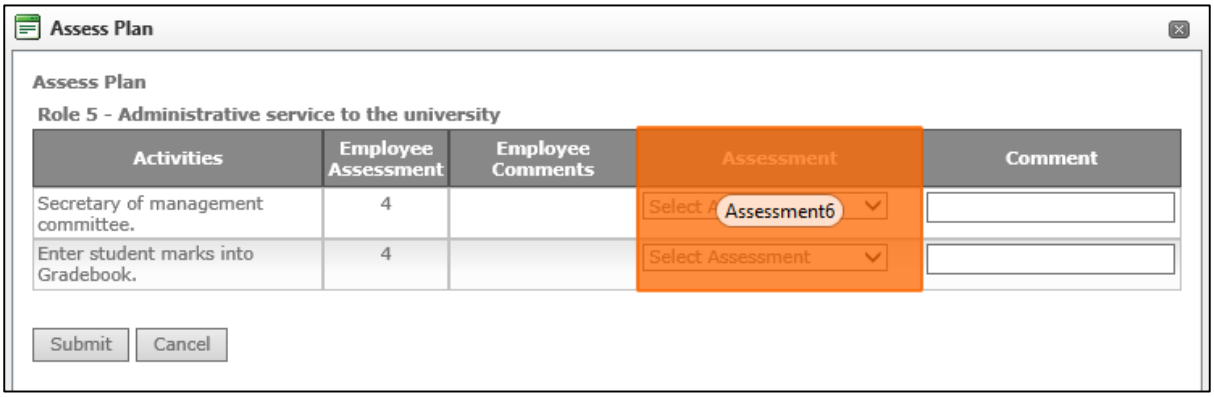

Figure D.26. Start of Task 7C

ABSTRACT

Performance management is a very important aspect of any modern organisation and the systems used to conduct performance management need to be well-designed and "easy to use". This study was conducted in order to evaluate the usability of the online performance management system (PMS) of the University of the Free State (UFS). The usability of any system is based on three components, namely effectiveness, efficiency and satisfaction.

This research study followed a blended design that consisted of questionnaires and eye tracking tests. The population consisted of support staff and line managers at the UFS and a sample of 20 participants were chosen through nonprobability, purposive sampling. Of the 20 participants, 12 were line managers and the remaining 8 were members of the support staff. Furthermore, a group of three power users were identified and used as a benchmark. These power users are staff members who make use of the online PMS on a daily basis. All participants were given a series of tasks to complete on a demo version of the online PMS. In order to analyse the eye tracking data, each task had to be divided into scenes and areas of interest were drawn on each scene. The time to first fixation and the time to first mouse click were analysed for each of the areas of interest.

The data from the questionnaires indicated that the majority of participants used the online PMS only once or twice a year. There was a clear difference in the time it took participants to complete each task and the time it took the power users to complete each task. The power users understood the system because they use it on a daily basis, while the other participants struggled to identify the necessary steps to complete each task.

The online PMS of the UFS has low levels of usability and this study recommended a number of changes with regard to the design of the online PMS of the UFS. It is the hope of the researcher that these recommendations will contribute to improving the online PMS of the UFS.

Key terms: Performance management, eye tracking, usability, user experience, human resources and online systems.